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Update of the Integrated National Energy and Climate Plan

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Update of the Integrated National Energy and Climate Plan

In accordance with Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council

Section A: National Plan

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Summary

1.1.i. Political, economic, environmental and social context of the plan

This plan is in the context of the jeopardised timely achievement of the goals of the United Nations General Assembly's resolution of 25 September 2015 'Transforming our world: the UN 2030 Agenda for Sustainable Development' and the Paris Agreement (Paris Climate Agreement). It contributes in particular to achieving Sustainable Development Goal 7 (ensuring access to affordable, reliable, sustainable and modern energy for all). In line with the systemic thinking behind the sustainability goals, the plan also contributes to the timely implementation of Goal 13 (taking immediate action to combat climate change and its effects).

In order to preserve peace and freedom and to safeguard our prosperity and quality of life in the future, it is crucial that we strengthen our resilience and competitiveness in Germany and Europe and that we achieve the goal of climate neutrality by the middle of the century at the latest, while ensuring that energy remains available at competitive prices and affordable for private households.

At European level, the course has been set with the REPowerEU plan, the Fit for 55 package and the European Climate Protection Act. The REPowerEU plan makes it possible to free ourselves from excessive dependence on individual suppliers of fossil fuels through ambitious energy savings, faster expansion of renewable energies and the establishment of broader international energy supply relationships that increasingly rely on renewable energies. With the Fit for 55 package, Europe is assuming an international leadership role and in the European Climate Protection Act it has set itself the goal of becoming the first continent to achieve climate neutrality by 2050. The aim is to limit global warming to below 1.5 degrees and

secure our future prosperity. By promoting innovation and investment in green technologies, the Green Deal Industrial Plan supports the transformation of industry towards environmentally friendly and competitive structures.

Against the backdrop of these far-reaching geopolitical, political and socio-economic changes, the Federal Government has revised its National Energy and Climate Plan 2021–2030 (NECP). The key components of German energy and climate policy are the Federal Climate Action Act, which was amended in 2024, committing Germany to achieving net greenhouse gas neutrality by 2045, as well as the Federal Government's climate action programmes. The lignite phase-out in North Rhine-Westphalia is being brought forward to 2030. The nuclear phase-out was completed in 2023. Based on the coal and nuclear phase-out, the Federal Government is basically pursuing a technology-neutral approach to achieving net greenhouse gas neutrality. In view of technological developments, no decisions should be made today that restrict future options for achieving the targets in an efficient and environmentally friendly manner, provided that these decisions do not result in foreseeable macroeconomic cost increases during the transformation.

Energy and climate policy are constantly being developed. For example, two legislative packages have removed numerous obstacles to the accelerated expansion of renewable energies and declared the use of renewable energies to be of paramount public interest. By 2030, 80% of gross electricity consumption is to be produced using renewable energies. By 2030, 215 GW of photovoltaics and around 115 GW of onshore wind are to be put out to tender as well as least 30 GW offshore. In 2023, the Energy Efficiency Act created for the first time a cross-sectoral framework for increasing energy efficiency, setting targets in line with the amendment to the EU Energy Efficiency Directive. With the 2024 revision of the Federal Climate Action Act and the new comprehensive Climate Action Programme 2023, the Federal Government has reaffirmed its ambitious climate goals.

Germany's climate goals remain unchanged – under the amended Federal Climate Action Act (KSG) not a single more tonne of CO_2 than before is to be emitted. Prior to the amendment, the Federal Climate Action Act focussed on past slippages whereas the amended Act now focuses more on the projected emissions trend. This makes it easier than before to check whether Germany is on the right path to greenhouse gas neutrality – or whether measures need to be stepped up. The focus is now on a cross-sectoral view of greenhouse gas emissions which results in greater flexibility

between the sectors. At the same time, the Federal Government continues to ensure full transparency for the individual sectors, such as transport, energy and buildings, by means of indicative paths – the sectoral view is retained in the monitoring as a benchmark. By reducing emissions especially in areas with the greatest potential for savings, the climate action goals can be achieved in a socially just and economically efficient manner. In future, the total cumulative annual emissions in the period 2021 to 2030 will be decisive for assessing compliance with goals. If the independent Expert Council finds that these goals have not been complied with in the forecast for two consecutive years, readjustment is then required. In preparation for the corresponding decision by the Federal Government, all competent federal ministries, in particular those in whose area of responsibility the sectors contributing to this non-compliance lie, will submit proposals for measures in the respective sectors for which they are responsible within three months after the Expert Council for Climate Issues has submitted the projection data assessment. The amendment also enshrined in the Federal Climate Action Act that the Federal Government will set a target for technical sinks for the years 2035, 2040 and 2045 in order to achieve the national climate action targets and that a comprehensive climate action programme will be adopted in the first twelve months of each legislative period in future that meets the requirements of the Act.

In order to achieve the climate goals and at the same time contribute to the diversification of energy imports and thus to Germany's security of supply, the Federal Government has decided to update the National Hydrogen Strategy. The second amendment to the German Buildings Energy Act introduces the decarbonisation of the heating sector. Under the Carbon Dioxide Cost Sharing Act, the costs of carbon dioxide incurred for heating oil, natural gas and other fuels in buildings are now to be divided between landlords and tenants. The sustainability of public finances also remains important for the future viability of the state. If future investments are to be realised, skilled workers will be needed. In some sectors and regions, the shortage of skilled labour is already challenging. The Federal Government is therefore working to secure and expand the skilled labour base in Germany. To this end, it has developed a new skilled labour strategy and, following a proposal by the Federal Government in summer 2023, the German Bundestag and Bundesrat passed a law and an ordinance on the further development of skilled labour immigration.

All the measures and strategies mentioned in the NECP or resulting from it are subject to funding as well as the financial constitutional competence/responsibility of the Federal Government. They neither contain a (preliminary) determination with regard to the budget nor do they constitute any prejudice for the budget legislator. Any additional requirements in terms of personnel and material resources resulting from the plan for the Federal Government must be fully and permanently financed within the framework of the applicable budget and financial planning in the respective individual plan or special fund.

1.1.ii. Strategy relating to the five dimensions of the Energy Union

European solutions are needed to bring together security of supply, competitiveness and climate action both efficiently and cost-effectively in the energy transition. German energy and climate policy is geared towards the European framework, including the five dimensions of the Energy Union.

1.1.iii. Overview table with the key objectives, policies and measures of the plan

Table A1: Key objectives for 2030 along the dimensions of the Energy Union

1. Decarbonisation

1.1. Greenhouse gas (GHG) emissions and removals

- National climate goals: at least -65% by 2030 compared to 1990, at least -88% by 2040, GHG neutrality by 2045

EU climate target: at least -55% net by 2030 compared to 1990, broken down into

- European Emissions Trading (ETS): EU-wide goal of -62% by 2030 compared to 2005
- ETS2: EU-wide goal of -43% by 2030 compared to 2005

- EU Effort Sharing Regulation (ESR): EU-wide goal of -40% by 2030 compared to 2005
- DEU ESR goal: -50% by 2030 compared to 2005

EU LULUCF Regulation:

- EU-wide goal is a sink of 310 Mt CO_2-eq in 2030, or improvement of the sink by 42.2 Mt in 2030 compared to 2016-18

- Germany's goal is to improve the sink by 3.8 Mt compared to 2016-18 (sink target of 30.8 Mt based on outdated inventory data)
- Goals for the expansion of natural sinks pursuant to Section 3a of the Federal Climate Action Act

Climate-neutral organisation of the Federal Administration by 2030

1.2. Renewable energy

- Increase the share of renewable energies in gross final energy consumption in 2030 to at least 41% as Germany's contribution[1] to the EU 2030 binding goal of 42.5%.
- Electricity (600 TWh of renewable electricity in 2030, at least 80% of gross electricity consumption)
- Heating and cooling: 50% of grid-connected heat from renewable sources and/or unavoidable waste heat by 2030
- Transport: 30% of gross final energy consumption in 2030 (pursuant to the RED II methodology)
- Supplementary: Technology-specific goals in the electricity sector in 2030 (2030 installed capacity in GW)
- Wind on land: 115 GW by 2030, 160 GW by 2040
- Photovoltaics: 215 GW by 2030, 400 GW by 2040
- Wind at sea: at least 30 GW by 2030, 40 GW by 2035 and 70 GW by 2045
- Biomass: 8.4 GW by 2030
- Hydropower and others: no specific legally defined targets for hydropower
- National Hydrogen Strategy: Accelerating the market ramp-up for hydrogen

2. Energy efficiency

- According to the Energy Efficiency Act, which came into force on 18 November 2023, Germany's final energy consumption is to be reduced by at least 26.5% compared to 2008 to a final energy consumption of 1,867 terawatt hours by 2030, while primary energy consumption is to be reduced by at least 39.3% to a primary energy consumption of 2,252 terawatt hours.

3. Energy security

- Meeting demand for energy in Germany at all times

[1] In accordance with the recommendations of the European Commission of 18 December 2023.

- Maintaining resilience to supply crises
- Further reduce the probability of supply crises occurring
- Precautionary measures and reserves ready in the event of a deterioration in the supply situation
- Ensuring stable grid operation

4. Internal energy market

- Achievement of the level of interconnectivity provided for pursuant to Article 4(d) of the Governance Regulation
- Expanding and modernising grids in line with demand
- Jointly viewing energy infrastructures
- Sectoral coupling for electricity, heat and transport:
- Gradual reduction and phase-out of coal-fired power generation
- Further strengthen the European internal electricity market and ensure the flexibility of electricity demand
- Further coupling of the electricity markets

5. Research, innovation, competitiveness

- The Federal Government aims to strengthen energy research as well as research and innovation for climate action in the period from 2020 to 2030.
- Driving forward pioneering innovations for the transformation of energy supply
- Maintaining a competitive basis for industry, trade and SMEs as well as preserving and expanding jobs in Germany and laying the foundations for prosperity and quality of life

Table A2: Key strategies and measures along the dimensions of the Energy Union

1. Decarbonisation

1.1. GHG emissions and removals

- Natural climate protection action programme for the preservation and expansion of natural sinks
- Drive change for passenger cars and heavy commercial vehicles (CO_2 surcharge on truck tolls, expansion of the truck toll to vehicles weighing more than 3.5 t, development of basic infrastructure networks for battery-electric and hydrogen trucks, Clean Vehicles Procurement Act for public fleets, special programme for special transport, fleet renewal programme for heavy commercial vehicles)
- Establishing digital and data-based ecosystems for a climate-neutral industry
- Acceleration of climate neutrality for cars (charging infrastructure masterplan, various short-term measures to increase the expansion of charging points, amendment to the Federal Car Sharing Act to speed up the conversion of car sharing fleets
- Federal funding for energy and resource efficiency in the economy
- Federal STARK programme (strengthening the transformation dynamics and new beginnings in the coalfields and at coal-fired power plant sites) to promote structural change in the coal regions
- Carbon pricing the transport and heating sectors (Fuel Emissions Trading Act (BEHG))
- Carbon Dioxide Cost Sharing Act
- Digitalisation for climate protection (funding guideline for the digitalisation of municipal transport systems, research into the application of AI methods in the mobility sector)
- Introduction of a digital nutrient origin system to improve the availability of data on agricultural fertilisation
- Development of a carbon management strategy
- Development of a nutrition strategy by the Federal Government, including measures to promote a more plant-based diet
- EU Emissions Trading System

- Federal Government skilled labour strategy, also to secure demand for skilled workers in areas particularly relevant to climate action
- Support programme for the adaptation of urban and rural areas to climate change
- Decarbonisation in the industry funding programme, in future federal funding for industry and climate action
- Support programmes for sustainable urban mobility plans and corporate mobility management
- Promotion of climate and animal-friendly livestock farming through the barn conversion funding programme
- Timber construction initiative
- IPCEI's hydrogen and battery cell production
- Climate-friendly air, sea and inland waterway transport (national action plan for climate-friendly shipping, federal funding for the expansion of shore power systems, further development of the aviation research programme to effectively reduce the impact of aviation on climate, support for renewable ground power supply at airports, new funding focus on climate-neutral ships in the Maritime Research Programme)
- Climate protection contracts
- Coal Phase-out Act
- Measures for climate-neutral organisation of the federal administration (Section 15(1) of the Climate Action Act (KSG))
- Modernisation of road traffic law with the aim of taking climate targets into account
- Strengthening market monitoring in the field of ecodesign and energy labelling
- Strengthening urban and regional rail transport (for instance, by boosting rail investments and strengthening and digitalising the existing rail network, pro-rata promotion of track access charges in rail freight transport as an investment incentive, introduction of the 'Deutschlandticket')
- Lightweight construction technology transfer programme, stronger focus on material efficiency and circular economy
- Improved data availability for agricultural fertilisation: With an amendment to the Fertiliser Act and the planned introduction of a monitoring ordinance to

review the effectiveness of the Fertiliser Ordinance, the prerequisites for a digital nutrient origin system are to be created, among other things

- Improvement of local public transport and the networking of different modes of transport (including strengthening combined transport terminals, expansion initiative for cycling infrastructure, expansion and quality campaign for local public transport, promotion of climate-neutral buses including infrastructure, pilot projects to strengthen local public transport, promotion of alternative drive systems for rail vehicles)
- Greater utilisation of the potential of synthetic fuels (including a roadmap for climate-neutral fuels)
- Further development of the funding programme to improve energy efficiency in agriculture, use and storage of renewable energy as a further funding priority

Further development of the national strategy to reduce food waste

1.2. Renewable energy

- Expediting planning and approval procedures for the expansion of onshore and offshore wind energy
- Improved regionalisation of the expansion of renewable energies
- Better synchronisation of the expansion of renewable energies with the expansion of the electricity grid
- Subsidies for purchasing/leasing purely electrically powered vehicles in the form of an environmental bonus
- Federal funding for efficient buildings (BEG)*
- Federal funding for efficient heating grids (BEW)*
- Key points for a geothermal energy campaign
- Energy Efficiency Strategy for Buildings (ESG)*
- Renewable Energy Sources Act (EEG 2023)
- Buildings Energy Act (GEG)*
- Act on heat planning and the decarbonisation of heating networks
- Power plant strategy
- National Hydrogen Strategy measures package
- Regional cooperation
- Strengthening self-consumption in the electricity sector
- Strengthening Germany as a location for battery cell production
- Further development of combined heat and power generation (CHP)
- Offshore Wind Energy Act (WindSeeG)

- Wind Energy Area Requirements Act

** Measures from the building sector (see 2. 'Energy efficiency'), which also contribute significantly to Dimension 1 'Reduction of CO_2 emissions'.*

2. Energy efficiency

- Federal funding for energy efficiency in the economy (EEW)
- Federal funding for efficient buildings (BEG)
- Federal funding for efficient heating grids (BEW)*
- Federal funding for serial refurbishment
- Federal programme 'Renovation of municipal sport, youth and cultural facilities'
- Carbon pricing in the heating and transport sectors
- Act on Energy Services and Other Energy Efficiency Measures (EDL-G)
- Energy efficiency specifications for climate-neutral new buildings/extensions and building refurbishments by the Federal Government 'Exemplary role of federal buildings for energy efficiency' (EEFB)
- Energy Efficiency Act
- Energy Efficiency Strategy for Buildings (ESG)
- Promotion of energy counselling for all consumer groups
- Buildings Energy Act (GEG)
- Public buildings initiative to increase the refurbishment rate of public buildings
- Long-term Renovation Strategy (LTRS)
- National Energy Efficiency Action Plan 2.0 (NAPE)
- Programme to promote measures for energy-efficient urban redevelopment: Support in the development of integrated neighbourhood concepts, support through redevelopment management and investment measures.
- Tax incentives for energy-efficient building refurbishment
- Heat pump campaign
- Future Building (*Zukunft Bau*) – Pilot project for innovation in the building sector

3. Energy security

- Establishing Germany as an LNG hub including the LNG Acceleration Act
- Petroleum Stockpiling Act (ErdölBevG)
- Act on electricity and gas supply (Energy Industry Act – EnWG)
- Act to secure energy supply (Energy Security Act – EnSiG)

- Ordinance on Rationing of Gasoline/Diesel Fuel (HeizölLBV)
- Ordinance on Rationing Fuel Oil (KraftstoffLBV)
- Ordinance on Fair Sharing of Oil (MinölAV)
- Ordinance on Management of Oil (MinölBewV)
- Act on the Collection of Mineral Oil Data (MinÖlDatG)
- National preventive and emergency plans for natural gas pursuant to Regulation (EU) No 2017/1938 (formerly Regulation (EU) No 994/2010)
- Roadmap for system stability for secure and robust grid operation with 100% renewable energies
- Solidarity mechanism pursuant to Regulation (EU) No 2017/1938
- Ordinance to Ensure the Supply of Gas in a Supply Crisis (Gas Security Ordinance – GasSV)

4. Internal energy market

Expanding and modernising grids in line with demand:

- Monitoring grid expansion projects for electricity and gas
- Optimisation of existing grids
- Faster expansion of electricity grids
- Massively accelerate the smart meter rollout with completion by 2030 (or 2032 for power-metered large installations and large consumers)

Gradual reduction and phase-out of coal-fired power generation:

- Coal Phase-out Act
- Structural policy supporting measures

Sectoral coupling for electricity, heat and transport:

- Removing barriers to sector coupling (electricity, heating and transport)

Keeping the electricity market 2.0 functional and ensuring the flexibility of the energy system:

- Further integration and greater flexibility of European electricity markets
- Re-dispatching principle: Optimisation measures relating to re-dispatching
- Making CHP plants more flexible through pilot projects for modernised CHP plants
- National flexibility check to identify barriers to flexibility and potential for flexibility

Further coupling of the electricity markets:

- Action plan to reduce grid congestion
- Optimisation of intra-day trading capacities

- Creation of a Central and Eastern European Capacity Calculation Region (CORE)

Achievement of the level of interconnectivity provided for pursuant to Article 4(d) of the Governance Regulation:

- Expansion of cross-border electricity interconnectors
- Strengthening regional cooperation

5. Research, innovation, competitiveness

- 7th Energy Research Programme – Innovations for the Energy Transition
- 8th Energy Research Programme for Applied Energy Research
- Improved integration of start-ups
- Real-world laboratories for the energy transition and increased technology transfer
- Stepping up international cooperation
- Cross-system issues (e.g. sector coupling, digitalisation)
- Future strategy for research and innovation (especially mission 1 and 2)

1.2. Overview of the current political situation

1.2.i. National and Union energy system and policy context of the national plan

Climate change is one of the greatest challenges of our time. At national, European and international level, the Federal Government is gearing its climate, energy and economic policy towards the 1.5 degree path, deriving its ambitious goals from the joint contribution to which the European Union has committed itself under the Paris Agreement.

Energy and climate policy requires a European context, since energy and climate policy decisions taken by one Member State inevitably impact other Member States.

Energy efficiency and the growth of renewables are becoming the mainstays of the European energy transition. This is in line with and supports Germany's strategy for transforming energy supply.

The realisation of a single European energy market is a key prerequisite for the success of the energy transition in Germany and the EU. Open, flexible markets and fair competition are needed to achieve a cost-efficient and secure energy supply and integrate renewable energies into the market.

The electricity markets need to be connected, and they need to send the necessary price signals. This will establish a solid foundation for the necessary investments and for increased flexibility of energy generation and consumption.

The updated NECP goes hand in hand with the German Recovery and Resilience Plan (GRRP). The GRRP focuses on tackling climate change and the digital transformation. It therefore also contains measures that serve to achieve the objectives of the updated NECP. The updated NECP is in line with other key initiatives of the EU and the Federal Government, tapping into synergies to enable their implementation.

1.2.ii. Current energy and climate policies and measures relating to the five dimensions of the Energy Union

See Section 1.1.ii. for a summary. A detailed explanation is provided in Section 3.

See Annex 1 (table on strategies and measures along the five dimensions of the Energy Union).

1.2.iii. Key issues of cross-border relevance

Dimension 1: Reducing carbon emissions

1.1 GHG emissions and removals

Germany's efforts contribute to the achievement of the EU's 2030 climate goal and the targets enshrined in the Paris Climate Agreement. Experiences and best practices are exchanged with other Member States in particular with regard to national climate action strategies and non-governmental or sub-national climate action projects (run by NGOs and municipalities), allowing potential impacts on other Member States to be identified and discussed as early as possible. Another central issue in the exchange with other Member States is the design and implementation of EU climate policy.

1.2 Renewable energy

Due to Germany's geographical location in the centre of Europe, the expansion of renewable energies in Germany has a wide range of impacts on its neighbouring countries. The network and system integration of renewable energies is a high priority for the Federal Government (see Section 3.1.2.). The focus here is on regional cooperation with other Member States as an important driver for the market integration of renewable energies. The Federal Government is therefore opening tenders for electricity from renewable energies for plants located in other EU Member States. On the island of Bornholm, Germany and Denmark will develop a joint offshore project and connect it to the German and Danish electricity grids. The Federal Government is also actively involved in the North Seas Energy Forum and participates in the working group on renewable energies as part of the Baltic Energy Market Inter-connection Plan (BEMIP) (see Sections 1.4., 3.2., 3.4.3.). Germany has also played an active role in the Concerted Action Forum for Renewable Energies (CA-RES) from the outset.

Dimension 2: Energy efficiency

In principle, this dimension does not include any issues of immediate cross-border significance. However, there are cross-border cooperation projects with neighbouring EU Member States

as well as various initiatives to exchange best practices relating to efficiency (see Section 3.2.).

Dimension 3: Energy security

Functioning energy markets are the best possible guarantee for energy supply security within the EU as a whole while lowering the risk that disruptions in supply will lead to adverse consequences. If the security of one Member State's energy supply is under threat, there is a risk that unilateral measures taken by this Member State could jeopardise the smooth functioning of the internal market and have an adverse impact on energy supply in other Member States. Gas can be supplied to the German market via a number of import routes which can also be used by neighbouring markets to purchase gas from Germany. Solidarity agreements have been concluded with several European countries to support each other with gas supplies in an emergency, most recently with Italy and Switzerland in March 2024. Import options are becoming more diverse due, for instance, to the establishment and expansion of LNG infrastructure for Germany and neighbouring countries. This reduces the risk of supply disruptions not only for Germany, but also for neighbouring gas markets. Germany's electricity market is also firmly integrated into the EU's internal electricity market. It is a key pillar for the security of electricity supply in Germany and Europe. Security of supply is also strengthened by the ramp-up of other energy sources. A high-performance hydrogen infrastructure is to be established in Germany, for instance, which will be connected to neighbouring EU countries via a first European hydrogen network as early as 2030.

In order to implement cross-border measures to maintain security of supply in neighbouring Member States in the event of a crisis, i.e. in the event of a significant and persistent shortfall in meeting demand for energy, preliminary cross-border collaboration between stakeholders in Germany and neighbouring countries is absolutely essential, if necessary with the support of the competent authorities.

Dimension 4: Internal energy market

The European internal market forms the backbone of Europe's energy transition and is also of central importance for ensuring a safe, cost-efficient and environmentally sound supply of energy in Germany.

This is why exchanges of electricity between EU Member States are becoming increasingly important: harnessing supra-regional

generation and consumption synergies makes the electricity system even more flexible. The Federal Government is therefore actively involved in various regional cooperation forums in an effort to achieve deeper integration of the European internal electricity market. Special mention should be made here of the Pentalateral Energy Forum and the Baltic Energy Market Interconnection Plan (BEMIP) (see Sections 1.4., 3.2., 3.4.3.).

Dimension 5: Research, innovation, competitiveness

Like many other European Member States, Germany also faces major challenges in the field of research and innovation as part of the energy transition towards greater use of clean and renewable energies. The integration of increasing yet fluctuating quantities of electricity fed in from wind and PV systems, the digitalisation of the energy supply and sector coupling (including thermal energy) are common topics where technical innovations are still needed. Regional cooperation makes it possible to tackle these issues together successfully, to make effective use of cross-border infrastructure and to deploy financial resources efficiently. Research cooperation takes place at international and more specifically European level thanks to the Federal Government's involvement in Horizon 2020/Europe and its implementation of the goals enshrined in the Strategic Energy Technology (SET) Plan on the basis of common research projects and coordinated funding priorities. Regional and bilateral cooperation provides an opportunity to join forces and take more effective action in areas where similar challenges are faced, be it at geographical or thematic level. Last but not least, international cooperation is crucial for maintaining Germany's research landscape at a top global level across all technologies.

1.2.iv. Administrative structures for implementing national energy and climate policies

The Federal Government, the federal states and municipalities are all involved in implementing the energy transition and climate action. At Federal Government level, the Federal Ministry for Economic Affairs and Climate Action (BMWK) is responsible for energy and climate policy.

The authorities at Federal Government and federal state level work together continuously to implement the energy transition. Meetings between the Federal Chancellor and the heads of government of the federal states are held every six months and are also attended by the competent federal ministers. The topics discussed at these

meetings include the progress achieved with the energy transition. The competent Federal Government and federal state ministers also discuss priorities and agree on the next steps for the energy transition at the (semi-)annual conferences of energy ministers, ministers for economic affairs and environmental ministers. These committees are prepared through ongoing cooperation and close dialogue at a technical level in subordinate working committees (such as the Standing Committee on Climate Protection). This institutional cooperation is supplemented by event-related conferences and workshops (e.g. regional conferences on the growth of renewables) as well as regular senior-level discussions.

1.3. Consultations with and involvement of national and Union entities and their outcome

1.3.i. National consultations with stakeholders, including social partners, and cooperation with civil society and the public

Energy and climate policy goals and measures are developed and refined in an on ongoing process in close dialogue with stakeholders, civil society and the public. The Federal Government is primarily focussing on action related opportunities for participation in energy and climate policy processes. A number of different dialogues and participation processes had already taken place for many of the policies and measures summarised in the updated NECP before the NECP was drawn up, while others are currently being implemented or planned.

This includes, in particular, dialogue formats, some of which involve several measures or sectors, that are geared towards supporting a coherent strategic direction for energy and climate policy in dialogue with stakeholders and civil society. Examples:

Monitoring of the System Development Strategy by a stakeholder plenum: The System Development Strategy is enshrined in the Energy Industry Act as one of the foundations of the electricity and gas/hydrogen Network Development Plans. This aims to ensure that infrastructure planning is carried out in a cross-sectoral and coherent manner. Work on the System Development Strategy is accompanied by a stakeholder plenum, involving around 40 representatives from the energy sector, industry, civil society and politics. The interim report on the System Development Strategy was published in November 2023 and subsequently consulted on. The consultation contributions and an evaluation are published at

https://www.bmwk.de/Redaktion/DE/Dossier/Energiewende/konsultation-zwischenbericht-systementwicklungsstrategie.html.

Climate Neutral Electricity System Platform (PKNS): In the coalition agreement of the governing parties, the Climate Neutral Electricity System Platform (PKNS) was designed as a process that includes the broad involvement of stakeholders from politics, business, science and civil society in order to develop approaches for the electricity market design in a largely climate-neutral electricity system. In a joint process, potential solutions will be identified, evaluated on the basis of criteria and specific measures for its medium and long-term design will be outlined. Federal Minister for Economic Affairs and Climate Action Dr Robert Habeck opened the process with a plenary session on 20 February 2023. Since then, in addition to other plenary meetings, regular meetings of the working groups have been held on the four topics of 'Securing funding for renewables', 'Expanding and integrating flexibility options', 'Financing controllable capacities to cover residual loads' and 'Local signals in the electricity markets'. In August 2023, the office published the first report entitled 'Bericht über die Arbeit der Plattform Klimaneutrales Stromsystem (PKNS)' (Report on the work of the Climate Neutral Electricity System Platform (PKNS). A further report was published in April 2024.

Industry dialogue on accelerating grid connections

The rapid connection of renewable energy systems, electricity storage systems, charging infrastructure and heat pumps to the electricity grid is crucial for achieving Germany's energy and climate policy goals. The steep increase in the number of systems and the complex processes pose a major challenge for all stakeholders, especially for grid operators and subscribers. The Federal Ministry for Economic Affairs and Climate Action therefore initiated the 'Acceleration of grid connections' industry dialogue in June 2022. The aim is to identify practical challenges when connecting to the grid and to develop and implement practical solutions. The regulatory framework and the grid connection processes of the more than 850 distribution grid operators in Germany must keep pace with the rapid development of the energy transition and decarbonisation. A focus agenda was developed in the industry dialogue that now serves as a work plan. At a 'grid connection summit' on 16 April 2024, the 24 associations participating in the industry dialogue agreed to jointly tackle the measures on the focus agenda in the presence of Federal Minister for Economic Affairs and Climate Affairs Dr Habeck. The industry dialogue will continue until the end of 2025. The associations take part through written consultations, surveys and workshops.

Energy Efficiency Roadmap 2045: The roadmap dialogue process was launched in summer 2020 with representatives from academia, business and civil society and will continue until 2023. The aim was to emphasise the need for energy efficiency and energy savings and to highlight their strategic role in the energy transition. To achieve this, the current situation was scientifically analysed and this was used to systematically derive the need for action.

Six working groups came together and discussed cross-sectoral paths to achieving the reduction goal, described ways to implement it and developed specific instruments and measures to increase energy efficiency. All energy consumption sectors and cross-sectoral aspects were addressed in the roadmap process. The topics were industry, buildings, transport, digitalisation, skilled workers & qualifications as well as system issues.

Round table on skilled trades for climate change mitigation: Since March 2023, the Federal Ministry for Economic Affairs and Climate Action has been conducting the dialogue on the future of skilled trades together with trade unions and the skilled crafts organisation. This industry dialogue focuses on topics such as the energy transition and sustainable management. A central component of the dialogue on the future is the round table on skilled trades for climate change mitigation. This focuses on those skilled trades that are particularly relevant to the success of the energy transition and aims to achieve a common understanding between the trades concerned and between the skilled trades, trade unions and other stakeholders as a whole on topics specific to the skilled trades and concrete measures of particular importance to the transformation process. The round table generates important momentum for other political or technical processes, for example with a view to improving cross-trade cooperation between skilled trades businesses by optimising processes and developing digital interfaces or discussing overarching issues relating to the qualification of skilled workers in the skilled trades sector.

Energy Transition Dialogue (DEW) and citizen dialogues as part of the '80 million together for the energy transition' information and activation campaign: The central format of the '80 million together for the energy transition' campaign launched in 2022 is the Energy Transition Dialogue, which ensures dialogue with stakeholders in the area of energy transition and energy efficiency. A dedicated office organises the active provision of information to associations and institutions, serves as a contact point for enquiries or suggestions and organises multiplier formats on the topics of energy transition, the expansion of renewable

energies and energy efficiency. At trade fairs and events that are open to the public, the Energy Transition Dialogue information booth provides an opportunity for stakeholders and citizens to exchange ideas and information.

In addition, a series of public dialogues was held in various regions of Germany in the second half of 2023 as part of the energy transition campaign in order to facilitate a direct exchange with local citizens. These dialogues provided citizens with the opportunity to discuss general and local topics relating to the energy transition and climate action in workshops and to put questions directly to state-secretary level representatives from the Federal Ministry for Economic Affairs and Climate Action. The public dialogues were flanked by an Energy Transition Dialogue campaign booth, which provided information on the growth of renewable energies and facilitated further dialogue with local experts.

Building Refurbishment Compass dialogue process – Acceleration campaign for climate-neutral buildings: The Building Refurbishment Compass dialogue process was initiated in April 2024 as part of the German Energy Agency's (dena) Climate Neutral Building Forum on behalf of the Federal Ministry for Economic Affairs and Climate Action. The aim of the dialogue process is to work together with stakeholders from throughout the industry to identify specific measures to improve the energy efficiency of the building sector in an effort to help achieve the goal of climate neutrality by 2045 even faster.

The format provides for the establishment of a dialogue platform at measures level, so that the focus is on dovetailing existing and new measures, creating synergies and identifying additional efforts to transform the building sector. The hope is that stakeholders will identify the necessary measures and pool their knowledge through collaboration.

The workshop format initially comprises a multi-stage process with thematic meetings on the topics of (1) communication, consultation, planning, (2) implementation of the refurbishment and (3) financing, mobilisation of private capital and social aspects.

Stakeholder dialogue on heat planning: By holding a stakeholder dialogue, the Federal Ministry of Housing, Urban Development and Building (BMWSB), in cooperation with the Federal Ministry for Economic Affairs and Climate Action (BMWK), aims to provide short-term technical support to the federal states during the

transposition of the Heat Planning Act into federal-state law and to the municipalities carrying out heat planning for the first time. It also creates a framework for dialogue between all those involved in heat planning. Other participants include selected institutions and industry associations, as well as selected municipalities and municipal utilities. Best-practice examples from the participating municipalities will be identified and presented. The dialogue is set to kick-off in July 2024 and will be followed by a workshop process.

Transformation of gas/hydrogen distribution networks: The transformation of the energy supply requires a framework of planning, legal and financial precautions for the gas distribution networks that, firstly, guarantees a secure and affordable energy supply for private households and companies and, secondly, offers planning security for municipalities and distribution network operators and does not lead to undue hardship. The requirements of the EU's hydrogen and gas decarbonisation market package and interactions with the Heat Planning Act and the Buildings Energy Act must also be taken into account. The Federal Ministry for Economic Affairs and Climate Action has put a Green Paper up for public discussion and is analysing the comments received. The consultation procedure is not an upfront decision, instead it poses questions regarding the necessary flexibility of the legal framework.

Other examples:

- Development of a PV strategy with public consultation and summit events for consultation with federal states and associations in spring 2023
- Development of an onshore wind strategy with public consultation and summit events for consultation with federal states, ministries, associations and social partners in spring 2023
- 'Heat pumps' summit events with the Federal Ministry for Economic Affairs and Climate Action and the Federal Ministry of Housing, Urban Development and Building for consultation with ministries, industry representatives, trade unions and consumer protection associations (2023)
- District heating summit for consultation with business, industry, environmental and consumer protection associations as well as trade unions in summer 2023
- Industry process for the development of the System Stability Roadmap

- ‘Momentum for renewables’ regional conference(s) with decision-makers from the areas of planning and approval at federal state, regional and municipal level, district administrators, representatives of federal state energy agencies and municipal associations (summer 2023, continued autumn 2024)

- ‘Climate-neutral heating’ dialogue with key players in the first half of 2021

- E-mail consultation of the federal states, associations, NGOs and scientific institutions on the draft for the 2023 Climate Action Programme in June/July 2023

In addition, hearings, consultations and participations are regularly organised as part of legislative and planning procedures.

For example, participation has been extensive in the legislative processes for the amendment to the Renewable Energy Sources Act, the amendment to the Buildings Energy Act and the development of the Heat Planning Act.

With a view to participation processes in planning procedures, the planning of energy infrastructure should be emphasised as one example:

Hydrogen core network: The Federal Ministry for Economic Affairs and Climate Action and the Federal Network Agency have launched a consultation process to accompany the planning of the hydrogen core network in order to involve stakeholders such as the federal states, municipalities, associations and companies and to take legitimate concerns into account. The consultation provided an opportunity to comment on the current planning status in July 2023 and a consultation on the draft application presented by the transmission system operators in winter 2023/2024. The Federal Network Agency is also consulting on the final core grid application prior to approval after the transmission system operators submitted the core grid application to the Agency in July 2024. The legal regulations also provide for multiple opportunities for participationin the preparation of the first integrated Network Development Plan for gas and hydrogen, which the Federal Network Agency is to confirm by 30 June 2026.

Electricity transmission grid: A multi-stage participation process is planned during the planning of the electricity transmission grid in the Network Development Plan. The Federal Network Agency publishes the transmission system operators’ draft of the Scenario

Framework for consultation (most recently in January 2022). The results are incorporated into the Federal Network Agency's approval of the Scenario Framework. The Network Development Plan Electricity, which is based on this, is drawn up and consulted on in several stages. First, the transmission system operators prepare an initial draft, which they put out for public consultation (most recently in March 2023). The revised second draft is reviewed by the Federal Network Agency and put out for consultation again (most recently in September 2023). Based on this, the Federal Network Agency confirms the Network Development Plan (latest Network Development Plan 2023-2037/2045 on 1 March 2024).

Consultation of the NECP draft: In addition to the action-related participation processes described above, an online consultation was carried out on the draft NECP between 24 January 2024 and 17 March 2024 and the adequacy and weighting of objectives and measures were queried across the board.

The online consultation was linked on the website of the Federal Ministry for Economic Affairs and Climate Action. The draft NECP is also available there, together with further information: https://www.bmwk.de/Redaktion/DE/Textsammlungen/Energie/necp.html. Following an initially cautious level of participation, the consultation was also publicised in the Ministry's Energy Transition Newsletter and on social media around halfway through the consultation period.

Most of the participants in the online consultation were associations and civil society organisations, but some companies and private individuals also took part.

The weighting of the various dimensions was only partially assessed as adqeuate. Additional comments were in favour of, among other things, greater consideration of impact assessments and investment requirements, gender equality aspects, the reduction of fossil subsidies and energy efficiency (including the utilisation of waste heat). A certain overweighting of energy security was also noted.

The respondents' own level of information on the NECP and energy and climate policy was rated as rather mixed. In addition, the form of participation was criticised several times. Further forms of participation and information will be examined for future procedures for establishing the NECP – giving consideration to

limiting the administrative burden and avoiding duplication with action related forms of participation.

In particular, the consultation asked participants to categorise the adequacy of goals and measures by providing five different options. The low level of ambition and measures was frequently criticised.

The consultation yielded the following results with regard to the individual dimensions:

In the 'decarbonisation' dimension, the greenhouse gas reduction targets were predominantly assessed as 'not ambitious enough' to 'adequate', and with regard to the measures taken, the level of ambition was predominantly found to be too low. None of the participants found the level of ambition to be far too high. The goals for the growth of renewable energies were also predominantly assessed as 'not ambitious enough' to 'adequate', although there was more feedback in the 'too ambitious' category compared to greenhouse gas reduction. With regard to the measures taken, the level of ambition was noted to be predominantly too low, but at no point too high or far too high. In addition, the importance of hydrogen and green molecules, the significance of CCS and negative emissions, the need for further measures, particularly in the building and transport sectors, unresolved financing issues and fair distribution were also highlighted.

In the 'energy efficiency' dimension, the targets were predominantly rated as 'not ambitious enough' to 'adequate', in some cases also 'far too unambitious' but rarely 'too ambitious'. With regard to the measures taken for this purpose, the level of ambition was predominantly found to be too low, albeit less clearly than in the 'decarbonisation' dimension. However, slightly more participants stated that they were unable to assess this. The feedback received regarding specific measures in the building sector was very similar. In addition, reference was also made to compliance with the 'efficiency first' principle. There were also calls for compliance with refurbishment obligations and an adjustment of new building standards, but the challenges of financing and energy poverty were also mentioned, despite funding opportunities.

In the 'energy security' dimension, the measures taken were predominantly rated as 'not ambitious enough' to 'adequate', in some cases also 'not ambitious enough by far' but rarely 'too ambitious'. Diversification was widely perceived to be insufficient. In addition, the importance of local and regional energy production

was emphasised, but at the same time (import) dependencies were also highlighted. With regard to energy sources, the importance of hydrogen technologies, liquid energy sources, bioenergy and nuclear energy was explicitly mentioned, but at the same time, technological openness and an excessive focus on fossil fuels were also noted. The importance of infrastructure and value chains was also emphasised.

In the 'internal market' dimension, specific questions were asked about infrastructure and the electricity market. The majority of respondents said that they were unable to assess their adequacy. With regard to energy transmission infrastructure, there was a tendency to express criticism, although the concept of a large electricity market area was widely welcomed. In addition, the importance of hydrogen infrastructure and 'green molecules' was mentioned, while greater consideration of energy poverty and the involvement of neighbouring countries were called for. Attention was also drawn to infrastructure costs.

In the 'innovation and competitiveness' dimension, the adequacy of the measures in terms of innovation was largely assessed as neutral, or positive and negative trends are present to a similar extent. With a view to competitiveness, there was more widespread criticism. Additional information on research/innovation included synthetic fuels, 'green molecules', CCS, biomass, new technologies for renewable energy generation and gender-specific research. With a view to competitiveness, global methane emissions and other standards or carbon pricing, but also high energy prices, subsidies with environmentally harmful effects and skilled labour were mentioned.

Further comments were also submitted via the e-mail address published in connection with the consultation.

In addition to environmental associations and civil society organisations, business associations also took part. The comments were mostly critical.

Criticism was expressed, for instance, regarding the procedure for drawing up the NECP, particularly with a view to the overarching participation procedure carried out for the NECP beyond the scope of action-related participation. Among other things, the fact that no consultation was carried out before the draft was prepared was criticised, which in light of the many different specific opportunities for participation is not correct nor is this mandatory pursuant to Article 10 of the Governance Regulation.

In addition, the scope and level of detail as well as the plausibility of the information included were criticised (including additions to the projections now included for planned measures, more detailed information on investment and financing requirements and price trends, more precise data on flexibility requirements and an overall lack of plausibility/underestimation of data bases and the assumptions on which these are based). Overall, there were also calls for a higher level of ambition (in particular to achieve the goals of the Paris Climate Agreement and with regard to (methane) emissions in agriculture and innovative renewable energy technologies) and further measures to achieve the targets set (in particular in the areas of buildings, transport and animal husbandry).

A number of action-related comments were also made.

With regard to the 'decarbonisation' dimension, the need for additional measures was mentioned. Particular emphasis was placed on the buildings sector (specifically the revision of the Buildings Energy Act, effective minimum standards, refurbishment campaign for public buildings), transport (specifically fiscal reforms in relation to company cars and reduction of climate-damaging subsidies; measures in relation to advanced biofuels) and agriculture/animal husbandry (specifically methane reduction target, reduction in animal numbers, consumption-based measures). With regard to renewable energies, greater detail was called for in the presentation (including in relation to sectors, generation volumes and price trends); a target for innovative renewable energy technologies should be included. There were also calls for the reduction of climate-damaging subsidies – also to close financing gaps. There was a need for clarification and revision here, particularly with regard to the term 'subsidy' used and the timetable.

With regard to the 'energy efficiency' dimension, there were calls for the remaining gap to the target to be closed and for greater compliance with the 'efficiency first' principle. Immediate measures were especially needed in the buildings and transport sectors.

There were no additional specific demands made with regard to the 'energy security' dimension.

With regard to the 'internal market' dimension, the role of flexibility/energy storage in the energy system was particularly emphasised. These topics are discussed in detail, particularly in the Climate Neutral Electricity System Platform and as part of the

electricity storage strategy (see Sections 2.4.3. and 3.4.3). The importance of energy poverty and mobility poverty was also emphasised, including the addition of a national indicative target, more detailed estimates and support options (see Sections 2.4.4. and 3.4.4.).

With regard to the 'innovation and competitiveness' dimension, particular reference was made to the importance of innovative renewable energy technologies and related research funding.

1.3.ii Consultations with other Member States

Consultations on the NECP with the other Member States took place as part of the NSEC/Penta meeting (see also Section 1.4). At the first consultations on 9 November 2023, the participating countries reported on the most important changes in the drafts of their updated NECPs, especially on the new energy efficiency and renewable energy goals. In the subsequent break-out groups, the representatives of the participating countries discussed joint projects, particularly in the areas of offshore wind and hydrogen. The topic of 'grid flexibility' was also discussed.

At the second NSEC/Penta consultations on 25 March 2024, the participating countries reported on the most important changes in the final updated NECPs compared to the submitted drafts. With a view to cross-border cooperation, hydrogen and carbon infrastructure as well as the availability of raw materials were also discussed.

A regional exchange also took place as part of the EU Strategy for the Baltic Sea Region (EUSBSR).

Germany's neighbouring countries were also invited to a bilateral exchange on the respective updated NECPs which took place both virtually and in-situ. In addition, the Federal Government fosters regular dialogue with all EU Member States on energy and climate policy issues.

1.4. Regional cooperation in preparing the plan

Germany is in regular contact with other Member States in order to cooperate in joint projects for the production of electricity, heat or cooling from renewable sources. For Germany, the development of offshore cooperation projects has a key role to play in this context (see Section 3.1.2.ii.). Against this backdrop, Germany is currently

developing a cooperation strategy for renewable energies that will pave the way for Germany's framework and objectives for cooperation projects with other Member States.

1.4.i. Elements forming the subject of joint or coordinated planning with other Member States

While preparing their draft NECPs, the EU Member States of the Pentalateral Energy Forum (Belgium, Luxembourg, the Netherlands, France, Austria and Germany) exchanged views and information. Germany also exchanged information and views bilaterally with several neighbouring countries, including Denmark, Austria and the Czech Republic.

Cooperation in the Pentalateral Forum is a joint collaboration between the ministers responsible for energy policy. Accordingly, the following chapter reflects the views of the energy ministers.

JOINT PENTA SECTION FOR NATIONAL ENERGY AND CLIMATE PLANS

Pentalateral Energy Forum – Platform for regional energy cooperation

As part of the Pentalateral Energy Forum for regional cooperation set up in 2005, Belgium, France, Germany, Luxembourg, the Netherlands and, since 2011, Austria work together on a voluntary basis. These countries together account for more than 40% of the population of the EU and more than 50% of the electricity generated in the EU. Switzerland joined in 2011 as a permanent observer and actively contributes to the technical work carried out and to the decision-making. In close cooperation with the European Commission (at the latter's invitation), the Pentalateral Energy Forum strengthens

cooperation between all relevant stakeholders, seeking to create a reliable, decarbonised and efficient electricity system based on integrated and smoothly operating markets. Since the electricity sector has a crucial role to play in the overall decarbonisation of our societies by 2050 at the latest, the Penta countries are committed to further increasing the share of renewable energy and fully decarbonising their electricity system as quickly as possible – ideally by 2035.

Cooperation is managed by the ministers responsible for energy policy, who meet on a regular basis. The follow-up of activities is supported by the Penta coordinators under the leadership of the respective Directors-General of the Penta countries. The work programme is carried out by ministries, transmission system operators (TSOs), distribution system operators (DSOs), regulatory authorities and market players, who currently meet regularly in four topic-related support groups. To ensure that each support group can achieve its goal, the exchange between and within the support groups is intensively promoted and supervised at NSEC coordinator level. The support groups also liaise with other international forums, such as the North Seas Energy Cooperation.

As the transition to a decarbonised energy system continues to accelerate, countries are becoming increasingly dependent on each other so that regional cooperation will be even more important when it comes to overcoming the challenges that emerge. The Pentalateral Energy Forum is in a good position to tackle these challenges, for instance, in the areas of security of supply, market integration, energy efficiency and decarbonisation. Over the past two decades, the Penta countries have shifted from a purely national perspective on the energy markets to a regional approach. This puts the Penta countries in an ideal position to contribute to the next phase of the energy transition.

Security of supply

Security of supply has been a key issue since the Pentalateral Energy Forum was first founded. Since then, the countries have been working closely together to promote security of supply, solidarity and confidence-building and to prevent, anticipate and manage electricity crises. Notable milestones have been achieved through various regional adequacy assessments, joint crisis exercises and a common framework under EU Regulation 2019/941 on risk-preparedness in the electricity sector.

Today, the work on security of supply is organised in a special support group, which is divided into two main task areas: assessments of the adequacy of resources and on risk-preparedness. Future work is planned for these two task areas and for the interface between them.

Assessments of the adequacy of resources

When it comes to assessing the adequacy of resources, the Penta countries will cooperate with the European studies conducted by

ENTSO-E (European resource adequacy assessment, seasonal forecasts) in order to improve both coordination and benefits for the Penta countries. Based on their extensive expertise and knowledge in this area, the Penta TSOs could conduct supplementary sensitivity analyses with a particular focus on the Penta region, taking into account regional characteristics and cross-border interdependencies. Other topics worthy of further regional investigation:

- The link between national energy system planning, the implementation of the TEN-E Regulation and the rapid development of the European energy system
- The role of demand-side response (DSR) and other flexible resources to ensure system adequacy
- Methodological improvements for assessing the adequacy of resources
- The need to increase network capacity and optimise the existing network
- Analysing critical situations and possible countermeasures

Risk appetite

In terms of risk appetite, the aim is to promote regional cooperation in the Penta region to prevent, prepare for and manage electricity crises in a spirit of solidarity and transparency, in full compliance with both the requirements of a competitive internal electricity market and the operational security procedures of the transmission system operators. The Penta countries will endeavour to ensure effective cooperation between all competent bodies involved in crisis management and between the European, regional and national levels. With this in mind, the work will focus on implementing the Memorandum of Understanding signed on 1 December 2021 on risk-preparedness in the electricity sector, in particular on:

- Analysing and evaluating regional measures, including the necessary technical, legal and financial arrangements for their implementation
- Organising regional exercises
- Revision of the relevant regional electricity crisis scenarios for the Penta region in close consultation with ENTSO-E and the Commission with a view to the applicable methods

- In the event of a power crisis within the Penta region, the agreed framework must be applied.

Interface between the assessment of resource adequacy and risk-preparedness

The Penta countries will also work on the interface between the assessment of resource adequacy and risk-preparedness. A first step was taken with the Penta study entitled *Methodological improvements in the assessment of resource adequacy* in which the differences and overlaps were analysed. Penta aims to close the gaps that exist between long-term analysis and short-term operational planning, technical and political decision-making and between the different countries. Penta is particularly keen to support the further development of analytical tools and procedures for exchanging information and for decision-making, closely involving ministries, transmission system operators (TSOs), distribution system operators (DSOs), regulatory authorities as well as ACER, ENTSO-E, EU DSOs and the regional security centres in the Penta region (Coreso and TSCNet).

Market integration

The Pentalateral Energy Forum has had two decades of experience in matters of market integration. During this time, Penta has witnessed and driven major changes in the political landscape, with notable milestones such as the introduction of flow-oriented market coupling, first in the Penta region and now in a larger part of continental Europe.

Promotion of a future-proof market design

In recent years, work on market integration within Penta has become more extensive both in terms of its focus and the topics covered. The Penta ministers have consistently placed hydrogen on the national and European agenda as a key element for system and market integration. The newly created SG4 is actively working to develop an integrated EU hydrogen market.

The Pentalateral Energy Forum will also contribute to the integration of renewable energies and the development of a future decarbonised electricity system in which integrated markets will have a key role to play. The 'Vision 2050' and 'Flexibility' studies, which were recently commissioned for this purpose, were carried out as part of Support Group 3 (SG3) for the future electricity system and will serve as a basis for future work within Penta.

The Vision 2050 report compares national scenarios for decarbonisation and proposes modules for a common political vision for the future electricity system. These modules describe the components required for the efficient development of a future electricity system. The Penta countries will continue the work on Vision 2050 by drafting a political declaration containing a common vision for the future integrated energy system.

To achieve such a future electricity system, the Penta countries recognise the need to future-proof market design and actively exchange views on how electricity market regulation can be improved and regulated while identifying areas where further action is needed. The Penta countries will join forces, building on their experience to date, to flesh out the benefits of taking an integrated and market-orientated approach to potential policy issues. They will continue to exchange technical know-how and organise projects that contribute to the concrete implementation of energy policy in the Penta regions.

Flexibility

The flexibility report provides additional insights into the current and future status of flexibility in the region. It outlines the flexibility requirements and sources of flexibility for the years 2030/40/50 that will result from the integration of renewables, highlighting that cooperation between countries can trigger considerable synergies and reduce overall flexibility requirements. The report also contains important recommendations to promote flexibility across the region and possible measures for improving the flexibility of market players. Therefore, the Penta countries will:

Exchange information on the harmonisation of non-standardised products such as grid congestion management (e.g. redispatching and topological measures)

Discuss how the flexible behaviour of market participants can help to balance the energy system via the wholesale markets and ensure secure and stable operation of the electricity grids

Monitor the development of technical requirements for additional electricity demand (e.g. heat pumps and other flexibility sources) to ensure interoperability so that additional electricity demand is truly flexible

Cooperate on the implementation of flexibility provisions in upcoming EU legislation such as the electricity market reform and

the grid code on demand-side management. When shaping national policy, the Penta countries will endeavour to take the flexibility requirements of the regions into account wherever possible.

Energy efficiency

The Pentalateral Energy Forum recognises the importance of increasing energy efficiency to reduce dependence on fossil fuels and mitigate the scale of the challenges of the energy transition. In this respect, Penta sees the value both in saving energy and in making electricity demand more flexible. The Penta countries exchanged views on the implementation of the obligation to reduce electricity demand as laid down by EU legislation in the winter of 2022/2023.

The Penta countries will continue to cooperate by exchanging views on the implementation of the revised Energy Efficiency Directive and sharing best practices in the field of energy saving.

Decarbonisation

As described above and based on the work conducted up to now on Vision 2050, the Penta countries will continue to work on a common political vision for a decarbonised electricity system which is to be implemented as soon as possible and ideally by 2035. The Penta countries will work together to promote the expansion of renewable energies while raising awareness of the importance of flexibility on the road to a fully decarbonised electricity system without compromising security of supply. The Penta countries recognise that they are striving for better regional cooperation in order to harness synergies and achieve efficiency gains. The Penta countries will analyse the added value of greater regional cooperation in integrating renewables, grid planning, connecting offshore to onshore (in cooperation with the North Sea Energy Cooperation) and addressing other issues with possible cross-border impacts during the transition to a decarbonised electricity system.

Hydrogen

In 2020, a special support group for hydrogen was set up to drive forward Penta's activities and close cooperation in the field of hydrogen. SG4 focuses on regulatory and market developments in conjunction with the use of hydrogen in the Penta countries in compliance with national, European and international regulations. Based on the political declaration signed in 2020 on the role of

hydrogen in the decarbonisation of the energy system in Europe and recent developments, including REPowerEU and the International Energy Agency's ten-point plan to reduce the European Union's dependence on Russian natural gas, the Penta countries exchange information and views while defining common positions on the future market design for developments related to the use of hydrogen. In particular, SG4 will focus on the development of hydrogen certification, the emerging hydrogen infrastructure in the Penta region and the steps needed to develop cross-border interconnections. In addition to monitoring progress of the Penta countries in implementing their hydrogen strategies, it will also address regulatory developments, support mechanisms, investments, supply and demand developments and trade.

JOINT NSEC SECTION FOR NATIONAL ENERGY AND CLIMATE PLANS

North Seas Energy Cooperation – Regional cooperation in the field of offshore renewable energy

Germany is part of the larger North Sea region, which has an impressive potential for renewable energy. Offshore wind energy will play an increasingly important role in achieving Europe's energy and climate goals. The EU offshore strategy has set itself the ambitious goal of unlocking 300 GW of offshore wind capacity and 40 GW of marine energy by 2050. On 19 January 2023, the North Seas Energy Cooperation (NSEC) facilitated the development of a non-binding agreement on the 2050 targets for offshore renewable energy generation, with intermediate steps in 2040 and 2030, for the priority offshore grid corridors of the North Sea under the TEN-E Regulation. The targets for the priority North Sea Offshore Grid corridor (NSOG) are 60.3 GW in 2030, between 134.9 and 158 GW in 2040 and between 171.6 and 218 GW in 2050. The offshore sector, the deployment of renewable energies and integrated strategic offshore development are thus taking on a far greater dimension. High energy prices, like in 2022, and geopolitical events that jeopardise the European energy system have made it all too clear that domestic renewable energy generation capacity and regional offshore transmission grids must be expanded and driven forward as quickly as possible in order to significantly improve the security of energy supply.

Germany is working with the other NSEC countries to identify, analyse and implement opportunities for specific cooperation projects. Founded in 2016, the NSEC is a voluntary, grassroots-based and market-oriented regional cooperation initiative with the following objectives:

- Create synergies
- Prevent incompatibilities in terms of national strategies
- Share and exchange knowledge on international best practice
- Promote common strategies where possible and appropriate.

The ministers responsible for energy meet regularly within the framework of the NSEC. In addition to the involvement of the

European Commission, in 2023, the NSEC included Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden. On 18 December 2022, the NSEC Energy Ministers and the European Commissioner for Energy signed a Memorandum of Understanding on cooperation with the United Kingdom in the field of offshore renewable energy. This Memorandum of Understanding is based on the Trade and Cooperation Agreement between the European Union and the United Kingdom of 30 December 2020, it builds on the NSEC and serves as both a stand-alone and complementary measure to the existing NSEC framework.

For the offshore wind sector, a predictable and long-term stable operating environment is essential to enable long-term investment and further cost reductions. To this end, existing barriers must be removed and attractive investment conditions created. Together, the NSEC members make an important contribution to achieving these objectives by regularly exchanging expertise on various topics in the four NSEC Support Groups (SGs):

- SG1: Development of hybrid and community projects
- SG2: Permits, maritime spatial planning and environmental aspects
- SG3: Funding and support framework
- SG4: Long-term network and infrastructure planning

To ensure that each support group can achieve its goal, exchanges between and within the support groups is strongly encouraged and supervised at NSEC-coordinator level. Examples of this include offshore wind farms (SG1 and SG4), maritime spatial planning and grid planning (SG2 and SG4), and how non-price criteria can foster innovation in relation to the major challenges facing accelerated, cost-effective and responsible deployment of offshore wind (SG1, SG3 and SG4). Finally, the support groups also work closely with other international forums such as the Pentalateral Energy F0orum and the Clean Industrial Forum on the planning of onshore grids, market regulations and stakeholder engagement.

Development of hybrid and community projects

The NSEC's SG1 acts as a platform for co-operation on concepts for potential offshore wind projects and coordinated electricity infrastructure, including transmission infrastructure. As the

number of joint and hybrid projects of the NSEC countries grows, the group has stepped up its activities in the North Sea region to support discussions at technical and inter-ministerial level and the exchange of best practices as the projects progress.

In addition to joint offshore wind energy projects involving several countries, the Support Group is also working on potential 'hybrid' solutions with cross-border options to connect offshore wind farms to more than one electricity market and tap into synergies between countries. The Support Group also discusses the relevant EU and national market regulations.

The members of SG1 are therefore developing ways of working together on hybrid projects while overcoming possible legal, regulatory and distribution barriers. SG1 will continue to work on removing barriers and on steps for hybrid and joint projects that can be implemented at both national and regional level. In addition, this cooperation will continue to serve as a forum to reflect on how to address issues relating to legislative procedures at EU and national level.

Permits, maritime spatial planning and environmental aspects

To achieve our energy and climate targets in the EU, we need to accelerate planning and approval procedures at EU and national level, while gaining a better understanding of the possible ecological limits of large-scale wind expansion in the North Sea and the impact on other sea users. In 2023, SG2 conducted an inventory of spatial tensions in the development of offshore wind farms at regional level. The next steps will involve defining the ecological tensions and potential threats to development in more detail and establishing spatial strategies to avoid or minimise these threats. To increase knowledge and support the deployment of offshore wind turbines in the North Sea, the countries bordering the North Sea will continue to work closely with the relevant authorities for energy, maritime spatial planning and the environment in the areas of maritime spatial planning, environmental research and cumulative impact assessment of wind farms.

Funding and support frameworks

Offshore tenders are a key issue for the funding and support framework. The NSEC members coordinate the offshore tenders by exchanging information on national procurement schedules within the framework of SG3. The countries also exchange best practices in this working group, addressing participation in tenders, zero

subsidy support, design elements to promote system and sector integration as well as grid connection rules. Joint projects are becoming increasingly important for achieving the ambitious goals,

which is why the group is also looking at funding opportunities for joint cross-border offshore projects, also through EU funding instruments such as the Connecting Europe Facility and the EU Renewable Energy Financing Mechanism. Finally, Power Purchase Agreements (PPAs) are playing an increasingly important role in financing offshore projects. The countries will address the problems, barriers and solutions needed for wider acceptance of the PPAs. The decommissioning, extension of operating times and retrofitting of wind farms are also topics discussed by the group.

Views and information are also exchanged in order to jointly develop and discuss ideas for the medium-term future of the offshore energy system in terms of installed capacity, for instance, through coordinated tender plans.

2050 horizon: long-term network and infrastructure planning

The NSEC's SG4 works with ENTSO-E to provide and coordinate input to the Offshore Network Development Plan for offshore grids in the northern seas under the EU TEN-E Regulation. In addition, SG4 aims to broaden the discussion on long-term network planning to include the early development and expansion of offshore hydrogen production and transport and its potential role in an increasingly interconnected North Sea energy system. Hydrogen will play an important role in the decarbonisation of our energy system. Power-to-X and hydrogen in particular will have a pivotal role to play in providing flexibility where and when it is needed. Demand for hydrogen is expected to increase significantly, especially after 2030, both because of its potential as a storable energy carrier and as a fuel and raw material for areas that are difficult to electrify. Several NSEC countries have announced targets for the onshore and offshore production of green hydrogen. In SG4, the NSEC countries will share first experiences with hydrogen related to offshore wind turbines as well as knowledge on transport infrastructure, renewable energy development and offshore power-to-X production. Working together, they will gain insights into offshore hydrogen production, discuss the introduction of electrolysis and increase synergies between the long-term planning of offshore and hydrogen networks. In all aspects of medium and long-term infrastructure planning, SG4 underlines the importance of comprehensive engagement in this planning process with the Member States and relevant stakeholders, including industry and

non-governmental organisations, in order to anticipate and eliminate supply chain bottlenecks (e.g. development and availability of wind farms) in deploying and accelerating the establishment of our North Sea energy system. This is closely linked to the importance of protecting the security of critical offshore and underwater infrastructure and the supply of critical raw materials through innovation and improved circular economy.

1.4.ii. Explanation of how regional cooperation is considered in the plan

The energy transition and climate action can only succeed and progress if both are enshrined at EU level and backed by regional cooperation. Regional cooperation – in the form of bilateral cooperation or joint initiatives and forums involving several EU Member States – therefore represents a core component of the Federal Government's energy and climate policy. This section is still to be fleshed out with regard to the preparation of the Federal Government's final energy and climate plan. The following overview contains some of the most important regional collaborations underway with European partners. They can be found in the corresponding sections on regional cooperation in the draft NECP:

Bilateral cooperation

The Federal Government cooperates closely with many other EU Member States (in particular its direct neighbours) on energy and climate policy. This cooperation has been confirmed and fleshed out in joint memorandums of understanding with some Member States. In the current legislative period, for instance, the existing and very good energy and climate policy cooperation between France and Germany was strengthened as part of the Franco-German Declaration of January 2023 and expanded to include Poland through the newly created German-Polish Energy Platform. Cooperation projects with France are established in the Franco-German Energy Platform, in the internal energy market and in energy research (see Sections 3.2., 3.4.3., 3.5.). In addition, a great deal of knowledge and experience is exchanged within the scope of the German/French Office for the Energy Transition (DFBEW). Solidarity agreements regarding gas supplies have been concluded with several European countries.

European Climate Action Initiative

The European Climate Action Initiative (EUKI) is a funding initiative by the Federal Ministry for Economic Affairs and Climate Action to strengthen European cooperation in the further development and implementation of ambitious climate policy. This initiative finances non-investive climate protection projects, particularly by civil society and sub-national administrations in Europe. Bilateral and multilateral projects within the framework of the European Climate Action Initiative will focus on the development of climate strategies and their implementation at various levels, exchanges of information on climate policy instruments, as well as measures and projects in the relevant sectors: climate policy, energy transition and climate-neutral buildings, mobility, just transition, carbon removal and sustainable economy. In addition to project implementation, the European Climate Action Initiative aims to promote the exchange of knowledge and experience between the project organisations and with other climate action experts.

Baltic Energy Market Interconnection Plan (BEMIP)

BEMIP was set up in 2009, and its members include all of the Baltic Sea coastal states that belong to the EU, as well as Norway in the role of observer; organisational matters are largely handled by European Commission. The Federal Government sits on the BEMIP working groups (see Section 3.1.2.).

North Seas Energy Forum/North Sea Energy Cooperation (NSEC)

In 2016, the North Sea coastal states and the European Commission set up the North Seas Energy Forum with a view to further expanding their cooperation in the energy sector. This forum focuses on cooperation on the development of offshore wind energy, the expansion of grid infrastructure and maritime spatial planning in the North Sea. As part of the initiative, the relevant Member States, including the Federal Republic of Germany, have also begun to exchange views on the relevant parts of the North Sea coastal states' NECPs and to develop common NECP elements (see Sections 3.1.2., 3.5.) The next annual NSEC conference will be organised by Germany in 2025.

Pentalateral Energy Forum

The Pentalateral Energy Forum was set up in 2005 to facilitate cooperation between the EU Member States of Belgium,

Luxembourg, the Netherlands, France, Austria and Germany in the areas of electricity market coupling, security of supply, crisis preparedness and increased flexibility of electricity markets. Switzerland participates in this Forum as an observer (see Section 3.4.3.).

Pentalateral Gas Forum

The Pentalateral Gas Form was set up in 2009 to facilitate cooperation between the EU Member States of Belgium, Luxembourg, the Netherlands, France and Germany in the area of gas supply (see Section 3.3.).

Cooperation in regional groups within the framework of the Trans-European Energy Networks (Trans-European Networks Energy – TEN-E regional groups)

The Federal Government cooperates with other Member States in several regional groups within the framework of TEN-E. The regional groups correspond to the priority energy infrastructure corridors defined in the TEN-E Regulation and are responsible at regional level for identifying projects of common interest (PCIs) for the development of energy infrastructure under the TEN-E Regulation. According to Article 4 of the TEN-E Regulation, one of the aims of these projects is to contribute to market integration, sustainability, competition (diversification of supply sources, routes and suppliers) and security of supply (see Sections 3.3. and 3.4.3.).

Greater North Sea Basin Initiative (GNSBI)

In 2023, France and the Netherlands launched the Greater North Sea Basin Initiative (GNSBI) in which the Federal Government is actively involved. With the GNSBI, the North Sea coastal states, including the United Kingdom and Norway, aim to work closer together across sectors in the areas of energy, environment, fisheries and spatial planning in order to coordinate development of the North Sea region.

2. NATIONAL OBJECTIVES AND TARGETS

2.1. ‘Decarbonisation’ dimension

2.1.1. GHG emissions and removals

The elements set out in Article 4(a)(1)

Annually binding national limits pursuant to the EU Effort Sharing Regulation (ESR)

To ensure that the EU’s 2030 climate goal (at least -55% net greenhouse gas reduction) can be achieved, the European Parliament and the European Council have also revised the Effort Sharing Regulation (ESR) and the LULUCF Regulation. The EU Effort Sharing Regulation now contains a binding reduction target for Germany of -50% compared to 2005 by 2030 (instead of the previous -38%) for those sectors that do not fall under the existing emissions trading system (EU ETS1), i.e. for transport, buildings, agriculture, smaller energy generation and industrial plants and waste. The national annual emission allocations (AEAs) between 2021 and 2030 are determined in implementing acts based on the authorisation under Article 4(3) of the Effort Sharing Regulation. Commission Implementing Decision (EU) 2020/2126 (last amended by Commission Implementing Decision (EU) 2023/1319 of 28 June 2023) provides for the following annual emission allocations for Germany in tonnes of CO_2 equivalent for the period 2021 to 2025:

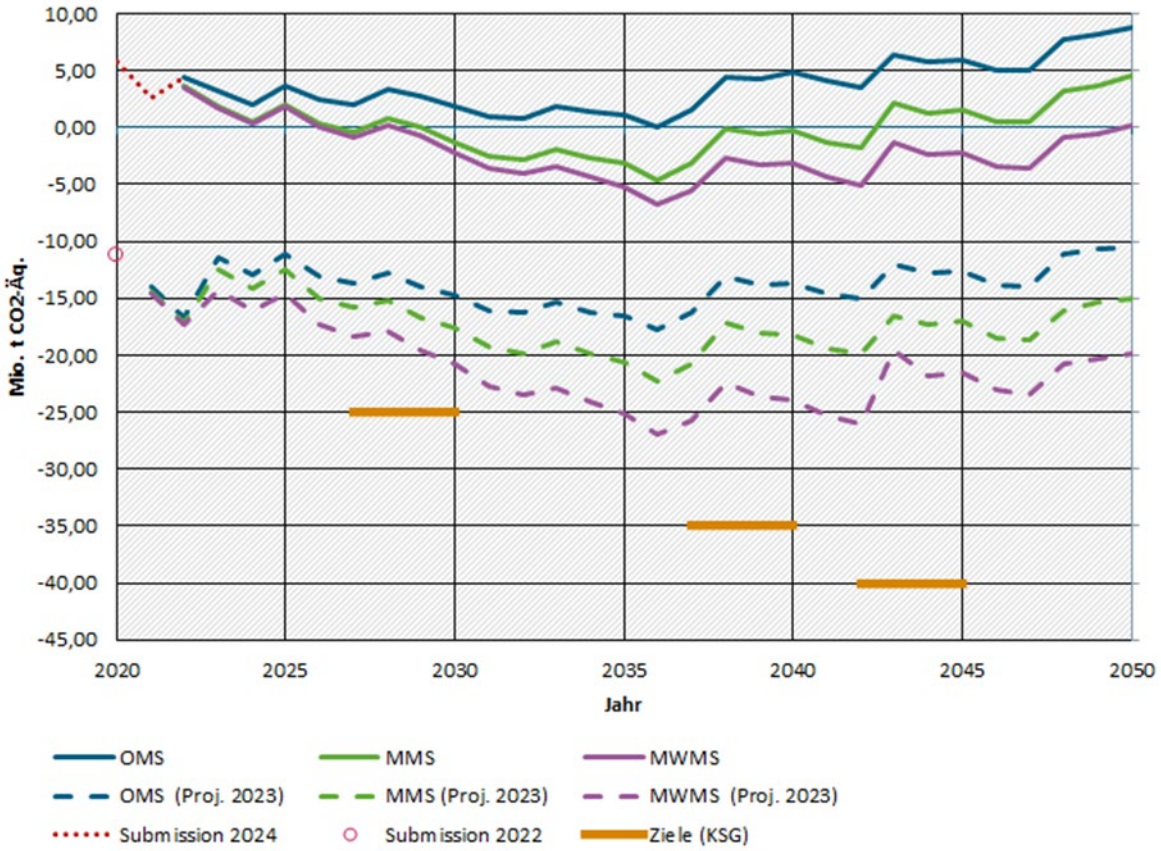
- 2021: 427 306 142
- 2022: 413 224 443
- 2023: 391 872 325
- 2024: 370 518 122
- 2025: 349 163 918.

The national annual emission allocations for the years 2026 to 2030 will be determined by further implementing acts to be adopted in 2025.

Assurances pursuant to the LULUCF Regulation (Land Use, Land Use Change and Forestry)

The LULUCF Regulation was revised as part of the European Fit for 55 package. Member States will receive a gap target for 2030 and a budget target for the period 2026 to 2029. For the period 2021 to 2025, the current LULUCF targets will continue to apply, however, the combined direct debits from the land use categories, which are taken into account pursuant to Article 2, may not exceed the credits at the end of the five-year period from 2021 to 2025 (so-called 'no net debit rule'). From 2026 onwards, the Regulation provides for absolute sink targets for each Member State, which are expressed as an improvement compared to the 2016 to 2018 baseline period. According to current estimates, the gap target for 2030 (improvement of the sink by 3.8 Mt of CO_2 equivalent) and the budget target for 2026 to 2029 are in line with the target value of the Federal Climate Action Act (KSG) for the LULUCF sector (improvement of the sink to an average of 25 Mt of CO_2 equivalent for the years 2027 to 2030). It should be noted that the 2030 target set out in the Federal Climate Action Act cannot be easily compared with the EU LULUCF target, as these two targets differ with a view to both the calculation method and data basis used.

For the years 2037 to 2040, the Federal Climate Action Act foresees an average annual emissions balance of minus 35 Mt of CO_2 equivalents for the LULUCF sector; for the years 2042 to 2045, the target for the average annual emissions balance is minus 40 Mt of CO_2 equivalents.



Projected development of the LULUCF sector's net balance without measures (OMS), with measures (MMS) and with further measures (MWMS). The solid line shows the projection data for 2024. Source: Öko-Institut et al: 2024 projection report for Germany

According to the 2024 projection data (see table), the LULUCF sector's net balance with measures (MMS) in 2030 totals -1.3 Mt CO2-eq, in 2040 -0.2 Mt CO2-eq and in 2045 1.6 Mt CO2-eq. The 2030 net balance with further measures (MWMS) totals -2.2 Mt CO2-eq, in 2040 -3.1 Mt CO2-eq and in 2045 -2.3 Mt CO2-eq. The target values laid down in the Federal Climate Action Act for the LULUCF sector are not achieved in either scenario. The LULUCF sector does not become a permanent net sink for greenhouse gases in any scenario. The scenario with further measures (MWMS) is the only scenario in which a continuous sink is reached between 2029 and 2049. The significant difference to the projections in the 2023 projection report results from the methodological improvements in emissions reporting (consideration of methane emissions from artificial waters, regionalisation of soil carbon stocks) between submission 2022 and submission 2024. As a result, additional GHG emissions in the LULUCF sector that were not previously taken into account for methodological reasons are recorded from the 2023 inventory reporting.

At the time the projections were made, the 'Action Plan on Nature-based Solutions for Climate and Biodiversity' (ANK) was not available in a sufficiently detailed and operationalised form so that it could not be fully taken into account.

Key GHG reduction measures for the LULUCF sector, which are largely implemented via the 'Action Plan on Nature-based Solutions for Climate and Biodiversity' (ANK), include the rewetting of peatlands, the reduction of peat use in growing media, the creation of species-rich and climate-resilient forests through restoration and forest conversion, financial incentives for additional climate action and biodiversity services in forests, a halt to logging in old beech forests, limiting the use of new land for settlement and transport purposes, creating compensation areas for land sealing resulting from the expansion of wind power and open-space photovoltaics and other measures, particularly as part of the Action Plan on Nature-based Solutions for Climate and Biodiversity. The Plan provides for measures in ten fields of action, including peatlands, forest ecosystems, water bodies and water balance, seas and coasts, settlement and transport areas.

The Plan focuses primarily on voluntary participation and corresponding support measures in order to achieve the objectives of Section 3a of the Federal Climate Action Act. Financial incentives will be offered to landowners or land managers to convert the management of their land in such a way that this contributes to improving the emissions balance in the LULUCF sector. Demand is high for the funding offered in the published funding guidelines of the Action Plan on Nature-based Solutions for Climate and Biodiversity.

It will take time to implement the measures laid down in the Plan because the two core areas (moorland and forest) in particular are very large-scale support measures.

In order to tailor support as effectively as possible, the different framework conditions for Federal Government and, in some cases, federal state funding programmes must also be taken into account when preparing funding guidelines. In addition, the funding programmes – especially in areas where agricultural or forestry operations are addressed, such as the rewetting of drained peatland used for agricultural purposes – must be checked for their relevance under state aid law and, if necessary, notified to the European Commission.

Besides funding measures, the Action Plan on Nature-based Solutions for Climate and Biodiversity provides for a variety of other measures which work together to create synergies and support the success of the funding measures. In addition to accompanying research, monitoring and capacity building measures, these measures include supporting measures such as the acquisition of special equipment and technology, communication and education measures, structural development measures and the creation of framework conditions – such as reviewing the legal framework in order to identify barriers to implementation in the field of peatland protection.

In addition, the Action Plan on Nature-based Solutions for Climate and Biodiversity contains an intrinsic mechanism for regular reporting and monitoring: "By 2025 at the latest, the Federal Government will prepare and publish a report on the implementation status of the Action Plan on Nature-based Solutions for Climate and Biodiversity and the impact of the measures in relation to effective greenhouse gas savings and other targets laid down in the Plan, if possible on the basis of measurable indicators. In this context, we will evaluate the measures implemented and check for any need for adjustment. [...] In particular, the trends in emissions balances in the LULUCF sector must be taken into account. If the emission projections show that it is unlikely that the targets for the LULUCF sector will be reached, the measures in the Action Plan on Nature-based Solutions for Climate and Biodiversity will be adjusted to ensure that the Plan makes a substantial contribution to closing the gap. This review and adjustment will be carried out every two years on the basis of the latest projection report. An evaluation should also be carried out taking into account the further development of the EU's climate framework."

Further details on the Action Plan on Nature-based Solutions for Climate and Biodiversity and the most important measures are described in Section 3.1.1.i in the section on agriculture, land use change and forestry.

The German LULUCF inventory is based on geographically specific land use change data. In those areas where Germany has not yet reached the tier level required for future reporting, the necessary research and implementation requirements are currently being examined. Recommendations for action by the European Commission are required in order to ensure future compliance with the reporting requirements. With regard to carbon pools for which the LULUCF Regulation requires Tier 3 methods only in certain areas, Germany plans to use Tier 3 methods for its entire territory.

Numerous monitoring measures and research projects, such as forest inventories, soil inventories, development of remote sensing devices, etc., are already underway to make this possible.

Other national objectives and targets consistent with the Paris Agreement and current long-term strategies. If these meet the Union's commitment to the reduction of greenhouse gas emissions, other objectives and targets, including sector targets and adaptation goals.

In the Federal Government's Climate Action Act, Germany has set itself the goal of becoming net greenhouse gas neutral by 2045. Greenhouse gas emissions are to be reduced by at least 65% by 2030 and by at least 88% by 2040 compared to the baseline year of 1990. This means that Germany's targets are even more ambitious than the European targets of achieving climate neutrality by 2050 and a net reduction in greenhouse gas emissions of at least 55% by 2030.

Pursuant to Section 15(1), first sentence, of the Federal Climate Action Act, the Federal Government has set itself the goal of achieving a climate-neutral federal administration by 2030.

2.1.2. Renewable energy

2.1.2.i. The elements set out in Article 4(a)(2)

The rapid expansion of renewable energies is key to achieving climate action goals and ensuring an affordable, secure energy supply. The revised Renewable Energy Directive with its more ambitious targets came into force on 20 November 2023. The share of renewable energies in the EU is to be increased to at least 42.5% of gross final energy consumption by 2030, however, with a target of as much as 45% (for Germany's target contribution, see Section 5.1.i). For Germany, too, this means hugely accelerating the development of renewable energies and their deployment in order to meet the targets set by the EU.

The revised Renewable Energy Directive came into force on 20 November 2023. must be implemented by the European Member States within 18 months. It envisages a joint greenhouse gas savings target of 14.5% for the entire transport sector by 2030.

In order to contribute to limiting global warming to 1.5°C, the Federal Government adopted a comprehensive amendment to its energy legislation in April 2022. The new Renewable Energy

Sources Act (EEG 2023) sets higher development targets for wind and solar energy, giving the development of renewables legal precedence over other interests to be weighed up in planning processes as long as this does not affect national and alliance defence interests. By 2030, at least 80% of gross electricity consumption in Germany is to come from renewable energy sources. The development paths for wind and solar energy will be significantly increased with the growth target for offshore wind energy increasing to at least 30 gigawatts (GW) by 2030, to at least 40 GW by 2035 and to at least 70 GW by 2045. For onshore wind energy, 10 GW of installed capacity is to be added annually to reach a total of 115 GW by 2030 and 160 GW from 2040. For solar installations, 22 GW is to be added annually to reach a total of around 215 GW by 2030 and 400 GW by 2040.

2.1.2.ii. Estimated trajectories for the sectoral share of renewable energy in gross final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sectors

Electricity

In 2022, renewable electricity generation in Germany (pursuant to EU Directive 2018/2001) was based on the pillars of onshore wind energy (102.5 TWh), solar power generation (60.3 TWh), offshore wind (26.6 TWh), hydropower (19.9 TWh) and biomass (51.3 TWh) (including other renewable energies). In total, 260.6 TWh of renewable electricity (pursuant to EU Directive 2018/2001) was generated in 2022, resulting in a 47.6% share of renewable energy in gross electricity consumption (pursuant to EU Directive 2018/2001).

For three technologies, identified as future growth technologies, expansion paths have been defined in Section 4 of the 2023 Renewable Energy Sources Act (EEG 2023) and in Section 1 (2) of the Offshore Wind Energy Act (WindSeeG).

Onshore wind energy (installed capacity in GW)

2023	2024	2025	2026	2027	2028	2029	2030
-	69	-	84	-	99	-	115

Offshore wind energy (installed capacity in GW)

2023	2024	2025	2026	2027	2028	2029	2030
-	-	-	-	-	-	-	30

Solar energy (installed capacity in GW)

2023	2024	2025	2026	2027	2028	2029	2030
-	88	-	128	-	172	-	215

Renewable electricity generation from biomass and hydropower is not seen to have any substantial potential for growth so that the contribution by these two energy sources will decrease proportionately.

Based on the expansion targets, a renewable electricity volume path is derived (electricity generation in TWh; Section 4a of the 2023 Renewable Energy Sources Act).

2023	2024	2025	2026	2027	2028	2029	2030
287	310	346	388	433	479	533	600

According to Section 1 of the 2023 Renewable Energy Sources Act, renewables are to account for 80% of gross electricity consumption by 2030. Accordingly, gross electricity consumption of 750 TWh is assumed for 2030.

Heating and cooling

In the heating and cooling sector, buildings account for the largest share of energy consumption (approx. two thirds of final energy consumption for heating and cooling). That being said, process heating and cooling in industry also play a decisive role (accounting for approx. one third of final energy consumption for heating and cooling).

At European level, the revised Renewable Energy Directive obliges Member States to increase their average share of renewable energies annually by 0.8 percentage points for the period 2021 to 2025 and by 1.1 percentage points from 2026 to 2030.

In addition, each Member State must endeavour to increase the share of renewable energy in its heating and cooling sector by the additional indicative percentage points set out in Annex Ia to the Directive. For Germany, an increase of 1 percentage point per year is the annual average benchmark for the period 2021 to 2025 and 0.7 percentage points as an annual average for the period 2026 to 2030. Combining the binding target and the indicative benchmark, this results in an annual average increase of 1.8 percentage points for both periods.

In response to these trajectories, Germany is required to achieve a share of 18% by 2025 and is aiming for an overall share of 23%. A share of 23.5% must be achieved by 2030 and Germany is aiming

for an overall share of 32%. The Federal Government is using this level of ambition for the heating and cooling sector as the basis for its contribution to achieving the EU targets in 2030.

Member States can count waste heat and cooling as well as electricity from renewable sources used for heating and cooling towards the mandatory average annual increases of up to a maximum of 0.4 percentage points. If they make use of this option, the binding target for the average annual increase is increased by half of the percentage points of waste heat and cooling or electricity from renewable sources consumed up to an upper limit of 1.0 percentage points for the period 2021 to 2025 and 1.3 percentage points for the period 2026 to 2030. The use of waste heat and cooling as well as the electrification of heating and cooling generation are important elements of the decarbonisation of the heating and cooling supply in Germany. The Federal Government therefore intends to offset waste heat and cooling as well as electricity used for heating and cooling in the future. The necessary legal and data basis for this is currently being created so that it can be recognised for the period from 2026 to 2030.

Against this background, the estimated volume for waste heat and cooling in 2030 totals around 7 TWh per year. The potential supply of waste heat from the manufacturing industry is estimated at 4.8 TWh, taking into account the transformation of the sectors concerned and how this heat can be deployed via heating networks. In addition, the potential for waste heat from data centres is expected to amount to 2 TWh in 2030. This is due to the increase in energy consumption by data centres to 25 TWh/a in 2030, a third of which, i.e. around 7 TWh/a, could be used as waste heat. Based on an energy demand in heating and cooling of around 1400 TWh/a, waste heat and cooling would account for 0.4%, thus raising the target by 0.2%. The actual target increase will be determined as soon as the waste heat and cooling consumed for the period 2026 to 2030 has been established.

The capacities of large heat pumps (i.e. with a heating capacity of 500 kW and more) are estimated at 2.1 GW electric and 6.3 GW thermal power for 2030. The capacity of decentralised heat pumps (i.e. with a heating capacity of less than 500 kW) is estimated at 57.6 GW thermal power for 2030.

	2020	2025	2030
Binding trajectory pursuant to Article 23	14%	18%	23.5%
Overall trajectory pursuant to Article 23	14%	23%	32%

(binding and indicative)			

2.1.2.iii. Expected trajectories by renewable energy technology that the Member States use to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030, indicating the expected total gross final energy consumption per technology and sector in Mtoe (million tonnes of oil equivalent) and the total planned installed capacity (broken down by new capacity and repowering) per technology and sector in MW

Heat

For large heat pumps (i.e. with a thermal output of more than 500 kW), an estimated expansion of 4 GW per year would be necessary in heating networks to achieve the target of climate neutrality in 2045. This expansion is currently still below 1 GW per year. Early in 2023, the total capacity of large heat pumps in Germany was around 60 MW. In 2030, large heat pumps are to generate 86 TWh per year in heating networks.

Heat pump campaign

Heat pumps are the key technology for renewing decentralised heat production. In summer 2022, the Federal Ministry for Economic Affairs and Climate Action (BMWK) launched a heat pump campaign based on a decision by the Federal Government. At the first heat pump summit hosted by the Federal Ministry for Economic Affairs and Climate Action and the Federal Ministry of Housing, Urban Development and Building (BMWSB), a memorandum of understanding was signed with representatives from industry, the skilled trades, the property sector, trade unions and academia to ensure that at least 500,000 new heat pumps are installed every year from 2024.

2.1.2.iv. Estimated trajectories on bioenergy demand broken down by heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports); for forest biomass, an assessment of its source and its impact on the LULUCF sink

Table: Projected consumption of biomass fuels by sector in 2030 and 2024 with measures (MMS) and with further measures (MWMS)

Biomass type	Sector	MMS 2030	MMS 2045	MWMS 2030	MWMS 2045
		PJ			
Solid biomass	Energy industry	178	267	178	268
	Industry	184	253	174	244
	Buildings	517	511	489	448
	Agriculture	7	8	7	8
	Subtotal	**886**	**1,039**	**847**	**968**
Gaseous biomass	Energy industry	155	121	155	124
	Buildings	38	85	40	88
	Transport	1	0	1	0
	Agriculture	13	12	13	12
	Subtotal	**207**	**217**	**209**	**223**
Liquid biomass	Buildings	3.35	12.46	3.37	12.28
	Transport	130	38	129	37
	Agriculture	6	6	6	6
	Subtotal	140	57	139	56
Total		**1,232**	**1,313**	**1,195**	**1,247**

Data source: Öko-Institut et al., Projection report for Germany, Table 28

According to projection data for 2024 (UBA 2024c), demand for biomass fuels is assumed to be 1,195 to 1,232 PJ in 2030, while 837 to 838 PJ can be provided from domestic sources. For 2045, demand for biomass fuels is estimated to be 1,247 to 1,313 PJ, while only 875 to 786 PJ can be provided from domestic sources.

Table: Projected consumption of biomass fuels by origin and potential demand for imports in 2030 and 2045 with measures (MMS) and with further measures (MWMS)

Biomass type	Origin	MMS 2030	MMS 2045	MWMS 2030	MWMS 2045
		In PJ			
Solid biomass	Projected volume of energy wood from domestic logging including forest energy wood assortments (logs, forest wood chips) and industrial waste wood from the first processing stage	253	271	253	271
	Projected energy wood from other industrial waste wood and scrap wood	273	276	273	276
	Estimate of solid biomass from biogenic residual and waste raw materials (DBFZ data, as of 2015)	67	67	67	67
	Potential import demand* for solid biomass	292	424	254	354
Gaseous biomass	Projected biogas production from cultivated biomass*	77	54	77	54

Biomass type	Origin	MMS 2030	MMS 2045	MWMS 2030	MWMS 2045
	Projected biogas production from animal faeces*	42	39	42	39
	Estimate of gaseous biomass from biogenic residual and waste raw materials (DBFZ data, as of 2015)	55	55	55	55
	Potential import demand* for gaseous biomass	32	69	34	75
Liquid biomass	Projected biofuel production from cultivated biomass (corresponds to demand)	66	20	65	19
	Estimate of other liquid biomass from biogenic residual and waste raw materials (DBFZ data, as of 2015)	3	3	3	3
	Potential import demand* for liquid biomass	71	34	70	34
Total		**1,232**	**1,313**	**1,195**	**1,247**
of which domestic		**838**	**786**	**837**	**785**
of which potential import		**394**	**527**	**358**	**462**

Data source: Öko-Institut et al., 2024 projection data for Germany

The Federal Government is currently developing the National Biomass Strategy (NABIS) in order to create the framework conditions for climate-friendly and resource-efficient production and use of biomass. Priority is to be given to the material use of biomass over its use as an energy source.

2.1.2.v. Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

Share of renewable energy in heating networks pursuant to Article 24(4) of the Renewable Energy Directive

According to the revised Renewable Energy Directive, the Member States are aiming to increase their share of renewable energies as well as waste heat and cooling by 2.2 percentage points per year as an annual average for the period 2021 to 2030.

Since the electrification of heat generation is a key element in the decarbonisation of district heating and cooling, the Federal Government intends to count electricity from renewable sources towards the targets for district heating and cooling. Renewable electricity capacities for district heating and cooling are estimated at 2.1 GW electrical and 6.3 GW thermal power for the year 2030.

Renewable energies and waste heat accounted for around 23% of district heating in Germany in 2020. Based on this, an increase to approx. 45% for renewable energy and waste heat in 2030 can be calculated using a trajectory compatible with the RED methodology.

The Act on Heat Planning and the Decarbonisation of Heating Networks (Heat Planning Act – WPG), which came into force on 1 January 2024, is designed to make a significant contribution to the transition to a cost-efficient, affordable and greenhouse gas-neutral heat supply by 2045. According to this Act, a nationwide average of share of 50% must be achieved by 2030 for renewable energy and waste heat. Each individual heating network must achieve a share of 30% in renewable energy or waste heat by 2030 and 80% by 2040. The complete decarbonisation of the heating networks is planned for 2045.

Use of renewable energy in buildings – indicative national trajectory pursuant to Article 15a of the Renewable Energy Directive

In accordance with the requirement of the new Article 15a of the Renewable Energy Directive to achieve the EU-wide target of a 49% share of renewable energy in final energy consumption in the buildings sector by 2030, Germany has set as its national contribution an indicative target corridor of 46% to 50%. This path essentially relates to the polluter-pays principle and therefore includes the proportion of renewable energy in the electricity mix and in district heating generation in addition to building-related energy production. A more precise definition is not possible in view of the lack of guidance for calculating the indicator. Against this background, the Federal Government reserves the right to specify the indicative target in more detail as part of the development of the National Building Renovation Plan.

In addition to measures to decarbonise electricity and district heating generation (see Section 3.1.2), the share of renewable heat used in buildings as now required since 1 January 2024 when the amended Buildings Energy Act came into effect is an important element in achieving the target value for 2030 (see Section 3.1.2).

Share of renewable energy in industry pursuant to Article 22a of the Renewable Energy Directive

In 2020, the share of renewable sources in the amount of energy sources used for final energy and non-energy purposes in the industry sector totalled approx. 14.3%, in 2021 approx. 15.0% and in 2022 approx. 16.3%. Based on the 2020 figure, this would result in the following indicative trajectory.

	2020	2025	2030
Indicative trajectory pursuant to Article 22a(1) subpara. 1	14.3%	22.3%	30.3%

2.2. 'Energy efficiency' dimension

2.2.i. The elements set out in Article 4(b)

National contributions to the Union's 2030 target

The amended EU Energy Efficiency Directive (EED) came into force on 10 October 2023. It envisages an 11.7% reduction in final energy consumption in the EU by 2030, measured against the 2030 final energy consumption estimated in 2020. This means a binding upper limit of 763 Mtoe (or 8,874 TWh) for final energy consumption at EU level. An indicative upper limit of 992.5 Mtoe (or 11,543 TWh) for primary energy consumption has now been agreed at EU level. All EU Member States are to contribute to achieving the targets by submitting indicative trajectories up to 2030 in their national energy and climate plans.

On 18 November 2023, a cross-sectoral framework for increasing energy efficiency came into force with the Energy Efficiency Act, which supports the implementation of the obligations under the EED (see also Table A1).

Germany's target contributions to primary and final energy consumption for 2030 are derived from the Energy Efficiency Act. The basis used to calculate the target was the 2020 EU reference scenario and the calculation method pursuant to the formula in Annex I to the EED. According to the new Eurostat method used in the EED[2], the reported German targets for 2030 are 2,252 TWh (or 193.64 Mtoe) for primary energy consumption and 1,809 TWh (or 155.55 Mtoe) for final energy consumption.

The following indicative trajectories are presented for the 2024 to 2030 observation period:

Primary energy consumption trajectory 2024 to 2030

Sector	Unit	2024	2025	2026	2027	2028	2029	2030
Industry	TWh	862	842	814	787	759	731	704
Trade, commerce and services	TWh	421	402	378	353	329	305	281

[2] The final energy consumption target in the Energy Efficiency Act includes the net energy input for the conversion of energy sources in blast furnaces. In contrast, the new Eurostat method used in the EED only includes the energy consumption of blast furnaces in primary energy consumption. The final energy consumption target in the Energy Efficiency Act contains a flat rate of 5 million tonnes of oil equivalent (or 58.15 TWh) for energy consumption by blast furnaces in 2030. If the new Eurostat method used in the EED is used, Germany's target of 1,867 TWh would be reduced by this value to 1,809 TWh.

Households	TWh	779	756	722	689	655	621	588
Transport	TWh	768	781	761	741	720	700	680
Total	**TWh**	2830	2780	2675	2569	2463	2358	2252

Final energy consumption trajectory 2024 to 2030

Sector	Unit	2024	2025	2026	2027	2028	2029	2030
Industry	TWh	576	573	562	551	541	530	520
Trade, commerce and services	TWh	312	306	289	273	256	240	224
Households	TWh	635	614	586	559	531	504	476
Transport	TWh	710	715	690	665	640	615	589
Total	**TWh**	2233	2208	2128	2048	1968	1889	1809

The indicative trajectories are calculated on the basis of the assumption that the target contributions will be achieved in 2030 and that many energy savings will be made towards the end of the decade. This is because significantly higher efficiency gains are expected from 2027 onwards due to the ongoing technological upheaval, which will lead to much higher efficiency increases than in the past. In addition, the framework conditions will have changed, in particular when European emissions trading is expanded in 2027 to include the buildings and transport sectors (ETS II). The price signals sent out by the ETS II will provide an additional incentive to use energy more efficiently.

The breakdown of the energy consumption target values by sector was based on the percentage breakdown of energy consumption by end-consumption sectors which were projected for 2030 in the 'with further measures' scenario in the 2024 Projection Report. The target for primary energy consumption for the year 2030 of 2252 TWh is broken down as follows: Industry (704 TWh or 31.26%), trade, commerce and services (281 TWh or 12.48%), households (588 TWh or 26.11%), transport (680 TWh or 30.2%). The final energy target for 2030 of 1,809 TWh is broken down by end consumer sectors as follows: Industry (520 TWh or 28.75%), trade, commerce and services (224 TWh or 12.38%), households (476 TWh or 26.31%), transport (589 TWh or 32.56%).

In the area of information and communication technology, electricity consumption in 2030 is forecast at 66.1 TWh.

Cumulative energy savings pursuant to Article 8 of the EU Energy Efficiency Directive (EED)

Based on the statistical data from Eurostat, the cumulative savings target pursuant to the new Article 8(1), first sentence, point (b) of

the Energy Efficiency Directive is 5757.1 PJ or 137.51 Mtoe for the period 2021 to 2030. The previous target pursuant to Article 7(1), first sentence, point (b) was 3996.5 PJ or 95.46 Mtoe. Notification is carried out on the basis of Annex III of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action (concerning the notification of Member States' measures and methodologies to implement Article 7 of Directive 2012/27/EU). The notification required under this provision, together with other required information, is attached to this text in the form of an Excel worksheet as an annex pursuant to Article 3(2), point (h) of Regulation (EU) 2018/1999. The savings target calculated pursuant to Article 8(1), first sentence, point (b) of the Energy Efficiency Directive is based on Eurostat data on final energy consumption in Germany for the years 2016 to 2018, as provided for in the Directive, which requires the use of data before 1 January 2019.

Public sector leading on energy efficiency pursuant to Article 5 of the EU Energy Efficiency Directive (EED)

The 2021 baseline for all public bodies is 68.9 TWh. Public transport and the armed forces are not included in this baseline pursuant to Article 5(1), subpara. 3, first sentence, EED. The baseline and the values of the individual sectors are also estimated pursuant to Article 5(2), second sentence, EED. The Energy Efficiency Act, which came into force on 18 November 2023, serves to implement Article 5 of the Energy Efficiency Directive. Section 6 of the Energy Efficiency Act stipulates an annual savings obligation of 2% for public bodies. In this context, the law requires public bodies whose annual consumption exceeds 3 GWh to set up an energy or environmental management system by 30 June 2026 at the latest. Smaller public bodies whose annual consumption is between 1 GWh and 3 GWh are obliged to set up a simplified energy management system by 30 June 2026 at the latest.

Federal Government	
Federal administration	5.3 TWh
Federal states	
Courts	1.0 TWh
General administration of the federal states	4.2 TWh
Police	1.0 TWh

Academia	6.7 TWh
Residential buildings	0.3 TWh
Commercial buildings	0.2 TWh
Cultural and other buildings	0.5 TWh
Correctional centres	0.9 TWh
Municipalities	
Municipal administration	3.3 TWh
Schools, kindergartens, further education	18.9 TWh
Swimming pools	1.1 TWh
Sports buildings	9.0 TWh
Youth centres/association buildings	2.0 TWh
Building yards, workshop buildings, fire brigade	2.7 TWh
Water/waste water	7.9 TWh
Street lighting	3.1 TWh
Museums/cultural buildings	0.8 TWh

Long-term Renovation Strategy pursuant to Article 2a of the Energy Performance of Buildings Directive (previous version)

The building sector has a key role to play in the energy transition and in achieving the long-term climate policy goal. According to preliminary data for 2022, final energy consumption in the building sector for space heating, hot water and electricity consumption for lighting (excluding private households) and air conditioning cooling amounted to 3,024 PJ (840 TWh), which is around 35% of total final energy consumption. Private households account for two thirds of this figure, i.e. 2,021 PJ (562 TWh) while trade, commerce and services as well as industry account for a third with a total of 1,002 PJ (278 TWh).

Direct emissions from the building sector (source principle) from the combustion of fossil oil, gas and in some cases coal for space heating and domestic hot water amounted to around 102 Mt CO_2-eq in 2023 and are therefore responsible for just under 15% of total emissions amounting to 674 Mt CO_2-eq. This is in addition to the contributions made by buildings resulting from increased electricity demand for heat supply in the energy sector and emissions in the industry sector, mainly due to the building material process and manufacturing emissions associated with the construction and refurbishment of buildings. Buildings are currently responsible for around 40% of emissions in Germany. At the same time, they contribute to reducing emissions in the industrial and energy sector by incentivising the use of sustainable building materials and processes as well as the increasing installation of PV systems on buildings. Overall, this underlines the cross-sectoral importance of buildings for decarbonisation.

To achieve its climate policy goals, Germany is working to further reduce final energy consumption in the buildings sector and increase the use of renewable energies while tapping into the potential for reduction between different sectors. This approach was already outlined in the Efficiency Strategy for Buildings back in 2016, although certain key framework parameters have changed since then. A wide range of instruments must be used to achieve the objectives.

What's important here is to ensure that these measures are feasible, affordable, economical, open to technology, ecological and – last but not least – reliable, durable and user-friendly, and that they always take into account the requirements of climate-adapted construction. Overall, they must not stand in the way of urgently needed living space and special consideration must be given to their social impact. Further greenhouse gas savings can be achieved across all sectors by reducing indirect emissions, which are generated during the production of building materials, components, technical equipment, etc. in the industrial sector. To achieve the transformation of the building sector towards comprehensive greenhouse gas neutrality, the environmental impact and resource consumption of buildings must be recorded over their entire life cycle in order to incentivise the use of construction products and materials with low greenhouse gas emissions. The Federal Government has already taken an important step in this direction by establishing the life cycle assessment of the Quality Seal for Sustainable Buildings (QNG) in the sustainability class of federal funding for efficient residential and non-residential buildings (BEG WG and NWG) and in the Climate-friendly New Building (KFN)

funding programme. In addition to promoting the use of resource-efficient building materials and circular construction, the selective demolition of buildings and the recycling of building materials can also help to reduce energy demand. The mix of instruments is to be based on a balanced combination of the increasingly important instrument of carbon pricing, regulatory requirements and an accompanying, socially balanced funding policy, and is to be supplemented by other incentive instruments (e.g. tax incentives).

The Federal Government's Long-term Renovation Strategy pursuant to Article 2a(2) of the previous EPBD represents the overall strategy for Germany's building stock. It contains a comprehensive overview of the building stock, instruments and measures planned at national level.

The climate targets that have been adjusted since the Long-term Renovation Strategy was drawn up – both at EU and national level – are reflected in further developed and new measures. The national goal of achieving climate neutrality by 2045 is therefore crucial for the transformation of the building sector. It marks a significant increase in ambition compared to the target still valid for the Long-term Renovation Strategy. The amended Federal Climate Action Act contains an indicative annual emission volume of 67 Mt CO_2 for the building sector in 2030. This benchmark is used as part of the monitoring of cross-sectoral total annual emissions and sectoral annual emission volumes if targets are not reached. At 67 Mt CO_2, it is more ambitious than the 70 Mt CO_2 set out in the Long-term Renovation Strategy. At the same time, the Federal Climate Action Act contains procedural rules that are designed to contribute to compliance with the specific ESR targets for the building and transport sector.

This national target architecture provides the basis for projections and long-term scenarios of the Federal Government and thus for defining new measures. The more ambitious, overarching targets for buildings are not currently being translated into the 2030 milestone defined for the Long-term Renovation Strategy because pursuant to the amended EPBD the requirements for the National Renovation Plan call for a revision of the transformation path along with the corresponding milestones. When preparing the National Renovation Plan, the indicative targets are to be adjusted together with any necessary adjustments to the overall indicators.

The overarching increase in ambition is also reflected in national, sectoral targets, which influence the transformation of the building sector and vice versa, and have been adjusted (increased) or

redefined since the Long-term Renovation Strategy was drawn up. The 2030 targets for the share of renewables in electricity consumption and district heating make an important contribution to the faster decarbonisation of buildings, which will also make a significant contribution to the ambitious targets for the energy sector.

The interplay between national policies and measures continues to be geared towards increasing the use of renewable energies used for heat generation and to increase the energy efficiency of both renewable energies and the building sector itself and/or reducing final energy consumption, as well as focussing more on cross-sectoral potential and reducing final energy consumption in the building sector.

Section 3 contains an update on the measures in the Long-term Renovation Strategy. The savings associated with the implementation of the measures described there are presented in connection with the obligation under Article 8 EED (see Annex on measures to implement Article 8 of Directive EU 2023/1791). The corresponding, detailed descriptions of the measures to implement Article 8 of Directive EU 2023/1791 also contain information regarding costs (budget), provided that the relevant information is available. In particular, the 2023 Climate Action Programme lists the correct measures for the GHG reduction targets. It takes up the Renovation Strategy and adapts it to the changed ambitions. When updating measures, it is crucial to make even more efficient and targeted use of existing financial resources while taking social aspects into account, thus ensuring that the requirements can be met by all stakeholders.

For the first time, the Buildings Energy Act lays down fundamental regulations on the use of renewable energies in all new heating systems: the so-called ‘65% rule’ and the ban on fossil-fuelled heating systems from 2045. These measures highlight the increase in ambition.

The amendment to the Buildings Energy Act and the revision of the EU Buildings Directive (EPBD) have adapted key legal framework conditions for the Long-term Renovation Strategy. The Directive came into force at the end of May 2024 and must be implemented at national level by 29 May 2026. The Federal Government is currently preparing the implementation of the requirements of the amended EU Buildings Directive. In view of the fact that fundamental agreements are still being finalised, it is not yet

possible to provide any concrete information on the implementation of the necessary measures.

2.2.ii. The indicative milestones for 2030, 2040 and 2050, nationally established measurable progress indicators, an evidence-based estimate of the expected energy savings and wider benefits and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, pursuant to Article 2a of Directive 2010/31/EU

Indicative milestones for the progress indicators from the Long-term Renovation Strategy pursuant to Article 2a(2) of the previous EPBD

The indicative milestone was derived using the Long-term Renovation Strategy pursuant to Article 2a(2) of the previous EPBD. Given that the contributions by the different sectors to reducing greenhouse gas emissions in Germany for the years after 2030 had not yet been determined nationally at the time the LTRS was drawn up, Germany has not yet quantified any milestones for the years 2040 and beyond. The indicators and indicative milestones are to be further developed as part of the development of the National Building Renovation Plan (NBRP) pursuant to Article 3 of the amended Energy Performance of Buildings Directive. To achieve climate neutrality in the building sector by 2045, further milestones are to be defined for the remaining period up to 2045, taking into account the trajectory already developed for 2030. In its LTRS, Germany defined energy performance as the first indicator pursuant to the EPBD in force at the time (see Fig. 14). The target shown in Table A3 corresponds to value defined in the LTRS. In addition to reviewing and further developing the overall indicators during preparation of the National Renovation Plan, further indicators are likely to be derived in the future as the building database stabilises.

Indicative milestone according to the Long-term Renovation Strategy (2020)

	2008 (baseline year)	2021	2022	2030
Overall energy efficiency – non-renewable primary energy consumption (PECn.r. in PJ)	4,400	3,410	3,273	2,000

Total floor area to be renovated/energy savings to be achieved pursuant to Article 6 (new) of the EU Energy Efficiency Directive using the example of public buildings

A significant proportion of the EU's energy savings are to be achieved through energy-efficient refurbishments. To this end, 3% of the total floor area of heated and/or cooled buildings owned by public bodies (Federal Government, federal states, municipalities) must be renovated each year to at least nearly zero-energy buildings (NZEB) or zero-emission buildings (ZEB). Germany is developing a public building inventory together with the federal states to document progress here. The Federal Government has notified the EU of the use of the alternative approach provided for in Article 6 EED by 31 December 2023. The relevant estimated savings will be submitted subsequently. Due to the difficult data situation, the building inventory, which records the public bodies of the Federal Government, the federal states and municipalities, must be compiled in order to precisely quantify the expected energy savings.

2.2.iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Greenhouse gas-neutral transport by 2045

The 2010 Energy Concept foresaw reducing final energy consumption in the transport sector by around 10% by 2020 and by around 40% by 2050 compared to 2005. In addition, in its Climate Action Plan 2050 the Federal Government is aiming for Germany's transport system to be almost independent of fossil carbon fuels by 2050 and therefore largely greenhouse gas-neutral.

Heat and cold

In addition to the targets set out under 2.1.2.v., another objective is to expand heating and cooling networks and, in the medium term, to connect at least 100,000 new buildings to heating networks every year.

2.3. 'Energy security' dimension

2.3.i. The elements set out in Article 4(c)

Ensuring a secure energy supply with sufficient availability of all required energy sources and secure infrastructures is crucial for a developed economy. This was highlighted recently by the energy crisis resulting from the Russian war of aggression against Ukraine. In the Federal Government's first National Security Strategy from 2023, resilience – also through diversification – and sustainability are enshrined as goals for achieving national security. The aim of the Federal Government's energy and climate policy is therefore to ensure a stable supply for the general public at all times under affordable, climate-friendly and socially acceptable conditions. The security of energy supply is typically assessed in two independent dimensions: resource availability as well as transmission, distribution and control security. The existence of effective mechanisms and management capacities for crisis prevention and management can be added as a third dimension. The Federal Government is taking numerous measures to strengthen security of supply in all three dimensions. This includes ensuring sufficient reserves and redundancies as this helps to increase resilience to supply crises and reduce the likelihood of supply crises occurring.

The accelerated expansion of renewable energies, together with energy saving, efficiency and the gradual phasing out of fossil energies without carbon capture and storage, is the key step towards diversifying energy supply and increasing energy security in the long term.

The Federal Government will ensure that energy supply continues to be guaranteed in the transition period until climate neutrality is achieved. To this end, an energy infrastructure is being built that is geared towards the precautionary principle, is flexible and is based on European solidarity. The diversification of energy supply sources and transport routes as well as sufficient flexibility, safety buffers and resilience are also essential on the transformation path so that impending bottlenecks can be handled effectively.

All decisions related to energy supply security are rooted in a high degree of diversification and stable relationships with supplier countries. The planning and development of our own LNG infrastructure, for instance, is designed to overcome one-sided dependencies while strengthening preparedness and resilience. The LNG Acceleration Act has created the necessary legal framework. Furthermore, the new infrastructure is already being planned in such a way that it can be successively converted to hydrogen.

In order to ensure an adequate, fast and flexible response to critical supply situations, sufficient safety buffers are needed in the form of energy storage systems that are protected from external influence. On the one hand, this concerns the storage of traditional fossil fuels, including natural gas. All operators of gas storage facilities that have at least one entry point to the German transmission network, for example, must be certified by the Federal Network Agency in future in order to counteract the potential risk of external influence on critical gas storage infrastructure. On the other hand, work is already underway on storage strategies for future energy sources, such as hydrogen. The aim is to develop overarching storage strategies in the future in order to address existing interdependencies.

In an energy supply system that is increasingly based on renewable energies, it will also be essential to compensate for temporary volatility. Long-term and stable framework conditions are required for investments in new and hydrogen-capable gas-fired power plants, which are needed for this purpose. The planned Power Plant Security Act sets the framework for this in the implementation of the power plant strategy, thus creating the basis for a stable and decarbonised energy supply.

Energy supply security also involves protecting critical infrastructure in the areas of electricity, gas, mineral oil and district heating. The BSI KRITIS Regulation, which refers to the BSI Act, defines critical services as general public services which – in the event of their failure or impairment – would lead to supply bottlenecks and disrupted public safety. The BSI KRITIS Regulation defines threshold values for specific asset categories above which an asset is considered critical infrastructure. The Energy Industry Act places cyber security requirements on electricity and gas supply operators. It also obliges electricity and gas grid operators to ensure safe and reliable grid operation. This also includes infrastructure security.

A further measure to ensure the security of energy supply is to ensure that no companies operating in the energy sector in Germany are sold to buyers from third countries if this poses a threat to the public security and order of the Federal Republic of Germany. A clearance certificate is required for investors from non-EU countries who wish to acquire all or part of a German company. Such company acquisitions are examined in detail as part of an investment review procedure in accordance with the Foreign Trade and Payments Ordinance. In order to keep track of new risks and develop adaptation strategies in good time, work is continuously

underway to improve and expand existing monitoring measures and risk analyses. Since complex interrelationships sometimes exist between energy sources, a systemic perspective is generally adopted here to ensure security of energy supply.

Natural gas supply in Germany is highly secure and reliable.

Pursuant to Article 8 of Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard security of gas supply and repealing Regulation (EU) No 994/2010 and in the context of good crisis preparedness, the Federal Republic of Germany is preparing an Emergency Plan for Gas for Germany. Regulation (EU) 2017/1938 strengthens the European Union's internal gas market, providing for a standardised approach by EU Member States in the event of a supply crisis. As part of Council Regulation (EU) 2022/1369 of 5 August 2022 on coordinated measures to reduce gas demand, which expired on 31 March 2024, Germany implemented a series of voluntary measures to reduce demand in 2022 that are helping to strengthen the security of energy supply.

On 24 February 2022, the Russian Federation launched a war of aggression against Ukraine, a contracting party to the Energy Community, in violation of international law, altering the conditions for assessing security of supply in Germany and the EU. Over the course of 2022, Russia initially made it more difficult to purchase natural gas by introducing rules for payment in roubles and sanctioning former Russian state-owned companies in Germany and Europe. In addition, Germany's direct supply via the Nord Stream 1 pipeline was gradually reduced at first; the cessation of the Yamal pipeline transit through Poland and the reduction in Ukraine's transit also reduced the supply of natural gas to Western and Eastern Europe. The explosions on both pipes of the Nord Stream 1 pipeline and one pipe of the Nord Stream 2 pipeline – which never went into operation – at the end of September 2022 and the termination of maintenance on the Belarus-Poland Yamal border crossing mean that it will not be possible to supply Germany with Russian pipeline gas. The deteriorating supply conditions and the sudden cessation of natural gas supplies from Russia led Germany and the EU to refocus and step up their security of gas supply in 2022.

In Germany, the tense supply situation was accompanied at political level by the first declaration of the early warning level on 30 March 2022 and the alert level announcement on 23 June 2022 by the Federal Ministry for Economic Affairs and Climate Action in

accordance with the Emergency Plan for Gas. Even before the early warning level was declared, a cross-functional Natural Gas Crisis Team was set up to advise the Federal Ministry for Economic Affairs and Climate Action both during the course of the supply crisis and in the run-up to a deterioration in the natural gas supply situation. In particular, the Gas Crisis Team ensured that a consultation mechanism was in place between the actors involved in managing the crisis while guaranteeing the exchange of the necessary information.

In order to master the critical supply situation in 2022 and with a view to the critical winters of 2022/23 and 2023/24, several emergency gas regulations were adopted by the Member States and the European Commission in addition to the the measures implemented in Germany. These regulations included in particular Council Regulation (EU) 2022/1369 of 5 August 2022 on coordinated demand-reduction measures for gas (Gas Reduction Regulation), which expired on 31 March 2024, Council Regulation (EU) 2022/2576 of 19 December 2022 enhancing solidarity through better coordination of gas purchases, reliable price benchmarks and exchanges of gas across borders (Gas Emergency Regulation), which expired on 18 December 2023, and the amendment of Regulation (EU) 2017/1938 with regard to mandatory filling targets for natural gas storage facilities.

Regulation (EU) 2017/1938, as a fundamental document of German and European natural gas supply security, provides for a comprehensive set of instruments to strengthen the EU's internal market for natural gas and to achieve an adequate level of preparedness in the event of a supply crisis. Building on this, the course of the energy and primarily natural gas crisis in 2022 highlighted the Federal Republic of Germany's acute ability to act to overcome the crisis, on the one hand, by adapting relevant crisis-mitigating German and European standards. On the other hand, cooperation between the Federal Government authorities, federal states, the Federal Network Agency and market players, such as transmission system operators and the German market area manager for gas, Trading Hub Europe GmbH (THE), significantly strengthened the resilience of the German gas supply situation. The management of this supply crisis showed in very practical terms that the secure supply of natural gas in the EU is the joint responsibility of the Member States, their relevant authorities and gas supply companies and the European Commission, that the German natural gas market can only be considered in an infrastructural network with neighbouring EU states and beyond, and that overcoming a supply crisis calls for a joint effort.

To categorise the severity of a supply crisis, Regulation (EU) 2017/1938 distinguishes between three crisis levels: early warning level, alert level and emergency level. The early warning and alert levels provide for market-based measures by gas supply companies. When the Federal Government declares an emergency level by way of an ordinance,'non-market-based measures' can be taken as sovereign intervention by the competent authority. Regulation (EU) 2017/1938 additionally supplements the crisis levels with obligations for companies and the responsibilities of national authorities and the European Commission. According to Article 8(2) of Regulation (EU) 2017/1938, the Member States establish the planned crisis management and preventive measures as part of preventive action and emergency plans. The Federal Ministry for Economic Affairs and Climate Action is responsible for drawing up the preventive action and emergency plan; the Federal Network Agency prepares the national and, if necessary, regional risk assessment as part of a regional group.

Events since 2022, including the supply bottleneck for natural gas that was ultimately averted, impressively demonstrated the need for a coordinated and coherent approach at both EU and national level. The overarching necessity and relevance of the measures and approach described became apparent in the wake of the 2022/2023 gas crisis. Previously inconceivable events quickly threatened the entire system, which was ultimately resolved by all the parties involved. In anticipation of a possible deterioration in the supply situation, adequate crisis foresight and preparedness continue to be highly relevant.

Oil

Germany's oil crisis preparedness is embedded within both the European Union and the supranational International Energy Agency (IEA). The EU and the IEA have rules on German oil crisis preparedness, which have been centrally transposed into national law by the Petroleum Stockpiling Act (ErdölBevG) and the Mineral Oil Data Act. In Germany, these acts form the legal basis for comprehensive stockpiling of oil and petroleum products for the purpose of crisis preparedness. Accordingly, Germany holds mineral oil stocks of crude oil, petrol, diesel, extra light liquid fuel (HEL) and fuel JET A-1 for 90 days of net imports. Proper oil stocks are ensured by the German National Petroleum Stockpiling Agency, a body governed by public law. In the event of a supply crisis, the Federal Ministry for Economic Affairs and Climate Action, the Federal Office for Economic Affairs and Export Control (BAFA) and the Petroleum Stockpiling Agency (EBV), including the Supply

Coordination Group (KGV), a group in which the mineral oil industry is represented, work together in accordance with established procedures to release EBV stocks in the event of a crisis.

Based on the Energy Security Act, the Ordinance on the prioritisation of transport of energy carriers by rail to secure energy supply (EnSiTr) was also issued, which is particularly relevant for the management of rail transport of oil and petroleum products with planning priority.

Electricity

Germany has a secure electricity supply and is one of the countries with the most secure supply system in the EU. Due to its geographical location in Europe, Germany's stable electricity supply is crucial for the entire European internal market. At the same time, Germany benefits from this situation, as the exchange of electricity with its neighbours provides an opportunity for export in times of surplus and import in times of shortage.

The secure supply of electricity is one of the most important objectives laid down in the Energy Industry Act (EnWG). This objective is particularly important in view of the ongoing expansion of renewable energies, increasing electricity consumption due to the electrification of other sectors and the simultaneous phase-out of nuclear energy and coal-fired power generation. Germany has therefore established multi-layered processes to continuously review and maintain security of supply, which allow for an early and preventative response to any unwanted lowering of the security of supply level. These processes include the annual review of the need for grid reserve power plants, the system relevance test for power plants leaving the market and the ongoing monitoring of security of supply in the area of grid-bound electricity supply. (See also Section 2.4.3.ii.).

As in the gas and oil sector, ensuring security of supply in the electricity sector is primarily a task for electricity supply companies. The following national requirements apply to companies:

- Pursuant to Sections 1 and 2 of the Energy Industry Act (EnWG), their task is to ensure the most secure, affordable, consumer-friendly, efficient and environmentally friendly electricity supply possible to the general public.

- Pursuant to Section 13 of the Energy Industry Act, transmission system operators are responsible for the system. The grid and market-related measures listed in Section 13 of the Energy Industry Act are available to them for this purpose.

- Pursuant to Section 14 of the Energy Industry Act, the distribution system operators have the same measures at their disposal as the transmission system operators. Accordingly, they must support measures taken by the transmission system operator or an upstream electricity distribution system operator in whose system they are integrated by taking their own measures in accordance with the latter's specifications.

The European requirements for risk-preparedness also have an important role to play in the electricity sector. Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC is decisive here. Based on this regulation, Germany has published its 'risk-preparedness plan in accordance with Article 10 of Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC' (issued: 20 January 2023).

Coal

Looking to the future, coal as an energy source will no longer be relevant for electricity generation in Germany. Therefore, Section 3.3 does not contain any comments on coal as an energy source. The last coal-fired power plant in Germany is to be decommissioned by 2038 at the latest. In North Rhine-Westphalia, lignite will already be phased out by 2030.

2.3.ii. National objectives with regard to increasing: the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

The Federal Government is constantly endeavouring to ensure that Germany's energy supply is adequately diversified. It continuously monitors the development of the energy supply and reports on this in its monitoring reports pursuant to Section 51 of the Energy Industry Act (EnWG). According to this, electricity supply in Germany is based on a relatively broad mix of energy sources,

which largely minimises the risk of supply shortages for individual energy sources. The diversification of supply sources and transport routes is a key pillar of Germany's gas supply. The gas industry is making intensive efforts to expand gas infrastructure (pipelines and storage facilities) and to further diversify the procurement of natural gas.

Natural gas/oil

In 2023, natural gas consumption in Germany totalled 810.4 TWh. A relatively large number of import routes are available for the supply of natural gas to the German market. The LNG Acceleration Act, which was adopted in May 2022 and amended in July 2023, these routes were expanded with the development of Germany's LNG infrastructure. The aim is to ensure a sustainable supply by rapidly integrating LNG into the existing natural gas pipeline network. The Floating Storage and Regasification Units (FSRUs) already commissioned and to be commissioned in the future should enable the import of LNG to the required extent. The gradual commissioning of a total of three fixed terminals is scheduled from 2027. The federal FSRUs at the relevant locations will then cease operations. This should also enable sufficient liquefied natural gas to be imported to Germany in the medium term.

Gas consumption in Germany fell by 17.4% year-on-year to 849.8 TWh in 2022 and by a further 4.7% to 810.4 TWh in 2023 as a result of the high prices caused by the crisis and the measures to reduce gas consumption. In structural terms, however, demand for gas in Germany and therefore also demand for imports are likely to continue to fall due to measures to increase energy efficiency, promote the heating transition in buildings and the decarbonisation of industry. According to various long-term scenarios commissioned by the Federal Ministry for Economic Affairs and Climate Action, gas demand could fall to between 549 and 648 TWh by 2030 as a result of the measures to achieve the climate action targets. The decline would then accelerate further. Accordingly, demand for imports would also decrease in the future.

Neighbouring markets can also purchase gas via various channels. This means that the risk of supply disruptions will be reduced not only for Germany, but also for neighbouring gas markets. There are cross-border load flows between all neighbouring countries, and gas supplies from Norway come directly via pipelines without transit through other countries. Germany has a sufficiently secure oil pipeline network. The supply of oil is based on market economy criteria and there is no need for further state regulation. The

natural gas and oil industry ensures that the supply of natural gas and oil is sufficiently diversified while taking precautions to maintain this diversification.

Coal

Lignite is mined entirely in Germany so that this supply can be considered as secure. Hard coal imports are widely diversified. The security of supply of hard coal is estimated to be high due to the liquid global market and international supply structures.

Electricity

Depending on several indicators (see Section 2.4.1.i), an increase in interconnectivity is planned in the electricity sector. The aim is to strengthen the internal electricity market through new interconnectors. At the same time, the interconnectors should also be primarily available to the electricity market. In this context, Internal Electricity Market Regulation 2019/943 requires Member States to have a minimum trading capacity of 70% by the end of 2025 at the latest. Further information on the expansion of interconnectors can be found in Section 2.4.

2.3.iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The Federal Government is continuously endeavouring to ensure that Germany's energy supply is adequately diversified. As a result of the Russian war of aggression against Ukraine, the Federal Government successfully ended its energy dependency on Russia.

2.3.iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

As already outlined in Section 2.1.2, the Federal Government is pursuing a continuous expansion of the share of renewable energies in gross final energy consumption, as well as in the electricity, heating and cooling and transport sectors. The national targets can be found in this section.

The integration of renewable energies into the electricity market and the increasing electrification of other sectors calls for flexibility on both the demand and supply side. This is discussed in more detail in Section 2.4.3.ii.

In future, renewable and transitional low-carbon hydrogen will offer an additional supply option that can reduce the need for fossil fuels while increasing flexibility. By updating the National Hydrogen Strategy 2023, the Federal Government has doubled its target for installed renewable hydrogen production capacity in Germany from 5 to 10 GW by 2030.

Biomethane, which is obtained from processed biogas, can also contribute to this target. For this reason, under the Renewable Energy Sources Act biomethane is promoted via competitive tenders. Every year, 600 MW of installed biomethane capacity is put out to tender. The Renewable Energy Sources Act does not provide for a specific expansion target for biomethane alone.

Since the potential for domestic production of natural gas and oil is limited, domestic production of both energy sources therefore only covers a limited proportion of demand today and is not a priority for the goal of ensuring security of supply in the future either.

Domestic natural gas production peaked in the years around the turn of the millennium at around 21 billion cubic metres (205 TWh) and has declined continuously since then. In 2022, the production of clean gas still totalled 4.8 billion m^3, corresponding to 46.8 TWh or 5.5% of consumption. At the end of 2022, industry representatives estimated that 36.4 billion m^3 could be extracted from proved or probable natural gas reserves.

Domestic oil production amounted to 1.7 million tonnes in 2022 and has also been trending downwards for 20 years. This still corresponded to around 2% of domestic demand for crude oil. Germany's proven or probable oil reserves were estimated at 23.8 million tonnes at the end of 2022.

2.3. v. Adaptation to climate change

At the end of 2023, the Bundestag passed the first Federal Climate Adaptation Act, which came into force in mid-2024.

The Act creates a first strategic framework for precautionary climate adaptation at all administrative levels in Germany. Cities and municipalities are particularly affected when it comes to

concrete measures to achieve preparedness for the consequences of the climate crisis. This Act therefore mandates the federal states to ensure systematic and comprehensive climate adaptation strategies in the federal states and climate adaptation concepts for the areas of the municipalities and districts. At the same time, the Federal Government is committed under this Act to develop and implement a precautionary climate adaptation strategy with measurable targets by September 2025 at the latest and to update this strategy every four years, taking into account the latest scientific knowledge.

In October 2022, the Federal Government's Interministerial Working Group on Adaptation to Climate Change (IMAA) initiated a comprehensive process to develop measurable climate adaptation targets grouped in clusters (in alphabetical order): Economy, Health, Infrastructure, Land and Land Use, Spatial Planning and Civil Protection, Urban Development, Water and in one 'cross-cutting' cluster. The measurable goals, measures/instruments and indicators for climate adaptation are developed by the federal ministries responsible for the clusters in dialogue with other relevant departments and with the support of the respective subordinate authorities.

The draft targets are aimed at priority areas of climate adaptation that can be addressed by the federal level and focus primarily on the climate impacts derived in the Climate Impact and Risk Assessment 2021 for Germany (KWRA) with particularly urgent requirements for action. At the end of 2023, a broad base of associations, federal states, municipal umbrella organisations and academia took part on an informal basis and the results of this participation were incorporated into the further development of the objectives and the overarching strategy.

Strategy development was continued in the first half of 2024. Following the formal involvement of the federal states and associations (presumably 09/2024), a decision by the Federal Cabinet is planned for the end of 2024.

2.4. 'Internal energy market' dimension

2.4.1. Interconnectivity of the electricity grids

Germany's top priority is to strengthen the internal European electricity market. The larger the market area for electricity and the higher the level of liquidity in electricity trading, the easier it is to compensate accurately and cost-efficiently for fluctuating wind and

solar-feed-ins through flexible producers and consumers throughout Europe. A large and liquid European market area like this is important for a cost-efficient and reliable energy transition in Europe. The fact that in Europe the most cost-efficient locations for electricity generation and load centres of electricity consumption are often geographically far apart is a structural challenge that needs to be overcome.

Grid expansion is crucial so that electricity can be traded at any time between all EU Member States. After all, Member States can only rely on electricity from their neighbouring countries and increase the efficiency of their energy transition if electricity is truly exchanged on the basis of balance sheet trading, so that they no longer have to rely solely on national resources, while at the same time ensuring security of supply. Grid expansion is therefore the backbone of the internal European electricity market by allowing traded electricity to be distributed to the Member States. This is why Germany will invest substantially in national and cross-border grid expansion.

Europe's grids need to be expanded. This is all the more true for Germany, which will continue to expand renewable energy sources in the future and thus make a significant contribution to the EU's 2030 target. What's more, electricity flowing through Germany's electricity grid not only moves from North Germany to South Germany, but due to its central geographical location also from Germany to our neighbouring countries and vice versa. The need to expand the grid is particularly challenging for Germany and the Federal Government is tackling this challenge with determination.

2.4.1.i. Level of electricity interconnectivity that the Member State aims for by 2030 in consideration of the electricity interconnection target for 2030 of at least 15%, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10% and the following indicators of the urgency of action:

(1) The difference in wholesale prices between Member States, regions or bidding zones exceeds the indicative threshold of €2/MWh.

(2) The nominal transmission capacity of interconnectors is less than 30% of the peak load.

(3) The nominal transmission capacity of interconnectors is less than 30% of the installed generation capacity of renewable energy.

New interconnectors are subject to a socio-economic and environmental cost-benefit analysis and are only installed if the potential benefits outweigh the costs.

The Federal Government generally supports the development of additional interconnectors with other Member States in the interests of a functioning internal European electricity market. Due to the significance of electricity grids for the exchange of electricity in Europe, Germany also supports the EU's 2030 goals for grid expansion.

Two things are important when realising the goals: Firstly, the requirements of Articles 13 and 14 of the EU Electricity Market Regulation make it essential to coordinate the expansion of national and European grids. In future, Germany will synchronise the development of interconnectors with the expansion of the corresponding national grids. Secondly, the general goals for the electricity interconnection target need the right indicator that takes into account differences between Member States in terms of geography and energy mix.

The general goals for the EU electricity interconnection target are based on installed generation capacity (10% by 2020, 15% by 2030). Germany's installed generation capacity is growing disproportionately to the expansion of interconnectors due to the expansion of renewable energy sources. In light of this, the three differentiated indicators provide an important basis for decisions on the development of interconnectors pursuant to Article 4(d)(1) – (3) of the Governance Regulation. By implementing the interconnectors already under construction and planned by 2030, Germany is aiming to comply with these indicators.

2.4.2. Energy transmission infrastructure

Germany is aware of the importance of national grid expansion for the functionality of the internal European electricity market. The Federal Government is therefore taking a decisive approach to grid expansion. By 2030, substantial development and reinforcement measures in the order of 9,300 km will be implemented for Germany's electricity grids. The transmission system operators anticipate an investment requirement of around €52 billion by 2030. These are investments in the internal European electricity market and in Europe as a business location. However, the

implementation of large-scale investments plans like these takes time. At the same time, the Federal Government is therefore preparing an action plan to reduce grid congestion as part of the Electricity Market Ordinance, which includes grid, generation and redispatching measures (see Section 3.4.3.i.).

The following sections explain the Federal Government's plans in detail.

2.4.2.i. Key electricity, gas and hydrogen transmission projects and, where relevant, modernisation projects necessary for the achievement of the objectives and targets under the five dimensions of the Energy Union Strategy

2.4.2.ii. Where relevant, planned key infrastructure projects other than projects of common interest

Subsections 2.4.2.i. and 2.4.2.ii. have been combined.

With a view to the development of energy transmission infrastructure for electricity and gas, the transmission system operators, pursuant to Section 12b of the Energy Industry Act for electricity and Section 15a of the Energy Industry Act for gas, prepare new Network Development Plans (NDPs) on a regular basis. The Network Development Plans for electricity and gas are prepared in a multi-stage process with the extensive involvement of the grid operators and the Federal Network Agency as the regulatory authority.

Electricity transmission infrastructure

Based on the Network Development Plans, the Federal Government has legally defined a total of almost 14,000 kilometres of lines to be urgently needed (see below), of which around 1,200 km are interconnectors. In addition, a considerable number of new measures were identified in the completed NDP process. This is due not least to the fact that the perspective of the current NDP has been changed for the first time and describes three pathways to greenhouse gas neutrality by 2045. The Federal Network Agency has confirmed that an expansion of around 7,300 kilometres is needed. Based on this, the Federal Network Agency issued a recommendation for the new measures to be enshrined in law, which is now being implemented.

Lines measuring approx. 1,800 km in total were already legally approved in 2009 in the Power Grid Expansion Act (EnLAG). In the

Federal Requirements Plan Act (BBPlG), lines with a total length of approx. 12,000 km were legally approved on the basis of previous NDPs. The status of projects under the Federal Requirements Plan Act and the Power Grid Expansion Act after the third quarter of 2023 was as follows:

- Expansion goals of the Federal Requirements Plan Act: total length of approx. 12,000 km; currently close to 1,200 km (around 10%) approved; 1,000 km (around 8%) completed. 35 of the 97 projects are labelled as transnational or cross-border. Of the 97 projects under the Federal Requirements Plan Act, eight are currently PCI projects (Nos. 1, 2, 3, 4, 5, 32, 48 and 49). Three PCI projects have already gone into operation (Nos. 29, 30 and 33).

- Expansion goals of the Power Grid Expansion Act: total length approx. 1,800 km; currently close to 600 km (around 30% of the total length) approved; 1,100 km (around 60%) completed. Project No. 1 under the Power Grid Expansion Act was also a PCI project (in operation since 2020).

Against this backdrop, the 2021 coalition agreement provides for stepped-up efforts to expand the electricity grids. In 2022 and 2023, numerous regulations were issued to facilitate and accelerate grid expansion. In addition to changes to the legal framework conditions, a 'best practice' exchange between the approval authorities will especially be promoted and the objectives of the most straightforward, economical and rapid grid expansion possible will be strengthened. Regular, transparent and realistic monitoring and controlling is particularly important for the timely implementation of all grid expansion projects under the NDP. In addition to the quarterly monitoring reports published by the Federal Network Agency, the Federal Ministry for Economic Affairs and Climate Action established a grid expansion controlling system in 2019 which was further strengthened and developed in autumn 2022.

Gas and hydrogen transmission infrastructure

The needs-based expansion and conversion of the gas transmission grid pursuant to Section 15a of the Energy Industry Act is determined by the NDP for gas, which is prepared by the transmission system operators in every even calendar year. In the draft Gas Network Development Plan 2022-2032 dated 31 March 2023, the grid expansion proposal includes a total of 140 measures with an investment volume of approx. €4.4 billion. A total of 82 new

measures have been added compared to the Gas Network Development Plan 2020-2030. The additional measures proposed in this Network Development Plan are largely related to the changed flow situation in the transmission network due to the loss of Russian natural gas. Against this backdrop and to ensure long-term security of supply, the grid expansion measures for the future transport of LNG volumes are crucial. In addition, further development measures are needed to meet future demand from gas-fired power plants and to switch from gas with a low calorific value to gas with a high calorific value.

The Federal Government is committed to the rapid and cost-efficient development of the hydrogen network infrastructure in Germany. Development is to take place in two stages and will be embedded in the internal European market. The first stage is the Germany-wide and expandable hydrogen core network, which will connect currently known central hydrogen locations (consumption and production) for supra-regional transport and is scheduled to go into operation by the target year 2032. The second stage foresees regular integrated network development planning for gas and hydrogen with the aim of developing the hydrogen core network further on the basis of scenarios and demand.

The legal framework for planning in the first stage (core grid) is laid down in the Act on the Adaptation of Energy Industry Law (EnWG) to Union Regulations and on the Amendment of Further Energy Law Requirements; the Act came into force on 29 December 2023. The Second Act Amending the Energy Industry Act, which came into force on 17 May 2024, laid the legal foundations for the integrated Network Development Plan (NDP) for gas and hydrogen (second stage of hydrogen transport network development) and the financing of the hydrogen core network. As part of this future ongoing network development planning for gas and hydrogen, the transmission system operators presented a draft scenario framework for the Network Development Plan on 1 July 2024, which is based on assumptions about the development of the production, supply and consumption of gas and hydrogen, among other things. Based on this, the first integrated gas and hydrogen Network Development Plan is to be drawn up and confirmed by the regulatory authority by 30 June 2026. With this recurring planning process, it will be generally possible to adjust the dimensions of the hydrogen network on the basis of both demand and the scenarios, for instance, in response to updated demand forecasts in individual regions.

2.4.3. Market integration

2.4.3.i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-redispatching and curtailment, and real-time price signals, including a timeframe for when the objectives are to be met

2.4.3.ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

2.4.3.iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters

Subsections 2.4.3.i., 2.4.3.ii. and 2.4.3.iii. have been combined.

Key levers discussed by the Climate Neutral Electricity System Platform

Since early 2023, the Climate Neutral Electricity System Platform (PKNS) has been discussing levers for the electricity market design of a future climate-neutral electricity system with a broad stakeholder group of around 400 participants from various interest groups from the energy sector, consumer protection, industry, civil society, science and politics (see also Section 1.3.i). In the more than 20 meetings to date, the energy policy goals of security of supply, affordability and environmental compatibility have always served as a compass.

In four working groups, the Platform addresses the key topics for the future design of the electricity market:

Working Group: Ensuring the Funding of Renewable Energy: Ensuring the necessary incentives for sufficient deployment and system-serving operation of renewable energy plants in a climate-neutral electricity system. The Platform has worked out that a form

of financing security at low market prices is also necessary for future investments in renewable energy plants in order to secure the ambitious expansion path of renewable energies for a climate-neutral electricity system.

Working group: Expansion and Integration of Flexibility Options: Develop the necessary framework so that the demand for electricity is increasingly orientated towards the supply of electricity and address obstacles on the way to achieving this. The Platform has identified obstacles in the grid fee system that hinder demand-side flexibility and has drawn up a roadmap for the ramp-up of dynamic tariffs in order to promote flexibility for the electricity system.

Working Group: Funding of Controllable Capacities to Cover Residual Load: Ensure investment incentives for controllable capacities to cover the remaining residual load (power plants, storage and load flexibility) in the electricity market. Key options have been identified here for securing the funding of controllable capacities to cover residual loads.

Working Group: Locational Signals in the Electricity Markets: Use locational signals to control consumption and generation in order to better map the electricity grid in the market. The advantages and disadvantages of various options for local incentives, for instance, were discussed.

In the **next step**, the range of options for the further development of the electricity market design will be further condensed **in an 'options paper'** . The discussion in the Climate Neutral Electricity System Platform showed that the majority of stakeholders consider a rapid further development of the electricity market to be necessary in order to meet the requirements of a climate-neutral electricity system with a high share of renewable energies. However, opinions differed widely when it came to the specific direction this further development should take. The options paper will be followed by a written consultation. Both should serve as an important basis for political decision-making.

A large, liquid market area for efficient balancing of generation and consumption

The stakeholders of the Climate Neutral Electricity System Platform also agreed with the expert opinions that the merit order ensures price transparency and therefore has an important information and

coordination function. It is therefore central to efficient dispatching and a centrepiece of the EU's internal market.

The provision and financing of sufficient controllable capacities is a key challenge for electricity market design. In addition to power plants, this also includes storage facilities and load flexibility. The system development strategy shows that controllable capacities must respond with increasing flexibility. This is necessary in order to integrate renewable energy generation into the electricity system, meet the increasing demand for electricity from new applications and enable the conversion of other power plants (reduction in coal-fired power generation, conversion, for instance, to hydrogen power plants, conversion to carbon capture and storage (CCS), etc.). The current market design poses challenges for the financing of controllable power plants. The Climate Neutral Electricity System Platform discussed various options for ensuring investment incentives for controllable capacities to cover the remaining residual load in the electricity market. These options form the basis for further steps.

In order to guarantee a secure and cost-effective supply of electricity while also integrating an increasing share of renewables into the electricity system, the large market area makes it possible to use geographic balancing effects during both generation and consumption. A high level of liquidity in the electricity market helps to consolidate supply and demand flexibly and efficiently, even with fluctuations in energy generated with renewable sources. It also reduces the power of major providers to determine market outcomes and allows innovative players to enter the market. Uniform wholesale prices ensure that the most cost-effective generation technologies prevail in the electricity mix, regardless of location. Facilities with the lowest input costs are used on a supra-regional basis. This reduces the variable costs of the system as a whole. Germany's electricity market as part of the large European market area for electricity reduces total demand for generation capacity, load management and storage facilities. This also reduces the investment and maintenance costs of the overall system.

Complementary to the expansion of renewable energies, the power plant strategy pursued with the planned Power Plant Security Act provides a framework for early investment in state-of-the-art, highly flexible and climate-friendly power plants that will be able to use hydrogen and thus contribute to the decarbonisation of the power plant fleet. It also ensures that the supply of electricity is climate-friendly even at times when there is little sun and wind. To this end, the power plant strategy provides for the early addition of

a total of 10 GW of new, controllable H2-ready power plants and controllable capacities in order to quickly achieve a no-regret quantity of power plants. In addition, 500 MW of H2 sprinter power plants and 500 MW of long-term storage facilities will be put out to tender for technology trials. Security of supply will also be guaranteed in future by a market-based, technology-neutral capacity mechanism, which should be operational by 2028 at the latest.

The Federal Government believes that a single European electricity market and the associated expansion of electricity grids is the best way to guarantee a cost-effective power supply.

Against this backdrop, exchanges of electricity between European countries are becoming increasingly important. Supra-regional generation and consumption synergies can be harnessed to make the electricity system even more flexible. European capacities can also provide a joint basis for security of supply. Both options reduce the overall costs of electricity production in Europe as a whole.

Sectoral coupling

Sectoral coupling, i.e. the efficient use of electricity from renewable energies, is to be driven forward in order to further decarbonise the industrial, building and transport sectors. As a result of sectoral coupling, electricity from renewables will play an increasingly important role in the demand sectors. The high targets set for photovoltaic (roof) installations means that buildings are also an important factor here as they increasingly serve as generators. Together with storage systems and mobility and heat pump applications, buildings will have a significant impact on flexibility in the electricity system.

Store renewable electricity

In December 2023, the Federal Ministry for Economic Affairs and Climate Action presented its electricity storage strategy, which includes the planned activities of the Ministry to further support the market-driven ramp-up of electricity storage. The fields of action include the consideration of electricity storage in the context of the Renewable Energy Sources Act, licensing issues, grid fee issues, contributions to grid construction costs, acceleration of grid connections, ensuring system stability, bidirectional charging and other topics.

In April 2024, stationary battery storage systems with a total capacity of almost 13 GWh were installed in Germany, which marks a doubling of capacity since January 2023.

Consumer participation in the digitalisation of the energy transition

The Act on the Relaunch of the Digitisation of the Energy Transition of 27 May 2023 (GNDEW) has reactivated the smart meter rollout with a statutory rollout timetable that includes binding targets and a clear schedule as well as measures to reduce bureaucracy. To enable consumers to share in the benefits of digitalisation, beginning 2025, consumers can apply for metering points to be equipped in advance with a smart metering system within four months.

Gradual reduction and phase-out of coal-fired power generation

The gradual reduction and phasing out of coal-fired power generation will contribute to achieving net greenhouse gas neutrality. The main instrument for controlling the use of coal is the Act to Reduce and End Coal-fired Power Generation (KVBG) from 2020. Under this Act, which applies to the use of hard coal and lignite to generate electricity, the last coal-fired power plant in Germany is to be decommissioned by 2038 at the latest. Other forms of coal utilisation are not directly addressed in this Act. Due to rising carbon prices in the European Emissions Trading System, the model-based analyses in Sections 4 and 5 come to the conclusion that, depending on carbon and fuel prices, which were applied as exogenous parameters in the analyses, coal-fired power generation will, due to market developments, come to an end before the target date specified in the Act (see Subsection 3.4.3.iii.). This includes industrial power plants. The political goal remains to phase out coal, ideally by 2030.

In North Rhine-Westphalia, lignite will already be phased out by 2030.

Increased coupling of the electricity markets

Increased coupling of Germany's electricity market with neighbouring markets is a key step towards implementation of the Energy Union and European market integration. The road ahead has been mapped out by Europe's harmonised capacity calculation

method for day-ahead and intra-day trading with its guidelines for capacity allocation and congestion management.

Reduction of grid congestion

At EU level, the proposals by the European Parliament and the Council on the Electricity Market Regulation foresee the Member States reducing their internal structural congestions. The demand for electricity transport in the German transmission grid will continue to rise and grid congestion will increase at least until the large high-voltage direct current (HVDC) transmission lines have been completed. One reason for this is the increasing geographical separation between production and consumption. A large part of Germany's load centres are located in the south and west of the country, while new wind turbines are primarily being built in the north and east. At the same time, power plants in southern Germany are being decommissioned as part of the nuclear and coal phase-out. Due to its geographical location between the Scandinavian electricity markets with their comparatively low prices and the western and southern European countries with comparatively high electricity prices, Germany is also a hub for international electricity trading: Germany often responds to market demand by exporting to its southern neighbours.

The EU provisions on the opening of interconnectors (Article 14 of the Electricity Market Regulation) emphasise cross-border electricity trading and lead to a growing need for transport, as internal grid congestion and loop flows will only be taken into account to a very limited extent in future when allocating capacity on cross-border interconnectors. In 2019, the Federal Government presented its 'Bidding Zone Action Plan', a package of measures that foresees a gradual increase in the minimum trading capacities available for cross-border electricity trading to 70% via a linear path by the end of 2025.

2.4.3.iv. National objectives with regard to ensuring electricity system adequacy, if applicable, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Guaranteeing the adequacy of resources

Germany's goal is to strengthen the internal European electricity market and jointly guarantee security of supply in Europe. In the

monitoring report on the security of electricity supply, which was approved by the Federal Cabinet on 1 February 2023, the Federal Network Agency examines the development of the electricity market assuming that the planned statutory expansion of renewables, the electricity grid and the conversion of the power plant fleet required for decarbonisation have taken place. The report shows that the reliability standard of 2.77 hours per year cannot be exceeded in the selected scenarios and that a secure supply of electricity can be guaranteed in the period from 2025 to 2031. This requires developments on both the market and grid side, such as the development of load flexibility on the demand side and the extensive use of cross-border redispatching.

That being said, markets, including the electricity market, do not adequately prepare themselves for events whose probability of occurrence is considered by market players to be either impossible to quantify or negligible. If the event does in fact occur, the potential damage caused to companies and the economy can be vast. Germany believes that it is essential to maintain reserves in order to strengthen the resilience of the German and European electricity system to unforeseeable developments and crises. This is particularly true in light of the phase-out of nuclear and coal-fired power generation in Germany. However, reserves are also likely to be required in the long term in a greenhouse gas-neutral electricity system.

At present, a strategic reserve, the so-called capacity reserve, protects the electricity market against unforeseeable events. The capacity reserve only includes those power plants that do not participate in the electricity market and do not distort competition and pricing.

Crisis preparedness is a high priority for Germany and the aim is to make Germany even more resilient to crises. During the gas supply crisis, keeping power plant capacities outside the market and using them to support the electricity system as required proved to be useful. Experience during the crisis showed that the European guidelines for the use of strategic reserves are too restrictive to help in a crisis. The Federal Government will therefore advocate a consistent legal framework at European level that also allows reserves to be held in order to address crisis situations.

The large-scale balancing of generation and consumption can take place much more efficiently in a large, liquid European market area than in small and poorly interconnected market areas. For instance, the highest residual loads in the individual countries, which must

be covered by controllable capacities, do not usually occur at the same time. What's more, synergies in generation can also be harnessed, for instance, with regard to fluctuating wind supply. The prerequisite for this is that security of supply is viewed from a European rather than just a national perspective, and that sufficient transport and trading capacities are available in the common internal market, even in scarcity situations.

Ensuring flexibility

The integration of renewables into the electricity market and the increasing electrification of other sectors call for flexibility on both the demand and supply side in order to compensate for the fluctuating supply of wind and solar power in Europe and Germany. The Federal Government has set itself the goal of building a flexible electricity system consisting of well-developed electricity grids as well as flexible power plants and consumers. Storage facilities are also to be deployed when this makes sense. Flexibility in the electricity market has become even more urgent now that the revised Renewable Energy Directive requires that the EU's 2030 target for the share of renewable energies in gross final energy consumption is to be increased from at least 32% to at least 42.5% plus an indicative additional 2.5%. This makes the expansion of renewable energies, their use in other sectors and a corresponding flexibility for the electricity market much more urgent, as the share of renewables in the EU will have to rise to well over two thirds of the European electricity mix in order to achieve this goal.

Flexibility (both on the market and grid side) is therefore becoming increasingly important. In addition to ensuring secure grid operation, many different technological, market, regulatory and other aspects must be taken into account, which in turn are strongly interdependent with other developments in the electricity system (e.g. grid expansion, power plants, roll-out of smart meters). As part of the Climate Neutral Electricity System Platform (PKNS), the Working Group 'Expansion and Integration of Flexibility Options' discussed how flexibility options can be used for system balancing and integrated into the electricity system and which obstacles and barriers need to be removed for this to happen. The grid fee system, for example, was found to pose obstacles to more flexible demand. According to the Climate Neutral Electricity System Platform, the current grid fee system is not only complex but also not designed to meet the requirements of the energy transition. Demand-side flexibility options and storage in particular are subject to systematic disincentives due to the current grid fee structure. Dynamic grid fees were mentioned as one possible

means of adjustment. Further technical discussions within the framework of the Climate Neutral Electricity System Platform will provide additional insights into the question of how more comprehensive use of dynamic tariffs in the electricity market and thus a more flexible electricity system can be promoted. (See Section 3.4.3.v. on the implementation of the EU's legal requirements for offering dynamic electricity tariffs).

2.4.3.v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

In Germany, competition is fierce among providers in the end customer sector. The aim is to maintain the high level of competition on the electricity and gas retail sector. Competitive pricing and market liberalisation are the key to achieving this goal. Where appropriate, the Federal Government is systematically developing the legislative framework for the protection of household customers. The implementation of the EU Directive on the internal market for electricity has further strengthened consumer protection by increasing transparency.

Further details regarding the protection of energy consumers and the competitiveness of the end customer market can be found in Section 3.4.3.iv.

2.4.4. Energy poverty

Where applicable, national objectives with regard to energy poverty including a timeframe for when the objectives are to be met.

It is important for Germany that energy remains affordable in the course of the energy transition. The Federal Government is working to ensure that this affordability is guaranteed for all citizens. The focus here is primarily on households that are at risk of being overburdened by high energy prices. In the wake of the energy price crisis, the Federal Government has been increasingly analysing the impact of high energy prices on households.

The price increases for energy seen in 2022 and 2023 placed considerable pressure on private households. Households with low incomes were relatively more affected (see Annual Economic Report, JWB, 2023). This is mainly due to the fact that the prices of basic goods such as energy, which account for a higher proportion of the expenditure of low-income households, have risen

disproportionately. Since 2022, the Federal Government has responded with substantial relief measures, reducing the burden on low-income households.

In 2024, in addition to the adjustments made as part of the Inflation Compensation Act, the Federal Government will also ensure that wage increases actually reach income taxpayers by increasing the basic tax-free allowance by €180 to €11,784. The increase in child benefit from €219 to €250 in 2023 has also strengthened the disposable income of families. At the lower end of the wage spectrum, the increase in the statutory minimum wage to €12 as part of the Minimum Wage Increase Act in October 2022 led to noticeable wage increases. According to the Federal Statistical Office, this increase had an impact on around 5.8 million jobs. As a result, the proportion of low-paid jobs among all employees fell from 19% to 16% within one year. On 1 January 2024, the minimum wage was further increased to €12.41 – again on the basis of a decision by the Minimum Wage Commission. The Federal Government expects real wages to rise in 2024. A return to rising real wages is a prerequisite for maintaining prosperity.

The electricity, gas and heating price brakes should cushion rising costs for both private households and companies. From March to December 2023, the price brakes effectively capped the price of electricity, gas and district heating for private households to 40 cents gross for electricity, 12 cents gross for gas and 9.5 cents gross for district heating per kilowatt hour for 80% of the previous year's consumption. In March, the relief for January and February was imputed retroactively. This move significantly reduced the burden on private households for the whole of 2023. At the same time, energy-saving incentives were retained.

Now that both the acute energy price crisis and the phase of very high inflation rates have been weathered, the Federal Government is focussing on strengthening certain price signals as an instrument for achieving the most efficient transformation possible towards greenhouse gas neutrality. The Federal Government is employing a series of measures to strengthen social security during the course of the transformation, be it through education and further training, the increase in housing benefit, the first income-based funding for heating replacement or the already implemented relief for the entire population with regard to the levy under the Renewable Energy Sources Act (EEG levy) (see Section 5.2.). The abolition of the EEG levy on 1 January 2023 and the associated reduction in electricity costs are significant for the current year. While the electricity and gas price brakes expired at the end of 2023, the

abolition of the EEG levy in 2024 will have a greater impact due to higher feed-in tariffs and will therefore lead to substantial relief, especially for private households.

In order to provide the population with faster and more targeted support in future, the Federal Government is continuing its work on establishing a mechanism for direct payments to private individuals. With the Annual Tax Act 2022 of 16 December 2022, the Federal Government created the legal basis for allowing the collection and storage of the IBAN (and BIC, if applicable) in the database of tax identification numbers (IdNr. database). The implementation of storage as the basis for the direct payment mechanism is underway. The Federal Government will soon decide on key points for the specific administrative organisation of the direct payment mechanism and appoint a competent authority.

In addition, the introduction of social monitoring for climate action aims to already analyse the distributional effects of climate action measures during their development and to design measures that are as socially equitable as possible.

The Federal Government pursues a comprehensive approach to combating poverty that does not restrict itself to individual elements of need – such as energy. If financial support is required to secure a livelihood, benefits are granted under the minimum guaranteed income schemes in accordance with the Volume II and Volume XII of the German Social Code (basic income for jobseekers – Volume II of the Social Code and social assistance – Volume XII of the Social Code). This includes the so-called 'normal requirement', which also covers the costs of general household electricity, for example. Expenses for heating energy are taken into account in the requirements for accommodation and heating in the amount of the reasonable actual costs. In addition, energy debts can usually be taken over as a loan.

The scope of these entitlements is determined by the legislature based on the requirement types and the funds required for them. Electricity is included in normal requirements on a flat-rate basis. This means that – unless the normal requirements for a year have to be recalculated – the electricity price trend is included in the annual update of the normal requirements. The need for heating energy is taken into account in the requirements for accommodation and heating to be granted in addition to the normal requirements (Section 22 of Volume II of the Social Code; Section 35 of Volume XII of the Social Code). Heating energy, including heating electricity, is taken into account in the amount of actual

costs, provided that these are reasonable (above-average costs are checked to ensure that these justified). Hot water costs are taken into account in the centralised hot water supply via the heating costs. In the case of decentralised hot water supply, a flat-rate additional requirement is recognised for each person in the respective household.

The basic prerequisite for entitlement to benefits from the minimum guaranteed income schemes of Volume II and Volume XII of the Social Code is that the person concerned is in need of assistance because they cannot cover their living expenses (minimum subsistence level) from their own income and assets (see, for instance, section 7(1), first sentence, (3) and Section (9) (1) of Volume II of the Social Code as well as Section 27(1) and (2) and Section 41(1) of Volume XII of the Social Code). If this is the case, benefits are provided for household electricity (as part of the normal requirement), decentralised hot water supply and appropriate heating energy (see, for instance, Section 20(1), Section 21(7), Section 22(1) of Volume II of the Social Code).

However, a housing allowance under the Housing Benefit Act for people on low incomes should be considered before entitlement to benefits under the minimum guaranteed income schemes. The purpose of housing benefit is to ensure adequate and family-friendly housing and is paid as a rent allowance or as an encumbrance allowance for owner-occupied residential property (Section 1 of the Housing Benefit Act).

Housing benefit is based on the number of household members to be taken into account, the rent or charges to be taken into account and the total income (Section 4 of the Housing Benefit Act). The municipalities and districts in Germany are assigned to different rent levels for housing benefit, which affect the maximum rent or burden that can be taken into account in housing benefit (Section 12 of the Housing Benefit Act). In this way, the regional housing cost level is taken into account when calculating benefits. Housing benefit also includes a heating cost component, which is added to the rent or charge to be taken into account as a flat-rate supplement differentiated according to the number of persons (Section 12(6) of the Housing Benefit Act). In this way, ancillary housing costs, including heating, are funded in a simple administrative form.

Housing benefit was increased significantly as of 1 January 2023 and the number of recipient households doubled to tripled. The amount of housing benefit was doubled on average for previous recipient households. In addition to the heating cost component, a

climate component was introduced to make it easier to live in energy-efficient buildings.

The Federal Government is also prioritising the provision of information as well as advice and support services for citizens with questions relating to energy issues. To this end, the Federal Government supports the energy advice provided by consumer advice centres and the Electricity Saving Check.

As part of the Electricity Saving Check (SSC) project, trained, formerly long-term unemployed people provide low-income households with advice on how to save heating energy, water and electricity. The focus of the consultation is on energy-saving behaviour in the areas of heat, water and electricity as well as on achieving additional savings by replacing cooling appliances. The project is being implemented by two partners (Deutscher Caritasverband e. V. and Bundesverband der Energie- und Klimaschutzagenturen Deutschlands e. V.). These two partners work at locations throughout Germany (around 150) where they organise and conduct advisory visits to households, among other things. In addition, nationwide online and telephone counselling is offered. The aim is to reduce CO_2 emissions and lower energy costs for households and the public sector. The term of the current project ends on 31 March 2026.

As part of the energy advice provided by the consumer advice centres, households receive independent and neutral advice on issues such as energy efficiency, energy saving, the transition from fossil fuels to renewable energies, energy-efficient refurbishment, modern heating technology and funding opportunities. Besides the online presentations offered, consumers can obtain free advice by visiting or calling the consumer advice centres. In addition, energy consultants can also analyse the specific situation of a house or flat if necessary in order to make suitable recommendations, e.g. for improving energy efficiency or using renewable energies. A small personal contribution of €30 is generally payable for such on-site consultations. However, low-income households also receive this and all other energy advice services offered by the Federation of German Consumer Organisations free of charge.

2.5. ‘Research, innovation and competitiveness’ dimension

2.5.i. National objectives and funding targets for public and, where available, private research and innovation relating to the Energy Union including, where appropriate, including a timeframe for when the objectives are to be met

Research, development into innovative technologies along with their demonstration rely on both private sector involvement and public research funding. The latter should support and promote collaboration on technological developments and innovations by industrial players, research institutions and universities in areas ranging from basic and applied research to the transfer of technology and innovation to the market. As a core element of energy policy, public funding for energy research is geared towards the Federal Government's political goals and addresses major challenges relating to the energy transition. The Federal Government coordinates energy research funding through its cross-departmental energy research programme.

As part of energy research funding, Germany promotes technical and non-technical innovations and research for the energy transition along the entire value chain. This includes the major fields of heat and electricity, but also increasing energy efficiency, integrating renewable energy into the energy system and developing alternative industrial processes that cause less or no greenhouse gas emissions.

Research funding in the energy sector is crucial for modernising the German and European economies and to maintaining industrial competitiveness. The aim here is to reap the benefits of new trends such as digitalisation and to maintain and expand technological expertise in the energy sector. Activating the innovation potential of small and medium-sized enterprises and young companies is particularly important.

The Federal Government's energy research funding programme aims to develop technology-neutral, diverse and sustainable solutions for the transformation process in the energy sector.

2.5.ii. Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy-intensive and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

Carbon dioxide emissions are a major driver of anthropogenic climate change. In Germany, most CO_2 emissions result from the use of fossil fuels such as coal, oil and gas. Reducing energy-related carbon emissions is therefore a key objective of energy policy. Energy research addresses this goal by developing alternative industrial processes that cause less or no greenhouse gas emissions, integrating renewable energy into the energy system and increasing energy efficiency.

Two complementary strategies are being pursued in the area of industrial processes. Firstly, increased energy efficiency through the use of less energy will lead to a permanent decline in energy-related carbon emissions in the industrial sector. Secondly, technologies to close the carbon cycle are being developed for certain industrial processes in which the generation of carbon is difficult or even impossible to avoid. In the chemical industry, for example, carbon can be used as a starting point for basic materials (conversion to polymers, basic chemicals, etc.). It can also be used to produce liquid fuels and combustibles in the context of sector coupling. Technologies that extract carbon from exhaust gases or the atmosphere are needed to close the carbon cycle. Biological (plant growth) or technological processes can be used here. Research and development of technologies for carbon capture, transport, storage and use are to be stepped up so that domestic companies and research institutions can take on a pioneering role with these technologies which are also relevant for export.

2.5.iii. Where applicable, national objectives with regard to competitiveness

A successful energy transition must be organised in such a way as to preserve the industrial basis as a key factor for creating and protecting jobs. The three factors that are of fundamental importance when it comes to the energy transition in energy-intensive industries are cost trends (including electricity costs), ensuring security of supply and reliable framework conditions. Increased energy and emissions trading costs can lead to competitive disadvantages, particularly for globally active

companies. It is important to ensure planning and investment security for companies in Germany and Europe. Their international competitiveness must be maintained in order to prevent the relocation of production and jobs abroad (so-called carbon leakage).

Industry in particular has a crucial role to play in overcoming the economic consequences of climate change, increasing resource and energy efficiency and using renewable energies. Innovative energy technologies that reconcile climate action and industrial policy goals are essential for this.

Research, industry, investors and authorities are working closely together on targeted innovation processes that deliver energy-efficient and climate-friendly solutions in an effort to leverage the opportunities that emerge in all of the leading markets and key areas of technologies where Germany is present. It is important, for instance, to harness the potential to be found in sectoral coupling, storage and efficiency technologies, plant engineering, microelectronics as well as the raw materials industries. A research and industrial policy orientated towards this goal can be expected to deliver ‘first mover’ advantages both in Germany and on international markets, with positive impacts on competitiveness and employment.

3. POLICIES AND MEASURES

3.1. Dimension “Decarbonisation”

3.1.1. GHG emissions and removals

The Federal Climate Change Act of 17 July 2024 sets out overall reduction pathways for greenhouse gas emissions and defines indicative sector-specific pathways for energy, industry, transport, buildings, agriculture and other areas (waste) by 2030. The sectors are not differentiated according to ETS and non-ETS emissions. The vast majority of emissions that are relevant to the Effort Sharing Regulation (ESR) are found in the transport, buildings, agriculture and waste sectors in particular. The Federal Government will conduct annual reviews of compliance with emission reduction pathways up to net greenhouse gas neutrality in 2045 in a monitoring process that is not only based on these reduction pathways but also anchored in the Federal Climate Change Act. The cumulative total annual emission volumes in the period 2021-2030 will be decisive in evaluating compliance with targets. A readjustment will be required if projected emissions exceed these targets for two consecutive years according to the assessment of the independent Council of Experts. The Federal Government is also adopting climate action programmes to achieve the climate targets set out in the Federal Climate Change Act in the medium to long term.

3.1.1.i. Policies and measures to achieve the target set out in Regulation (EU) 2018/842 as referred to in point 2.1.1, as well as policies and measures to comply with Regulation (EU) 2018/841 covering all key emitting sectors and sectors suitable for the enhancement of removals, with a view to achieving the Union's climate neutrality objective set out in Article 2(1) of Regulation (EU) 2021/1119

Cross-sectoral measures

Since 1 January 2021, the Fuel Emission Allowance Trading Act (BEHG) has been used to price emissions from combustibles and fuels that are not yet covered by EU emissions trading. This act therefore plays a key role in achieving the reduction targets under the EU Effort Sharing Regulation. As part of the Budget Financing

Act 2024, the price level in the BEHG was adjusted back to the original price path decided by the previous government in 2020 before the price increase was put on hold in 2023 due to high energy prices. From 2027, national fuel emissions trading will be replaced by EU fuel emissions trading, which was introduced with the amendment to the EU Emissions Trading Directive 2003/87/EC. The Energy Efficiency Act came into force on 18 November 2023. This act creates a cross-sectoral framework for increasing energy efficiency and implements the amended EU Energy Efficiency Directive, for example by setting national efficiency targets, obliging companies with an energy consumption exceeding 7.5 GWh to introduce an energy management system, defining obligations to avoid, use and provide information on waste heat and specifying efficiency and heating requirements for data centres.

Buildings sector

Key measures in the buildings sector include federal funding for energy-efficient buildings, tax incentives for energy-efficient building renovation and the Buildings Energy Act (GEG). In particular, the GEG's requirement for the use of 65% renewable energy in new heating systems reduces the use of fossil fuels in heat generation. The act is designed to be technology-neutral and covers, for example, switching to heat pumps, district heating, biomass or, in future, hydrogen and hydrogen derivatives. This effect is now taken into account with the quantifications in the final NECP update.

As a central element of growing importance in the instrument package (introduction of ETS-II from 2027), carbon pricing based on the Fuel Emission Allowance Trading Act serves primarily to improve the competitiveness of greenhouse gas-neutral heating variants compared to gas and oil boilers. The Carbon Dioxide Cost Allocation Act ensures that the CO_2 price incentive also has an appropriate impact on rented buildings. In addition, the manner in which it splits costs between landlords and tenants based on the energy quality of buildings, also incentivises landlords to renovate their buildings.

Furthermore, the Heat Planning Act (WPG) came into force on 1 January 2024. Among other things, this legislation obliges *Länder* to ensure that heat plans are drawn up for their entire jurisdiction by certain deadlines. Systematic, large-scale heat planning seeks to achieve an ever-growing share of renewable energy in the heat supply. Areas with increased energy-saving potential are also

identified. Heat planning also aims to provide supply companies, building owners and others with guidance in relation to their future heat supply and to create greater investment security. The measures are described in more detail in the chapter on energy efficiency.

Transport sector

Key measures in the transport sector include the Fuel Emissions Trading Act (BEHG) and the CO_2 differentiation of the truck toll, the amendment and updating of EU CO_2 emission standards for new cars, light commercial vehicles and heavy commercial vehicles and the increase and updating of the GHG quota. The Federal Government welcomes the fact that emissions trading for the buildings and transport sectors (ETS II) is expected to be in place as of 2027. In the coming years, the Federal Government will provide considerable funding for the modernisation and expansion of the rail network. By 2027, Deutsche Bahn AG's investment requirements of around €45 billion are to be covered in part by a share of the revenue from the newly introduced CO_2 surcharge on the truck toll. As one measure to ensure that rail freight transport achieves a market share of 25% by 2030, the pro rata funding of track access charges in rail freight transport and the innovation funding of the Federal Government Programme on the Future of Rail Freight Transport will be continued and support for single wagonload traffic, which is under particular competitive pressure, will be significantly increased. The use of automation and vehicle technology in freight transport will be reinforced. The introduction of the new *Deutschlandticket*, a nationwide public transport pass, on 1 May 2023, made it easier and cheaper to use public transport in Germany.

Waste sector

Key measures in waste management include the expansion of measures for landfill aeration, optimised gas collection and the reduction of food waste.

Agriculture

Key measures in agriculture include reducing nitrogen surpluses, including the reduction of ammonia emissions and the targeted reduction of nitrous oxide emissions, as well as improving nitrogen efficiency, in particular through changes to fertiliser legislation, increasing the use of low-emission slurry stores and emission-reducing application techniques, in addition to research, the

expansion of organic farming and promotion of the fermentation of manure of animal origin, accompanied by gas-tight storage of fermentation residues. In addition, the Federal Government is working on adjusting the development of livestock numbers to the available land capacity and bringing them into line with the goals of climate, water and emission control.

Some of the measures being implemented in the individual spheres of activity are described below:

Reducing nitrogen surpluses:

Implementation of the Fertiliser Application Ordinance, evaluation/further development of the Ordinance on Material Balances, the Federal Programme for Nutrient Management; reduction of ammonia emissions as part of the National Clean Air Programme, investment and funding programmes for operational adaptation and the Technical Instruction on Air Quality Control (TA Luft); research into nitrous oxide emissions, interaction between N_2O/NH_3, etc;

In the area of precision agriculture, research into the emission savings potential associated with more efficient fertilisation (nitrogen), e.g. in the digital experimental fields; strengthening of the data basis/monitoring, in particular of funding measures for reporting, etc.

Increasing the fermentation of livestock manure and agricultural residues:

Encouraging the conversion of existing biogas plants to use greater volumes of liquid manure; promoting the gas-tight storage of fermentation residues in existing plants; funding research and development as well as pilot and demonstration projects for the co-digestion of livestock manure with other residual materials, digitisation, efficiency improvement measures, etc.

Expansion of organic farming:

The expansion of organically farmed areas is also a climate measure – switching to organic farming halves the greenhouse gas emissions per unit area in crop production. In its coalition agreement, the Federal Government has set itself the target of farming 30% of agricultural land organically by 2030. To achieve this ambitious goal, the Federal Ministry of Food and Agriculture (BMEL) presented the Organic Strategy 2030 in November 2023 – the

national strategy for 30% organic agriculture and food production by 2030. Key areas for action outlined in the Organic Strategy 2030 are strong organic breeding activities, research, advisory services and the provision of tools and materials for organic farming, the strengthening of organic value chains, including in rural regions, the expansion of organic away-from-home catering (especially in mass catering facilities), education and communication at both vocational and general education level and a coherent legal framework. Promoting research into knowledge-based organic farming is another essential lever for achieving the land area target of 30%.

Reducing greenhouse gas emissions in livestock farming

The Federal Government will realise further savings potential in livestock farming and animal nutrition. In addition to research, the future development of livestock will be of importance here. A combination of appropriate measures should ensure that the reorganisation of agricultural livestock farming reduces greenhouse gas emissions and other environmental impacts. These include measures for area-based livestock farming and measures to indirectly influence Germany's livestock population. The Federal Government is directing funding towards ensuring that livestock is kept on farms at a maximum ratio of two livestock units per hectare. Area-based farming (i.e., taking account of stocking densities) is, for example, part of the new federal programme to promote the restructuring of livestock farming in the pig farming sector. Other measures relating to animal feed include, for example, funding the further development and establishment of the use of practicable, electronically supported systems for precision feeding of farm animals, with the aim of maximising the nutrient and energy utilisation of the feed in optimised rations.

Energy efficiency in agriculture

The technology used in agriculture and horticulture can be further improved in terms of its energy requirements. With this in mind, the Federal Programme for Energy Efficiency in Agriculture and Horticulture will be continued and further developed and the use of renewable energies will be supported. Measures include investment aid programmes for individual holdings. These may involve relatively complex investments in CO_2 savings following an energy consultation on energy saving or the generation of renewable energy for the holding's own requirements, or simpler individual measures for energy saving and the use of renewable energy for stationary small-scale consumers, buildings and mobile

farm equipment, for which an energy consultation is not required. Individual measures also include the funding of alternative drive systems for mobile machinery and equipment.

On the demand side, the Federal Ministry of Food and Agriculture plans to support sustainable consumption in the area of nutrition. It is the task of policymakers to create better conditions that make it easy for consumers to eat well, i.e. healthily and sustainably. This requires an integrated food policy based on a combination of various instruments. Nutritional environments are of central importance in this context. It is essential that they be designed to promote factors that facilitate sustainable nutrition. The Federal Government has developed a nutrition strategy to facilitate healthy and sustainable nutrition.

Land use, land-use change and forestry

The Federal Government adopted the Federal Action Plan for Nature-based Solutions for Climate and Biodiversity on 29 March 2023. It aims to protect, strengthen and restore ecosystems. The programme unites climate change mitigation with nature conservation and seeks to use a raft of measures to ensure that degraded ecosystems are regenerated, resilient and diverse and can therefore make a lasting contribution to climate targets.

The Federal Government is using the Federal Action Plan for Nature-based Solutions for Climate and Biodiversity and other instruments, such as agri-environmental and climate change mitigation measures under Pillar II of the CAP, to implement measures in the LULUCF sector, including the following:

Accelerating the rewetting of peat soils: To accelerate the measures it has already adopted, the Federal Government will soon bring forward federal funding measures for climate change mitigation through peatland protection. The Federal Government has adopted the National Peatland Protection Strategy and will initiate its implementation without delay. As part of the acceleration of planning and approval procedures, it will also conclude suitable agreements on peatland protection with the *Länder*, review planning law instruments together with the *Länder* with a view to giving greater prominence to peatland protection in sectoral planning and cross-sectoral spatial planning, put in place a right of first refusal for the public sector to purchase peat soils and create a federal funding programme in coordination with the *Länder*, successfully establish alternative management forms, e.g. with paludiculture on rewetted peat soils formerly managed using

drainage techniques and improve the condition of unused and protected moorlands with rewetting and renaturation measures. The aim is to reduce annual GHG emissions from drained peatlands by 5 Mt CO_2-eq by 2030.

Increasing forested land to promote biodiversity: The details of this measure are still being worked out. Initial afforestation on suitable areas, possibly in pilot regions, is to be implemented in accordance with biodiversity-promoting guidelines. The suspension of the existing funding for the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK) is being examined by the Federal Government and the *Länder*.

Creating species-rich and climate-resilient forests through reforestation and forest restructuring: As extreme weather events become more frequent with advancing climate change and site conditions change due to climate change, there is an urgent need to better adapt existing forests to climate change through accelerated forest restructuring. The aim is to restore already damaged areas as species-rich and thus climate-resilient mixed forests. To this end, the Federal Government, together with the *Länder*, will continue to implement the existing "Forest Restructuring" and "Reforestation" measures as part of the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK). From 2024, the funds for these two measures will be provided from the ANK and thus the KTF. The Federal Government has committed up to €125 million to this sector for 2024.

"Climate-adapted forest management" funding programme: Forests can only sustainably fulfil their other ecosystem functions alongside CO_2 storage in forests and timber if they are climate-resilient. With its funding programme for the introduction of climate-adapted forest management launched in November 2022, the Federal Ministry of Food and Agriculture initiated long-term funding to finance and thus reward additional climate change mitigation and biodiversity performance. Private and municipal forest owners who commit to complying with 11 or 12 climate-adapted forest management criteria over 10 or 20 years are eligible for funding. Over 21% of private and municipal forests in Germany have already signed up to the programme. As of 1 January 2024, the Climate-Adapted Forest Management funding programme is financed from the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)'s share of the Federal Action Plan on Nature-based Solutions for Climate and Biodiversity (ANK).

Financial incentives for additional climate change mitigation and biodiversity in forests: In addition to the existing "Climate-adapted forest management" funding programme, which further accelerates the transformation of forests into climate-adapted forests by supporting targeted measures, the development of a supplementary funding instrument is also planned. It will create targeted financial incentives for achieving desirable conditions, such as additional structural diversity and biodiversity in forests that are already more naturally managed and thus also seeks to achieve partially non-intensive forest management. In this way, the funding instrument also contributes to stabilising and increasing carbon storage in climate-stable, ecologically valuable forest ecosystems.

Protection of old, near-natural beech forests: This measure was implemented for federally owned forest land on 4 March 2024 by means of a special agreement with the Institute for Federal Real Estate. In addition, the measure for private and municipal forests is implemented in a funding guideline with a measure comprising financial incentives for additional climate change mitigation and biodiversity in forests.

ClimateWilderness (KlimaWildnis): A programme to safeguard smaller wilderness areas in/on forests, moors, floodplains, coasts, mountains, former military training areas and post-mining landscapes will be relaunched.

Funding for near-natural areas: In the context of natural climate change mitigation, measures for carbon storage in the agricultural landscape with a simultaneous positive effect on biodiversity, high permanence, good verifiability, appropriate additionality and low leakage effects will continue to be supported as part of the Joint Task for the Improvement of Agricultural Structures and Coastal Protection and, in addition, under the Federal Action Plan on Nature-based Solutions for Climate and Biodiversity. This involves, for example, extending support for the creation of strips of woody plants, field copses, hedgerows, boundary hedges and avenues of e.g. fruit trees, especially around field boundaries, as well as agroforestry systems. The creation of flower strips and flower pastures and the maintenance and establishment of agroforestry systems are also supported, for example, as part of the agri-environmental and climate change mitigation measures of Pillar II and the eco-schemes of Pillar I of the CAP.

Increasing and funding urban trees, urban forests and forest gardens: A new investment programme will seek to promote tree

planting and the planting of urban forests for natural climate change mitigation and to promote biodiversity within the scope of funding options available to the Federal Government under constitutional financial provisions.

Supporting ecological green space management in municipalities: This new funding programme is intended to support local authorities in making the transition to ecological green space management within the scope of funding options available to the Federal Government under constitutional financial provisions.

Additional measures to increase the resilience of land-based ecosystems: The resilience of land-based ecosystems is to be increased by means of various measures, including, in particular, those listed below:

- The National Water Strategy adopted by the Federal Government on 15 March 2023 is to be implemented without delay and a "Federal Programme for Climate-related Measures in Water Management and Water Body Development" is to be established.

- A national restoration programme is to be developed in line with the European Union's nature restoration objectives.

- The legal basis for soil protection is be reviewed and federal soil protection legislation adapted to meet the challenges of climate change mitigation, climate adaptation and the preservation of biodiversity, while also taking account of the various uses of soil.

- Land consumption and soil sealing are to be reduced and existing unsealing potential is to utilised to a greater extent that it has been to date.

- Other funding programmes, not listed in detail here, are being launched as part of the Federal Action Plan on Nature-based Solutions for Climate and Biodiversity for the renaturation of ecosystems.

Improved GHG monitoring and reporting: The accuracy and informative value of emissions data and forecasting tools for reporting are to be improved and, where possible, remote sensing systems are to be integrated into data collection. The authorisation of issue ordinances under section 3a (3) of the Federal Climate

Change Act will be used to regulate the basis for recording and reporting greenhouse gas emissions in the LULUCF sector.

Forest Climate Fund: Since 2013, the Forest Climate Fund (WKF), which is in turn funded by the Climate and Transformation Fund (KTF), has been funding research, development, pilot and communication projects to maintain and improve the climate change mitigation performance of forests and adapt forests to climate change. The main aim here is to strengthen the interface between forest-related research, development and practice (practicability and knowledge transfer). The WKF is being phased out as of 2024 as part of the budget preparation process. Funding will be cut with the exception of the commitment appropriations that are already legally binding. Ongoing projects will be funded to completion, but no new applications will be approved. The new WKF funding guidelines planned by the Federal Ministry of Food and Agriculture and Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, which were intended to further increase funding for research and development in the forestry sector as of the start of 2024, will no longer be published due to the lack of funds available for new applications.

Improving communication and public relations: Suitable measures will be taken to ensure that all new and ongoing climate change mitigation activities in the LULUCF sector, in particular those relating to nature-based solutions for climate change mitigation, are publicised more widely and advertised more heavily with a view to further improving the acceptance and success of the measures.

Humus preservation and formation on arable land: Agricultural measures such as multiple crop rotations, catch crops and undersowing, perennial humus-building crops, flower strips and agroforestry systems can contribute to humus formation and thus to carbon sequestration. These measures are being extensively trialled and demonstrated to the public throughout Germany as part of the pilot and demonstration projects funded by the Federal Government to promote humus formation in arable farming and special crops. The expansion of organic farming also contributes to carbon accumulation. In addition, the planting of hedgerows, boundary hedges and avenues of trees, for example, helps promote humus formation. Strips of forest on agricultural land improve soil quality and reduce CO_2 and pollution.

Preserving permanent grassland: Grassland stores large amounts of carbon stock. Therefore, the preservation of permanent grassland is another important climate change mitigation measure, provided it does not involve peatland that cannot be rewetted. The continuation of the regulations on the protection of permanent grassland in the Common Agricultural Policy contributes to this objective.

Further measures to reduce greenhouse gases

Funding programme to expand landfill aeration and optimise gas collection

Key core measures in the area of "Other Emissions" focus on the largest group of emissions attributable to this area. The measures comprise landfill aeration, whereby the methane that would otherwise be produced is converted into carbon dioxide that is based on biogenic carbon and is therefore greenhouse gas-neutral, as well as the optimisation of gas collection.

Lightweight Construction Technology Transfer Programme

Lightweight construction seeks to reduce the weight of products, save material and energy and increase recyclability while maintaining or improving functionality. Resources can be saved and carbon emissions reduced at all stages, from design to production, use and recycling of materials and products.

The Lightweight Construction Technology Transfer Programme has been funding policy-relevant, application-oriented projects with a high level of industry involvement since 2020 and will continue to do so until 2027. This promotes Germany as location for business and investment in the important field of lightweight construction, while simultaneously promoting environmental protection and climate change mitigation. Innovative lightweight construction technologies and materials contribute to the transformation of industry in the medium and long term and to the resilience of companies as they face bottlenecks in raw material supply and rising energy prices.

3.1.1.ii. Where relevant, regional cooperation in this area

European Climate Initiative (EUKI)

The European Climate Initiative (EUKI) is a funding initiative of the Federal Ministry for Economic Affairs and Climate Action to foster

European cooperation in the continuing development and implementation of ambitious climate policy. The target countries are the European Member States in Eastern and South-Eastern Europe, the Baltic States and the six countries of the Western Balkans. The programme supports non-investment, cross-border projects promoting the exchange of good practices between sub-state actors, civil society, industry and research.

However, the Federal Government is also in regular dialogue with other Member States. Bilateral formats are well established for this purpose with many EU Member States.

Meseberg Climate Working Group

In the Meseberg Declaration issued on 19 June 2018, Germany and France agreed to set up an interdepartmental high-level climate working group. The Climate Working Group supports the implementation of the Paris Climate Agreement. The Ministerial Working Group on Climate Change met in 2020 and, most recently, on 31 May 2021 as part of the Franco-German Council of Ministers. Views on the energy transition and on instruments for sustainable funding and economic incentives, including aspects of carbon pricing, have already been discussed. The Working Group comprises relevant officials from the French and German sides and continues its work "behind the scenes" on an ongoing basis. Climate also forms part of the Franco-German Declaration of the Franco-German Council of Ministers of January 2023.

3.1.1.iii. Without prejudice to the applicability of State aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

National Climate Initiative (NKI)

Since 2008, the Federal Government has initiated and funded numerous climate change mitigation projects through the NKI (initially under the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety until 2021, and since 2021 under the Federal Ministry for Economic Affairs and Climate Action). These projects contribute significantly to achieving national climate targets. The NKI's programmes and projects cover a broad spectrum of activities relating to climate change mitigation: The NKI helps anchor climate change mitigation at a local level through the development of long-term strategies, support for professional climate change mitigation management and investment funding measures. The main target groups of the NKI are local authorities,

industry and consumers, as well as schools and educational institutions. By the end of 2022, around 45,200 projects had been implemented with a total funding volume of around €1.54 billion.

Mission "100 Climate-Neutral and Smart Cities by 2030"

As part of its mission-oriented innovation policies, the European Union launched the mission „100 Climate-Neutral and Smart Cities by 2030“ and, in April 2022, announced the cities that have been selected for participation, including nine in Germany. In 2022 and 2023, the European Union funded the implementation as part of research projects (Research and Innovation Actions; RIA) within its Horizon Europe funding programme. The participating cities draw up climate city contracts that include an overall plan for climate neutrality in relevant areas, such as energy, buildings, waste management and transport, as well as corresponding investment plans. The NetZeroCities mission platform provides cities with technical, regulatory and financial support for implementing climate neutrality. Meanwhile, the National Contact Point at the BMWSB guides and supports the participating German cities (note: there are now only eight German cities after Frankfurt/Main withdrew from the programme).

Implementing the Sustainable Finance Strategy

The Sustainable Finance Strategy seeks to further develop Germany into a leading sustainable centre of finance, to support discussion and implementation processes at national, European and global levels and to contribute to a structured, bundled stakeholder dialogue. On 25 February 2019, the State Secretaries' Committee for Sustainable Development passed a resolution to develop a Sustainable Finance Strategy for the Federal Government (which subsequently came into force on 5 May 2021) and to set up a Sustainable Finance Committee for the Federal Government (which recommenced on 10 June 2022). Important steps towards more sustainable finances and increased mobilisation of private capital have already been taken, e.g. expanding the issuance of green Federal bonds (the Federal Government has been successfully issuing green Federal securities since 2020); the Spending Review 2021/2022 "Linking sustainability goals with the federal budget" and establishing the International Sustainability Standards Board in Frankfurt as the prevailing standard-setting body for global sustainability reporting.

Further development of the KfW into a transformative promotional bank to support the transformation of business sectors and the financial market for a GHG-neutral future

The KfW is being further developed as a promotional bank to support the transformation of business sectors and the financial market for a greenhouse gas-neutral future. Proposals for practical implementation take account of the Sustainable Finance Strategy, within the framework of the KfW's given equity capitalisation and in accordance with its strategic target system.

Green Federal securities

Since 2020, the Federal Government has been issuing green Federal securities, thereby supporting the development of sustainable financial markets in line with the UN 2030 Agenda. Issuing these securities creates transparency in terms of the Federal Government's green expenditure. The preparation for and follow-up to the issuance of green Federal securities is an interministerial measure. The tasks involved include selecting and evaluating suitable green expenditure and subsequently reporting on its effects on climate, environment and nature, all of which must take place within the relevant departments (e.g. energy, transport, research, etc.). The Federal Government is continuing to pursue its issuing strategy in the green bond segment. The establishment of a green yield curve in Europe will position Germany as an international centre of sustainable finance.

Digital ecosystems for climate-friendly industry

The digital transformation of supply chains across all sectors and the development of digital ecosystems is enabling new Industry 4.0 applications and business models. These multilateral and reliable data ecosystems are intended to enable the scalable, automated and broad-based application of data-based solutions to achieve potential energy and resource savings, even across company lines. One of the goals of the programme is to enable companies to use data-based solutions to map and manage their CO_2 footprint in a transparent way along entire supply chains.

The evaluation on which the Federal Government's Immediate Climate Action Programme (KSSP) is based estimates that this instrument will have an impact of 1.59 Mt CO_2/a by 2030 with available funding of €550 million. The further development of the programme is projected on a proportionate basis; it is not expected

that this instrument will see a significant expansion beyond the goals set for 2030.

Climate and Transformation Fund (KTF)

The KTF is a key instrument for financing the energy transition and climate change mitigation. The Federal Government uses this special fund to support energy-efficient building renovation in particular, as well as climate-friendly new construction, the decarbonisation of industry and the expansion of renewable energy, alternative drive systems and refuelling and charging infrastructure.

The KTF also funds the development of a hydrogen economy, including refuelling infrastructure and, as of 2024, the promotion of semiconductor production. Semiconductor production is of central importance to greenhouse gas-neutral technologies – and thus to the successful transformation of the German economy towards greenhouse gas neutrality.

DARP

In the German Recovery and Resilience Plan (DARP), three KTF projects coordinated by the Federal Ministry for Economic Affairs and Climate Action seek to decarbonise industry, i.e., the "IPCEI Hydrogen", "Decarbonisation of Industry" and "Carbon Contracts for Difference" funding programmes. These are partly funded by the EU's Recovery and Resilience Facility to the value of €2.5 billion.

The measures that comprise the "climate-friendly mobility" component of the DARP aim to establish sustainable alternative technologies in the transport sector and to make the sector more energy-efficient, climate-friendly and environmentally friendly with a view to further advancing the energy transition in transport.

IPCEI Hydrogen

The "IPCEI Hydrogen" programme aims to promote integrated projects along the entire hydrogen value chain, from the production of green hydrogen to infrastructure and use in industry and mobility. The IPCEI Hydrogen is jointly financed by the Federal Ministry for Economic Affairs and Climate Action (BMWK), Federal Ministry for Digital and Transport (BMDV) and the federal states. The Federal Government provides 70% of the total funding for IPCEI projects, while the *Länder* provide 30%.

Decarbonisation of Industry funding programme, to be replaced by the Federal Fund for Industry and Climate Action

Since 2021, the Federal Government's "Decarbonisation in Industry" funding programme has been supporting energy-intensive (primary) industries (including steel, chemicals and cement) in developing and investing in innovative climate protection technologies to avoid process-related greenhouse gas emissions. This often involves the modification of entire industrial sites. In 2024, the programme will be merged into the Federal Fund for Industry and Climate Action, which makes decarbonisation funding accessible to other industrial sectors and even more SME-friendly.

Carbon contracts for difference

With its newly devised instrument "carbon contracts for difference", the Federal Government is establishing the economic framework for the construction and operation (CAPEX and OPEX) of modern, climate-friendly production facilities in energy-intensive industries. The contracts offer industrial companies protection from price risks and compensate them for the higher costs of climate-friendly processes compared with conventional processes during the technological transition phase. In this way, the instrument contributes to meeting national climate targets and to reinforcing Germany's position as a centre for business and investment and as an innovation hub.

3.1.2. Renewable energy

3.1.2.i. Policies and measures to achieve the national contribution to the binding 2030 Union target for renewable energy and trajectories as referred to in Article 4(a)(2) and, where applicable or available, the elements referred to in point 2.1.2, including sector- and technology-specific measures

3.1.2.i.a) Renewable energy sources in general

Reform of the Renewable Energy Sources Act (EEG 2023)

The reform of the Renewable Energy Sources Act (EEG 2023), which entered into force on 1 January 2023, represents the biggest reform in decades. It contains numerous measures to accelerate the expansion of renewable energy and achieve the expansion target of a share of at least 80% of gross electricity consumption from renewable sources by 2030. Of particular note is the newly

introduced principle that renewable energy is in the overriding public interest and serves public security. This means that, in future, renewable energy will take precedence over other interests in balancing decisions, provided that these other interests are not related to national and collective defence. This will speed up planning and approval procedures.

Offshore Wind Energy Act (WindSeeG)

A comprehensive amendment to the Offshore Energy Act (WindSeeG) came into effect on 1 January 2023. The amendment aims to help achieve the target of increasing the share of renewable energy in electricity consumption to at least 80% by 2030. To this end, it substantially increases expansion paths and tender volumes. The expansion target for offshore wind energy will increase to at least 30 gigawatts (GW) by 2030. The goal is to achieve at least 40 GW of installed capacity by 2035 and at least 70 GW by 2045. In particular, the amendment speeds up the tendering, planning and approval procedures by bundling and streamlining assessments. The relevant tender design will be revamped. In future, offshore expansion will also be explicitly considered to be in the overriding public interest and will therefore be given greater weight compared with other public goods in balancing decisions, provided that national and collective defence is not impacted.

Site Development Plan 2023 for offshore wind energy

In January 2023, the Federal Maritime and Hydrographic Agency published its new 2023 Site Development Plan for offshore wind energy. It secures the sites that are needed to achieve the 2030 target and lays the initial foundations for achieving the 2040 target.

Offshore Realisation Agreement 2022

In addition, the Offshore Realisation Agreement 2022 was concluded between the participating *Länder* and industry stakeholders in the field of offshore wind energy. Key elements of the agreement include, in particular, precise scheduling of defined milestones regarding the start and end of the relevant planning and approval procedures, as well as the start of construction and commissioning of offshore grid connections.

Onshore Wind Energy Act

The Onshore Wind Energy Act came into force on 1 February 2023. It includes the introduction of the Act on the Need for Wind Energy Sites (WindBG), regulations on legal consequences in the Federal Building Code (BauGB) and monitoring regulations in the Renewable Energy Sources Act (EEG 2023).

Onshore Wind Energy Strategy

The Onshore Wind Energy Strategy is a comprehensive work programme with statutory and non-statutory measures in twelve fields of action with the aim of accelerating and removing obstacles to the expansion of onshore wind energy.

Surface area targets for 2032

The Onshore Wind Energy Act, incorporating the Act on the Need for Wind Energy Sites (WindBG), marks the first time that the Federal Government has fixed a target for the land area that is to be designated for onshore wind energy. Specifically, the law stipulates that a total of 2% of Germany's total surface area must be designated for this purpose by the end of 2032. The WindBG also ensures that a total of 1.4% of the country's surface area will be available for onshore wind energy by the end of 2027. A distribution formula defines binding individual surface area targets for each of the *Länder*, amounting to between 1.8% and 2.2% of total surface area in each case by 2032. If the targets are not met by the target dates, wind turbines will then be granted special privilege outside of designated wind energy sites throughout the entire planning area. Integrating surface area targets into planning law simplifies and accelerates planning procedures. Regulations have also been put in place for the legal consequences that will apply in the case of target achievement or target shortfall. If the surface area target is achieved, wind turbines will only be granted special planning privilege within designated wind energy areas. If the surface area target is not met, wind energy projects will continue to have privileged planning permission in the entire undesignated area. In addition, any minimum distance regulations under *Länder*-specific legislation no longer apply if the target is not achieved.

For monitoring purposes, the *Länder* have until 31 May 2024 to demonstrate, via reporting channels, that they have begun the

process of implementing measures to achieve the target area contribution values by means of corresponding planning decisions at *Länder* level or the entry into force of *Länder*-specific legislation or regional development plans to define binding lower-level (regional or municipal) area targets (see Section 3 (3) WindBG).

Acceleration and simplification of approval procedures (onshore wind)

In 2021, approval procedures took, on average, more than two years from when initial documents were submitted and more than ten months from when it was determined that the application documents were complete. Since then, various important measures have been initiated to shorten procedures, some of which are beginning to show signs of success.

For example, the special significance of renewable energy for the transformation to climate neutrality was enshrined in law by including in the Renewable Energy Sources Act the principle that the construction and operation of renewable energy plants and the associated ancillary facilities are in the overriding public interest and serve public security (see Section 2 EEG 2023). This means that renewable energy plants must be given priority over other concerns when balancing all protected interests until the point at which electricity generation in Germany is almost greenhouse gas-neutral, provided that no national and collective defence concerns are impacted.

Significant acceleration is enabled by the rules of application for Article 6 of EU Emergency Regulation 2022/2577 on licensing in the Act on the Need for Wind Energy Sites (WindBG). The WindBG provides for temporary relaxation of the permit-granting process for wind turbines in designated wind energy areas. Under Section 6 WindBG, the environmental impact assessment and the species protection assessment are not required for a temporary period of 18 months in designated wind energy areas. A precondition for this relaxation is that the wind energy areas must have already undergone a strategic environmental assessment (SEA) at the planning level. To satisfy species conservation legislation, operators must implement appropriate and proportionate preventive and mitigation measures. Notably, if such measures are not in place, operators are required to make a financial contribution to the National Species Recovery Programme.

Federally uniform standardisation in the area of species conservation also significantly simplifies approval procedures. The

Federal Nature Conservation Act (BNatschG) was amended for this purpose. A key measure in this amendment is that the assessment required in accordance with the prohibition of killing and injuring protected species under species conservation legislation is now based on an exhaustive list of 15 nesting bird species (individual nesting pairs) at risk of collision with wind turbines, each with defined assessment areas. At the same time, conservation measures approved by experts in the field have been defined for these species. In addition, the amended regulations in the Federal Nature Conservation Act (BNatschG) make the granting of a species conservation exemption permit legally secure and considerably easier, especially for non-endangered species.

Further relaxations of restrictions in designated wind energy areas and standardisation of species conservation legislation are planned. These include the planned standardisation of habitat potential analysis (HPA) and the agreed introduction of probabilistic modelling. The latter is to be carried out initially for the red kite, before being gradually extended to other species.

In addition to the planned species conservation measures, numerous other measures are planned to improve the general conditions for expanding onshore wind energy. For example, an amendment of the Federal Immission Control Act (BImSchG) – the central law under which onshore wind turbines are approved in Germany – is currently the subject of parliamentary negotiations. The current government draft of the amendment contains important measures to simplify and accelerate approval procedures for onshore wind turbines and electrolysers for green hydrogen. For example, according to the planned new regulations, authorities will no longer be able to extend the deadlines for approval procedures an unlimited number of times – which to date has been a major cause of lengthy application processing times. In future, only one extension will be permitted and only then with the explicit consent of the applicant. Furthermore, a public hearing will no longer be required for onshore wind energy approval procedures, the subsequent submission of documents will be made easier for project developers and (urgent) legal redress procedures will be more efficient. In addition, the role of the project manager – a third party who provides administrative support – is strengthened. This role already exists under current legislation but will, in future, be made mandatory at the request of the project developer and the associated catalogue of tasks will be significantly expanded (to include monitoring deadlines, evaluating documents, chairing public hearings, drafting decisions – final decisions will continue to be made by the authorities).

The planned amendment to the BImSchG also contains important improvements for the repowering of wind turbines (Section 16b BImSchG). These include a delta assessment for all public interests (Section 16b BImSchG) – in other words, the approval authority will only examine whether repowering will have negative effects compared with the current situation. The amendment also facilitates the repowering of old installations (para. 3) and further simplifies the process.

Additional significant simplification and acceleration measures will come into force with the planned implementation of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (RED III) in national law. To accelerate the growth of energy from renewable sources, RED III provides for certain relaxations of approval legislation in what are referred to as "acceleration areas".

Photovoltaic Strategy

The Photovoltaic Strategy of the Federal Ministry for Economic Affairs and Climate Action is the result of an extensive consultation process. Stakeholders submitted over 600 opinions, which were incorporated into the final version of the strategy. The strategy aims to ensure that the growth of photovoltaics optimises the overall energy supply system. It also identifies eleven fields of action with measures to facilitate and accelerate this growth. Most of the measures included will be implemented in "Solar Packages I and II".

Solar Package I

Solar Package I aims to significantly accelerate the growth of photovoltaics against the backdrop of the ambitious growth targets to be achieved by 2030 (215 GW, currently ~ 82 GW). Key elements of the solar package include improved funding of special solar installations (agri PV, moorland PV, parking PV and floating PV systems), the introduction of shared building supply and thus the creation of an additional model for the consumption of PV electricity within a building close to where it is generated, various improvements and reductions in red tape for rooftop installations and simplifications for balcony PV systems ("plug & play").

Concessions for photovoltaic systems

The Annual Tax Act (JStG) 2024 extends the tax exemption for smaller photovoltaic systems (Section 3 no. 72 Income Tax Act) that

was introduced with the Annual Tax Act 2022 to systems with a rating of up to 30 kW(peak) per building unit (previously 15 kW(peak)).

3.1.2.i.b) Electricity

Growth of renewable energy to at least 80% of gross electricity consumption by 2030

The targeted, efficient, grid-synchronised and increasingly market-oriented expansion of renewable energy is a key element in achieving climate targets in the energy industry. The Federal Government aims to ensure that renewable energy accounts for a share of at least 80% of total electricity consumption by 2030. Renewable energy sources accounted for just under 52% of gross electricity consumption in 2023. The expansion of renewable energy sources in electricity generation is mainly promoted and controlled by the Renewable Energy Sources Act. The Renewable Energy Sources Act sets out expansion paths for this objective: The expansion paths for wind and solar energy were significantly increased with the most recent amendment (Amendment 3): For onshore wind energy, 10 gigawatts (GW) of installed capacity will be added annually from 2025 to reach a total of 115 GW by 2030 and 160 GW from 2040. For solar installations, 22 GW will be added annually from 2026 to reach a total of around 215 GW by 2030 and 400 GW by 2040. The expansion target for offshore wind energy will increase to at least 30 GW by 2030, at least 40 GW by 2035 and at least 70 GW by 2045.

In addition to these expansion paths, the share of renewable energy in gross electricity consumption is largely determined by the development of electricity consumption (including efficiency and sector coupling). As set out in the Climate Action Programme, additional measures are planned in connection with expanding the share of renewable energy to at least 80% of gross electricity consumption by 2030. These measures will be specified in the draft legislation.

Contracts for Difference (CfD), as envisaged in the proposal for a reform of the EU electricity market, have the potential, if properly designed, to reduce the investment risks associated with sources of renewable energy and thus their capital costs. In addition, green electricity Power Purchase Agreements (PPAs) will play an increasingly important role in future, both by securing investments and by hedging prices for renewable electricity.

In Germany, guarantees of origin in accordance with Section 79 (1) EEG 2023 are only issued for non-subsidised energy volumes from renewable energy sources. These guarantees of origin can be traded and plant operators can use them to generate additional income.

Improved synchronisation of the growth of renewable energy with electricity grid expansion

In the current phase of the Renewable Energy Sources Act, the focus is on grid and system integration of renewable energy sources. As a large EU Member State in the centre of Europe, the main future tasks of the Federal Government will therefore be to expand transmission systems and to modernise and optimise existing systems. Optimisation and further development of system operation control, including redispatch, may also be considered. This is essentially a challenge for Europe – Electricity generation in the most cost-effective locations requires adequate transport to consumption centres. The early expansion of renewable energy sources has made this challenge particularly visible in Germany. In addition, the steadily increasing electricity feed-in from renewable energy sources often takes place at the distribution network level. This creates additional challenges for the expansion and further development of regional power grids. Direct control of the growth of renewable energy is being implemented alongside grid-related measures to better synchronize the growth of renewable energy sources in the electricity sector with grid expansion.

Review of the regional control of renewable energy sources in the electricity sector

Regional control of renewable energy has a particular impact on the expansion plans and targets of the *Länder*, on network development planning and on the acceptance of the growth of renewables and is therefore very significant in terms of policy. It also contributes to improved synchronisation of the expansion of power grids and renewable energy. The options for regional control in the expansion of renewables are very flexible: While the flexibility of large power plants lies in the generation itself, the generation capacity of renewable energy sources can be geographically controlled in the short and medium term if a need for remedial action is identified and the corresponding policy framework is in place. In addition, regional control with a higher installed wind capacity in southern Germany would reduce cost-intensive curtailments by lowering transport requirements from north to south.

Energy Industry Act

Changes to the Energy Industry Act (EnWG) in 2022 serve to further accelerate the construction of offshore transmission links, in particular by means of the parallel construction of several transmission links per year in one route corridor.

EU Emergency Regulation on licensing

In addition, rules of application Article 6 of the EU Emergency Regulation on the licensing of renewable energy installations were transposed into national law in March 2023. This will further accelerate the processes of expanding renewable energy and power grids. The Regulation temporarily eliminates the need for an environmental impact assessment and species protection assessment in designated renewable energy and grid areas that have already undergone a strategic environmental assessment (SEA). To protect species, proportionate avoidance and mitigation measures are implemented on the basis of the available data.

3.1.2.i.c) Heating and cooling

Heating and cooling in the buildings sector

For the buildings sector, the measures for implementing the Energy Efficiency Strategy for Buildings (ESG) were set out in the Long-Term Renovation Strategy (see heating and cooling-related measures in the buildings sector in Chapter 3.2 on energy efficiency). The “Immediate Action Programme for Buildings” from 2022 adapts this set of measures to current developments and new objectives. Many of these measures also contribute to the achievement of targets in the “Renewable Energy" dimension, in particular the Federal Funding Programme for Energy-efficient Buildings (BEG), the Federal Funding Programme for Efficient Heat Networks (BEW), and the climate-friendly new build programme (KFN) as well as the heat pump initiative.

Of particular importance in this regard is the amendment to the Buildings Energy Act (requiring the use of 65% renewable energy) in connection with the Heat Planning Act. The Buildings Energy Act (GEG) mandates the use of energy from renewable sources (effective from 1 January 2024 for new buildings in development areas; and at the latest from 1 July 2026 and 1 July 2028 for other areas). It also stipulates that no boilers fuelled by fossil fuels may be operated from 2045 onwards. Transitional arrangements, an application-based hardship regulation, and improved conditions

under the Federal funding programme for energy-efficient buildings (BEG) complement the provisions of the Buildings Energy Act and assist citizens and businesses in implementing the requirements.

In addition, buildings with photovoltaic systems, which are increasingly supported as part of the reform of the Renewable Energy Act, contribute significantly to achieving national renewable energy expansion targets.

Heating networks

The Heat Planning Act includes the indicative target of generating 50% of grid-bound heating on a national average from renewable energy sources and unavoidable waste heat by 2030. Furthermore, the Heat Planning Act contains binding requirements for minimum shares of renewable energy or unavoidable waste heat, which establish a decarbonisation path. By 2045, heating networks must be fully decarbonised.

3.1.2.i.d) Transport

The update to the National Hydrogen Strategy (NWS), adopted in July 2023, establishes a cross-sector framework for the future production of green hydrogen and the use of green, blue, orange, and turquoise hydrogen, thereby promoting innovation and investment. One of the goals of the NWS is to double the production capacity of green hydrogen and to take into account the increased ambition level in climate change mitigation and the challenges in the energy market. The transport sector plays an important role in the NWS update, as hydrogen and its derivatives are expected to be used by 2030, not only in industrial applications but also increasingly in heavy-duty vehicles, as well as in aviation and shipping, and for special applications, such as military use. Short, medium and long-term measures towards this end are bundled within the strategy. Accordingly, alongside direct electrification, hydrogen and fuel cell technologies, as well as Power-to-X (PtX) fuels, will play an increasingly important role. The steadily increasing greenhouse gas (GHG) quota is an important instrument here in promoting the use of green hydrogen in the transport sector. In addition, a triple credit for green hydrogen towards the GHG quota in the transport sector is planned [37. BImSchV]. A prerequisite for this is the availability of sufficient green hydrogen, which is crucial, for example, in view of the EU legal requirements incorporated with the recent RED amendment regarding the use of renewable gases not of biogenic origin in industry, especially green

hydrogen. This availability is addressed by the NWS. Incentives provided by the GHG quota are not limited to national production and can also promote imports and thus cross-border trade. Measures in the transport sector include the establishment of a basic network of hydrogen refuelling points, the promotion of renewable fuels and the creation of the necessary regulatory environment for the use of hydrogen in transport. A master plan for hydrogen and fuel cell technology in transportation is being developed to advance the scaling of hydrogen, hydrogen-derived fuels, fuel cell vehicles, as well as fuel cell components and systems, along with the required infrastructure in a targeted manner. Taking into account and integrating existing processes and strategies, funding programmes and regulatory measures, this master plan will define specific action steps according to a timetable and address their potential contribution to achieving the national climate targets by 2045. With the amendment to the 10th Federal Immission Control Ordinance (10. BImSchV), following the Federal Cabinet's decision on 10 April 2024, HVO 100 may be made available at refuelling stations.

Environmental bonus

With the environmental bonus, the Federal Government has supported the purchase of electric vehicles. Since 2016, a total of around €10 billion has been paid out under the environmental bonus for more than 2 million electric vehicles. This has significantly advanced electric mobility in Germany. Most recently, newly registered and nearly new battery electric vehicles and fuel cell vehicles have been subsidised. In addition, vehicles with zero local CO_2 emissions, regardless of their drive system, have been subsidised. These were treated in the same way as battery electric vehicles under the funding guidelines. Plug-in hybrid vehicles have no longer been eligible for the environmental bonus since 1 January 2023. Since 1 September 2023, only private individuals have been eligible to apply for the environmental bonus.

In a press release dated 16 December 2023, the Federal Ministry for Economic Affairs and Climate Action announced that, as of 17 December 2023, no new applications for the environmental bonus may be submitted to the Federal Office of Economics and Export Control (BAFA).
The basis for this decision was a decision made during negotiations on the Climate and Transformation Fund (KTF) on 13 December 2023 to phase out funding through the environmental bonus in the near future. The background to this decision in turn was that the Federal Constitutional Court, on 15 November 2023, declared the

corresponding provisions in the Second Supplementary Budget Act of 2021, and therefore the increase of the KTF through unused credits from the COVID-19 pandemic, to be unlawful.

3.1.2.i.e) Industry (Article 22a (1) subpara. (1))

To increase the share of renewable sources in the energy sources used for final energy consumption and non-energy purposes in the industrial sector, the Federal Government relies on national and European emissions trading systems and a number of other national measures. These include, in particular, the funding programme for Carbon Contracts for Difference, the "Federal funding for energy and resource efficiency in industry" (EEW) programme, the IPCEI Hydrogen programme for industrial production, the “Decarbonisation in Industry” funding programme (as of 2024: Federal Funding for Industry and Climate Protection), as well as the creation of markets for climate-friendly basic materials (green lead markets).

3.1.2.ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in point 2.1.2.

A further driver of market integration for renewable energy is enhanced regional cooperation with other Member States. This will be a key focus for the Federal Government in the coming years.

Opening up tenders in the electricity sector

Following the state aid approval of the Renewable Energy Act, the Federal Government has been required since 2017 to open tenders for electricity from renewable energy amounting to 5% of the newly installed capacity each year for installations located in other EU Member States. The aim of this opening is to enhance regional cooperation, which will lead to a shared understanding of market integration and the promotion of renewable energy, and to contribute to greater convergence of national support schemes. The prerequisites for cross-border tenders are the principle of reciprocity, a cooperation agreement with the partner country, and the physical import of the subsidised electricity into the partner country. Cross-border tenders can be implemented both through mutually opened and joint tenders with one or more partner countries. The Cross-Border Renewable Energy Regulation already provides a legal basis for cross-border tenders for onshore wind

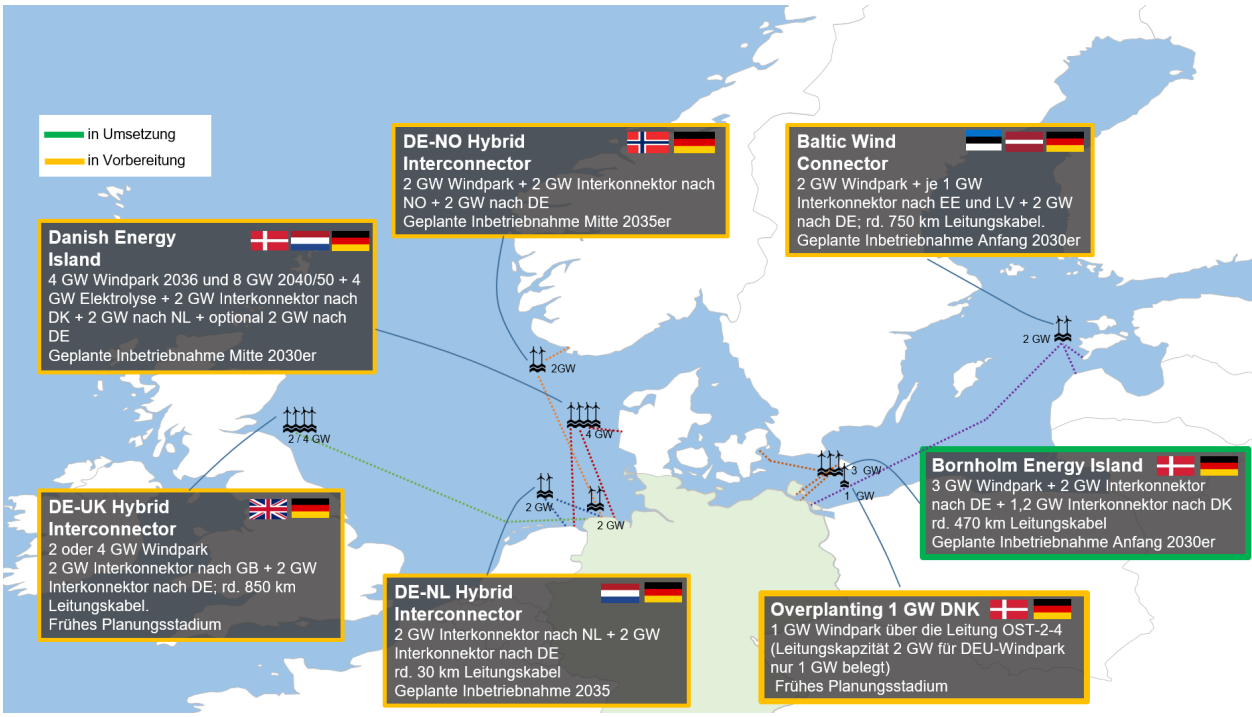
and photovoltaic production. Experience has already been gained in the implementation of such tenders: in 2016, a pilot cooperation with Denmark was carried out with mutually opened tenders for ground-mounted photovoltaic systems. In this open tender, only ground-mounted photovoltaic systems in Denmark were awarded contracts. Additionally, the Federal Government is actively working to attract partners for further cooperation and is currently in talks with Luxembourg and France. Based on the experience gained, the Federal Government is also planning to develop a "showcase concept" to increase the transparency of cross-border tenders for stakeholders in other Member States. The concept is intended to offer governments and companies in other Member States the opportunity to participate in cross-border tenders organised by the Federal Government, while clarifying the tender conditions that would apply in the event of cooperation.

Wind-offshore cooperation

The rapid expansion of renewable energy and cross-border infrastructure is crucial for Europe's energy security and resilience. Hybrid offshore projects can offer an ideal combination of cross-border electricity trading and offshore wind energy generation.

As a future importer of green electricity and hydrogen, Germany plans to work closely with countries bordering the North Sea and Baltic Sea to implement significant capacities in offshore wind cooperation projects. To provide political guidance in this regard, Germany will host the third North Sea Summit with heads of state and energy ministers in June 2025.

The following is a current overview of hybrid offshore projects in Germany that are currently in planning, under discussion, or being implemented.



Baltic Energy Market Interconnection Plan (BEMIP) – Working Group on Renewable Energy

The BEMIP Working Group on Renewable Energy provides a platform for the exchange of experience in expanding renewable energy among the participating Member States, particularly with regard to planning and promoting further expansion of renewable energy. The group also aims to develop a common vision of the European Union's Baltic Sea states for the development of renewable energy, particularly in the field of offshore wind energy, and to identify potential cooperation projects. Additionally,

increased cooperation among the Baltic Sea states in the field of green hydrogen is to be strengthened and prioritised to fully exploit the potential of the Baltic Sea in this area. Germany is actively supporting this and is committed to ensuring that the Baltic Sea states in the European Union exchange the relevant parts of their National Energy and Climate Plans (NECPs) within the framework of the working group. Synergies with the North Sea Energy Cooperation (see below) are to be leveraged in this regard. There is potential for cooperation in the Baltic Sea region, for example, in the joint use of electricity infrastructure in connection with the expansion of offshore wind energy and the development of cross-border hydrogen infrastructures.

North Sea energy co-operation in the field of renewable energy

The key focus areas of this cooperation are collaboration on the expansion of offshore wind energy, the development of grid infrastructure, and cross-border maritime spatial planning in the North Sea. As part of the initiative, the relevant Member States, including the Federal Republic of Germany, have also begun to exchange views on the relevant parts of the NECPs of countries bordering the North Sea. The focus of the North Sea cooperation is on coordinating targets and expansion strategies, including the timing of individual tenders for offshore wind, as well as the exchange of experience in the expansion of offshore wind energy (support systems, spatial and grid planning, etc.). In the context of NECP cooperation, the aim is to create an aggregated expansion plan for offshore wind energy in the North Sea region and establish a highly coordinated and continuous project pipeline. In addition, the relevant Member States, including the Federal Republic of Germany, are working within the framework of the North Sea Energy Cooperation on concepts for possible joint projects for offshore wind energy use, or on hybrid projects, in which the grid connection and interconnection of the wind turbines at sea can also serve as interconnectors and for discharging the electricity generated. The Federal Government is actively involved in the North Sea Energy Cooperation (among other things by co-chairing Working Group 1 on hybrid and joint projects, as well as Working Group 3 on the promotion and financing of offshore wind energy). It sees the North Sea Energy Cooperation as a major opportunity for the further integration of the internal energy market and will continue to push for an intensified exchange of best practices, improved coordination in energy use and grid expansion in the North Sea, as well as the preparation and development of concrete joint projects. Germany has actively contributed to the joint chapter of the North Sea Energy Cooperation.

Technical support in Greece and Cyprus

A strategic partnership between the Federal Republic of Germany and Greece in the field of renewable energy and energy efficiency has been in place since 2013. The Federal Government provides funding for technical support in Greece under the Technical Support Instrument (TSI) and its predecessor, the Structural Reform Support Service (SRSS) of the European Commission, to assist with reforms in the renewable energy and efficiency sectors (TARES-, TARES+ and TARES4 projects, as well as H2Greece). This support is provided through advisory services provided by the Gesellschaft für Internationale Zusammenarbeit (GIZ) on-site in Berlin and Athens. The focus of the consultancy is on supporting reform measures to achieve Greece's national targets by 2020 and on developing a long-term strategy for energy and climate policy up to 2050, particularly in terms of further expanding renewable energy and energy efficiency, as well as implementing the necessary adjustments to the Greek electricity market in response to increasing shares of renewable energy. The projects also facilitate the exchange of experience between the Federal Republic of Germany and Greece in the creation of National Climate and Energy Plans (NECPs). The technical support further includes the development and implementation of concrete renewable pilot projects, for example in public buildings or on a Greek island, while also extending to the implementation of Greece's National Hydrogen Strategy. The aim is to demonstrate the feasibility and cost efficiency of projects with a high proportion of renewables in Greece using concrete examples.

In Cyprus, the Federal Ministry for Economic Affairs and Climate Action has been supporting a TSI project since September 2023, aimed at floating photovoltaics, energy storage, and renewable offshore energy. In line with the goals of Cyprus's NECP, the project supports the increased use of renewable energy and energy storage in Cyprus, with the goal of reducing greenhouse gas emissions in the electricity sector and improving its energy security.

Cross-border district heating projects

The Federal Ministry for Economic Affairs and Climate Action supports the development of cross-border projects aimed at expanding and decarbonising district heating and cooling systems. For example, the heating alliance between Kehl and Strasbourg is supported by the Franco-German Energy Platform. Furthermore, in 2024, an application for funding for the project "Unified Network for Innovative Transition in Energy Decarbonisation of HEATing -

UNITED HEAT" was supported under the Connecting Europa Facility. This cross-border project will link the district heating networks of the cities of Görlitz (Germany) and Zgorzelec (Poland); the German-Polish Energy Platform is supporting the initiative.

Concerted Action on Renewable Energy Sources

The “Concerted Action” forum on Renewable Energy Sources (CA-RES) was established in 2010 with the aim of facilitating an informal exchange of experiences among Member State experts regarding the implementation of the Renewable Energy Directive. From the outset, Germany has played an active role in the forum by taking on the leadership of thematic subgroups. In the current CA-RES phase, which began in 2021, Germany leads "Core Theme 1: Governance, Target Achievement, and Cooperation" and is responsible for preparing and following up on the content of the twice-yearly plenary meetings. In this role, Germany focuses on improving the coordination of national energy policies in the field of renewable energy. For example, at the Plenary Meeting in Lisbon in October 2023, an initiative led by Germany organised a session on the target architecture and implementation of RED III among Member States.

3.1.2. v. Specific measures on financial support, where applicable, including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

Surcharge system under the Renewable Energy Sources Act (EEG 2023)

Citizens and businesses are seeing a reduction in electricity prices due to the EEG surcharge being lowered to zero as of 1 July 2022, and fully abolished as of 1 January 2023. The promotion of renewable energy is now being funded from the special fund "Climate and Transformation Fund" (KTF).

Investments in storage technology

In the coalition agreement for the 19th legislative period, the Federal Government committed to investing in storage technologies and intelligent marketing concepts in order to continue ensuring security of supply across all regions of Germany, while keeping EEG and system costs as low as possible.

KfW Programme for Renewable Energy

The programme provides long-term, low-interest financing for measures aimed at using renewable energy for electricity generation and for electricity and heat generation in combined heat and power plants, as well as for measures to integrate renewable energy into the energy system. Up to 100% of eligible investment costs can be financed, up to a maximum of €50 million per project.

Heating networks

The expansion and conversion of heating networks towards a greenhouse gas-neutral heat supply has been financially supported since September 2022 through the Federal Funding Programme for Efficient Heat Networks (BEW). The programme supports the construction, expansion, and conversion of heating networks to renewable energy and the use of unavoidable waste heat. Connections to a heating network are also eligible for funding under the Federal Funding Programme for Efficient Heat networks (BEW), while connections to smaller heat networks (building networks) with up to 16 connected buildings or 100 residential units are financially supported by the Federal Funding Programme for Energy-efficient Buildings (BEG).

Buildings

Through the Federal Funding Programme for Energy-efficient Buildings (BEG), measures aimed at increasing energy efficiency in residential and non-residential buildings are supported, including the replacement of old, fossil-fuel-based heating systems with heating systems powered by renewable energy. The programme supports complete renovations to achieve the "Efficiency House" standard through low-interest loans from the KfW development bank with repayment subsidies, as well as individual measures, particularly for building envelopes, through grants from BAFA. As of January 2024, grants for renewable heat generators can now be applied for through KfW. There are special funding incentives (bonuses) for the refurbishment of buildings with poor energy performance, the implementation of serial renovations, and heat pumps that are particularly efficient or use natural refrigerants. (see 3.2.ii)

Surcharge system under the Combined Heat and Power Act (KWKG)

By introducing instruments for switching fuel from coal to gas and for the increased use of renewable energy, such as in heat generation, the 2020 amendment to the KWKG Act established

decarbonisation and flexibility as essential guiding principles for further developing combined heat and power (CHP). A central goal was to support the phasing out of coal-based power in Germany. The reduction in eligible full-load hours, which began in 2020, was continued with the "Immediate Climate Action Programme" from spring 2022. This gives CHP plants a greater incentive to operate in a way that is responsive to the electricity market. At the same time, the use of innovative renewable heat is promoted to support the decarbonisation of heating and cooling networks connected to the CHP plants. In addition, as part of a major shift in 2022, the requirement for hydrogen compatibility was introduced. As a result, new CHP plants with an electrical capacity of more than 10 megawatts must be planned and built in such a way that they can later be retrofitted for hydrogen operation with minimal additional costs. This measure helps avoid lock-in effects that would otherwise restrict power plants to fossil fuel use.

Promotion of green hydrogen production (offshore electrolysis)

In addition to offshore electricity production, offshore electrolysis is crucial for the decarbonisation of industry. The Federal Government is pushing ahead with offshore electrolysis and aims to financially support technologies for the production of green hydrogen at sea. For this reason, the Ordinance for the Awarding of Other Energy Generation Sectors (SoEnergieV) is currently being revised to incorporate the possibility of financial support.

Transport

As part of the National Innovation Programme for Hydrogen and Fuel Cell Technology, the Federal Ministry for Digital and Transport supports research and development for all transport applications, as well as the procurement of vehicles, necessary refuelling infrastructure, and electrolysis systems for hydrogen production for use in mobility. The second phase of the NIP (2016–2026) increasingly focuses on scaling hydrogen and fuel cell technologies, optimising the technology, and addressing remaining market gaps. Since 2016, more than €1 billion have already been made available for this purpose.

The promotion of a public refuelling infrastructure is a key focus of the NIP. A separate budget item is provided within the Climate and Transformation Fund (KTF) for the development of refuelling and charging infrastructure. Thanks in part to funding from the Federal Ministry for Digital and Transport via the NIP, Germany has been

able to build one of the most advanced networks in Europe, with almost 90 hydrogen refuelling stations for cars, light commercial vehicles, and waste collection vehicles; 35 of these can also be used for heavy trucks and buses (as of June 2024). The Federal Ministry for Digital and Transport is now focusing its support primarily on expanding a publicly accessible refuelling network for heavy goods vehicles (trucks and buses, may also be used by cars) in line with Regulation (EU) 2023/1804 on the deployment of Alternative Fuels Infrastructure (AFIR), i.e. along the TEN-T road core network and in the 78 urban nodes defined by the TEN-T Regulation.

The “HyLand – Hydrogen Regions in Germany” programme adopts a comprehensive approach under the NIP (National Innovation Programme for Hydrogen and Fuel Cell Technology) to promote the regional implementation of hydrogen applications in transport. The first use cases, in addition to vehicle applications, also include the necessary refuelling infrastructure and, where applicable, hydrogen production. Regions are supported through a three-stage approach in developing integrated regional hydrogen concepts: from networking and conceptualisation to concrete implementation.

Through the "Guideline for the Promotion of Alternative Drives in Rail Transport," the Federal Ministry for Digital and Transport is supporting the conversion of rail vehicles to alternative drives and the development of the necessary infrastructure. The funding is technology-neutral, ensuring that the appropriate technological options are available for each application scenario. The focus is on battery-electric and fuel cell-based trains. The guideline thus helps to close gaps in the rail network where overhead lines are lacking and contributes to achieving climate targets in the rail transport sector. This guideline was in effect for three calls for funding, which ran until 31 December 2023.

The Federal Ministry for Digital and Transport supports the establishment of a decentralised hydrogen innovation and technology centre with locations in Duisburg, Chemnitz, Pfeffenhausen, and Northern Germany (Northern German cluster comprising Bremen/Bremerhaven, Hamburg, and Stade). The approvals are targeted for 2024. The Federal Ministry for Digital and Transport is providing initial funding of up to €290 million for the ITZ. As part of the hydrogen IPCEI (Important Project of Common European Interest), the Federal Ministry for Digital and Transport is taking the lead on transport-related projects, including two in the technology wave (IPCEI Hy2Tech, approved by the European Commission in July 2022). Four transport-related

projects are part of the mobility wave (IPCEI Hy2Move, pre-notified to the European Commission since November 2022), which is coordinated by the Federal Ministry for Digital and Transport for the eight participating EU Member States. The goal is to establish a hydrogen market as comprehensively as possible along the value chain through cross-border projects between EU partners. These initiatives also play a key role in the implementation of the National Hydrogen Strategy, among other related goals.

3.1.2.iv. Where applicable, the assessment of the support for electricity from renewable sources that Member States are to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001

3.1.2.v. Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of PPAs
Summary of the policies and measures under the enabling framework that Member States have to put in place, pursuant to Article 21(6) and Article 22(5) of Directive (EU) 2018/2001 to promote and facilitate the development of self-consumption of energy from renewable sources and renewable energy communities

Central contact points

Federal Network Agency

Handles, among other things, notifications from power generation plants, grid development, and the execution of tenders under the Renewable Energy Act.

Federal Maritime and Hydrographic Agency

Responsible for spatial planning and preliminary site investigations as well as approvals for offshore wind energy installations.

NOW GmbH (National Organisation Hydrogen)

Founded in 2008 as the programme company of the Federal Ministry for Digital and Transport, NOW GmbH is tasked, on behalf of the Federal Government, with the design, coordination, and implementation of national strategies and public programmes in the field of sustainable drive systems. This includes, in particular, the promotion of electric mobility with fuel cells and batteries, as well as electricity-based fuels (e-fuels), and the introduction and

market ramp-up of fuel cell technology in transport and stationary applications.

In this role, NOW GmbH is responsible, among other things, for the implementation of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP), the funding guideline for electric mobility, the Master Plan for Charging Infrastructure II, and the technology-neutral funding programmes for the procurement of buses, commercial vehicles, and rail vehicles with alternative drives.

Public dialogue on grids

The public dialogue on grids initiative (*Bürgerdialog Stromnetz)* serves as an open and transparent platform for all stakeholders on issues surrounding power grid expansion in Germany. It provides essential information and answers questions about grid development. The initiative was discontinued on 31 December 2023. However, information and participation opportunities will continue to be ensured through formal and informal channels offered by project developers and the Federal Network Agency.

Competence Centre for Municipal Heat Transition (KWW)

The Competence Centre for Municipal Heat Transition, launched in April 2022, focuses on providing reliable, quality-assured information on heat planning, as well as practical expertise and advisory materials for stakeholders in Germany involved in the heat transition. The centre serves as a platform for exchanging knowledge and as a coordinator for a network on heat planning, helping to organise and formalise practical knowledge and best practices, while also contributing to the development of solutions. It promotes the implementation of comprehensive heat planning as a central coordination instrument for local, efficient heat supply based on renewable energy and unavoidable waste heat.

Regulatory framework for the development of renewable energy communities

Renewable energy communities have the capacity to play an important role in the successful expansion of energy from renewable sources at national and European level. In Germany, the regulatory framework for renewable energy communities focuses on key aspects such as: Ensuring that end consumers have non-discriminatory access to renewable energy communities, while

guaranteeing that those communities have equal access to existing support schemes.

In addition, citizen energy companies operating onshore wind power plants with an installed capacity of up to 18 megawatts and/or solar power plants of the first segment with an installed capacity of up to 6 megawatts do not need to participate in the EEG tenders to receive EEG funding. Moreover, these plants benefit from uniform pricing: the remuneration for onshore wind power plants is determined based on the average of the bid values of the highest awarded bid from the previous year's auction rounds. For solar power plants, the remuneration is similarly based on the average of the highest awarded bid values from the previous year prior to commissioning.

3.1.2. iv. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

The conversion of the heat supply to greenhouse gas-neutral energies must be implemented locally, taking local conditions into account. To this end, the Federal Act on Heat Planning and the Decarbonisation of Heating Networks (Heat Planning Act) introduced heat planning as a key strategic instrument for the heat transition. The heating plans should outline the development of a greenhouse gas-neutral heat supply by 2045 and identify sub-areas that are suitable, for example, for a grid-bound or decentralised heat supply.

An analysis of various scenarios for achieving climate neutrality in Germany indicates that a significant expansion of heating network connections is necessary to meet the climate targets in the heat supply sector. In June 2023, representatives of the heat sector declared, in a joint statement, the goal of connecting at least 100,000 new buildings annually to heat networks in the medium term.

In addition, the gradual obligation from the Building Energy Act to use renewable energy sources when replacing heating systems can be met by connecting to a heat network by 2028. This is intended to increase the demand for heating network connections and incentivise the construction, expansion, and densification of heat networks At the same time, a review is currently being conducted on how the regulations of section 556c of the German Civil Code (BGB) in connection with the Heat Supply Ordinance can be designed in a forward-looking manner.

3.1.2.vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account: biomass availability, including sustainable biomass: both domestic potential and imports from third countries; other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

In accordance with Article 29, (7) point b of Directive (EU) 2023/2413 (RED III), Member States are to submit, as part of their final updated integrated national energy and climate plans, an assessment of the domestic supply of forest biomass available for energy purposes for the period 2021-2030, in accordance with the criteria laid out in this article.

Forest biomass available for energy purposes is defined as wood which is harvested directly for energy use, including roundwood and forestry residues. It does not include wood residues from the wood-processing industry, wood harvested for the production of wood pellets and briquettes primarily used as industrial wood, as well as harvested wood for the production of firewood, which is available in traceable quantities, old wood, and wood from areas outside of forests.

For 2021, it was estimated as part of the harvest recalculation for 2024 that approximately 22.7 million cubic metres of domestic forest biomass were used for energy purposes. 2021 was a year strongly affected by calamities (see 2021 Timber Market Report, BMEL), resulting in a significantly larger amount of wood available for use than in previous years.

Alongside periods of drought, this is one of the reasons why estimates of the amount of forest biomass available for energy purposes in the future are associated with great uncertainty. The extent can only be reassessed at the end of 2024 based on the results of the 2022 National Forest Inventory in future scenarios (or projection reports).

As the use of forest biomass is increasingly prioritised for material purposes, such as replacing fossil-based raw materials, and with the focus on cascading use, the amount of forest biomass available for energy use is expected to gradually decrease.

The forest biomass quantity determined for 2021 is in line with the requirements of Article 4 of Regulation (EU) 2018/841, as current

policies have been considered, aiming at compliance with the conditions mentioned in Article 4.

“Renewable resources" funding programme

The aim of this programme is to promote research, development, and demonstration projects for the use of renewable resources for energy production. Alongside research and development projects, the emphasis is particularly on optimising processes and procedures through practical demonstrations and pilot-phase projects.

3.1.3. Other elements of the dimension

3.1.3.i. Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

Transposition of the EU Directive 2003/87 into national law through the Greenhouse Gas Emissions Trading Act (TEHG)

The reform of the EU ETS at the European level is currently being implemented into national law as part of an amendment to the Greenhouse Gas Emissions Trading Act (TEHG).

National strategies and measures aimed at achieving the goals of the 2050 Climate Protection Plan in the sectors of the European Emissions Trading System (ETS) effectively reduce carbon emissions across the European Union, provided that unused emissions allowances do not lead to emissions in other Member States (the “waterbed effect”). The extent to which such a waterbed effect exists depends, among other things, on the effect of the Market Stability Reserve (MSR) in the ETS.

Decommissioning of power generation capacities

In the event of decommissioning of electricity generation capacity due to additional national measures, Article 12(4) sentence 2 of the ETS Directive gives Member States the option of cancelling allowances from national auction volumes. With the draft bill to amend the Greenhouse Gas Emissions Trading Act, the Federal Government is proposing to transpose this option into national law in accordance with the provisions of Article 12(4) of the ETS Directive and to placing the decision on this within the discretion of the Federal Government. This discretionary decision must also take

into account the reduction in surpluses that has already been addressed by the MSR, which has been operational since 2019. The cancellation requires a decision by the Federal Government. In deciding on the cancellation of allowances, the Federal Government must take account of the relevant budgetary framework conditions.

3.1.3.ii. Policies and measures to fulfil any other national requirements, where applicable

Climate-neutral federal administration

Under the Federal Climate Change Act (KSG), the federal administration is expected to take on a particular role model function on the pathway towards a greenhouse gas-neutral Germany. As stated in section 15 (1) of the KSG, the Federal Government has set the goal of achieving a climate-neutral federal administration by 2030 The Federal Government has already adopted measures to implement this goal in the Climate Action Programme 2030, the Climate Action Programme 2023 and the Sustainability Action Programme - Further Development 2021. The implementation status of the measures contained in the Sustainability Action Programme is recorded in an annual monitoring report.

In order to achieve climate neutrality by 2030, each authority and institution of the federal administration undertakes its own efforts to reduce greenhouse gas emissions. To coordinate and support the activities and measures of the federal administration, the Coordination Office for Climate-Neutral Federal Administration (KKB) was established. The KKB also develops proposals for measures with guidelines for achieving a climate-neutral organisation of the federal administration. Furthermore, it prepares an initial climate balance sheet to determine the greenhouse gas emissions of the core federal administration, based on data from 2022, which will then be updated annually.

The climate-neutral organisation of the Federal Administration is to be achieved in particular by saving energy, through the efficient provision, conversion, use and storage of energy, as well as through the efficient use of renewable energy and the selection of the most climate-friendly transportation possible. Special attention must be paid to the efficient use of natural resources (section 15 (2) KSG).

The measures adopted so far in the Climate Action Programme 2030 and in the Sustainability Action Programme - Further Development 2021 concern various fields of action and include,

among others, the introduction of environmental management systems in the federal administration, exceeding the current legal energy efficiency requirements for new construction and renovation projects of federal buildings (see cabinet resolution of 25 August 2021 on energy efficiency standards for federal buildings “Exemplary role of federal buildings for energy efficiency"), the electrification of the federal administration's vehicle fleet, and the reduction of emissions from business trips.

Digital ecosystems for climate-friendly industry

The digital transformation of supply chains across all sectors and the development of digital ecosystems is enabling new Industry 4.0 applications and business models. These multilateral and reliable data ecosystems are intended to enable the scalable, automated and broad-based application of data-based solutions to achieve potential energy and resource savings, even across company lines. One of the goals of the programme is to enable companies to use data-based solutions to map and manage their CO_2 footprint in a transparent way along entire supply chains, as well as supporting a closed-loop circular economy.

National Hydrogen Strategy (NWS)

Accelerated hydrogen market ramp-up: The market ramp-up of hydrogen, its derivatives, and hydrogen application technologies is being significantly accelerated, with a substantial increase in the level of ambition across the entire value chain.

Ensuring sufficient availability of hydrogen and its derivatives: The domestic electrolysis capacity target for 2030 will be increased from 5 GW to at least 10 GW. The remaining demand will be met through imports. The Federal Government aims to achieve a reliable supply of green, sustainable hydrogen in the long term. In order to ensure rapid establishment and expansion of the hydrogen market and to meet the expected demand, especially during the transformation phase, and thus enable the technological shift to hydrogen, other colours of hydrogen will also be used, at least until sufficient green hydrogen is available. These include, in particular low-carbon hydrogen from waste or natural gas in combination with CCS. A dedicated import strategy for hydrogen and its derivatives has been developed.

Development of an efficient hydrogen infrastructure: A key priority is establishing the necessary hydrogen transport network infrastructure. The Federal Government aims to rapidly and cost-

effectively build this transport network, ensuring it is integrated with the hydrogen market and aligned with the EU internal market. The development will proceed in two stages. The first stage will establish a nationwide and expandable core hydrogen network, connecting key hydrogen sites (both consumption and production) for interregional transport. This network is expected to be operational by 2032. The second stage involves scheduled and integrated network development planning for gas and hydrogen. This will focus on further expanding the core hydrogen network through scenario- and demand-based planning, conducted every two years, in order to establish and expand a meshed hydrogen transport network that meets evolving needs.

The legal framework for planning the first stage (core network) is outlined in the Act Amending Energy Industry Law (EnWG) to comply with EU requirements and amend further energy-related regulations. This act came into force on 29 December 2023. With the Second Act Amending the EnWG, which entered into force on 17 May 2024, the legal foundations were established for the integrated network development plan (NEP) for gas and hydrogen (second stage of hydrogen transport network development), as well as for financing the hydrogen core network.

On 22 July 2024, the transmission system operators (TSOs) submitted their application for the hydrogen core network to the Federal Network Agency. According to this, a core network of approximately 9,700 km is planned to be established by 2032, connecting ports, industry, storage facilities, and power plants. Around 60% of the existing natural gas pipelines are to be repurposed, while new construction will be required for the remaining portion. Following review and follow-up consultation, the Federal Network Agency is responsible for approving this core network.

It is expected that hydrogen may be used in various sectors. Hydrogen and its derivatives will be applied particularly in industrial processes, heavy-duty vehicles, and increasingly in air and maritime transport. In the electricity sector, hydrogen contributes to energy security through gas power plants that are convertible (H2-ready) to greenhouse gas-neutral gases and through system-supporting electrolysers, especially for use as variable and system-supporting stabilisers and flexible loads.. The frameworks established in the Buildings Energy Act (GEG), in heating planning and in the European gas market have been further developed to take account of the long-term use of hydrogen in the centralised and decentralised supply of heat.

By 2030, Germany will become a leading provider of hydrogen technologies: German suppliers are advancing their technological leadership and offering the entire value chain of hydrogen technologies, from production (e.g. electrolysers) to various applications (e.g. fuel cell technology).

Creation of suitable framework conditions: Coherent legal requirements at national, European and preferably international levels support the market ramp-up. This includes, in particular, efficient planning and approval procedures, uniform standards and certification systems, adequately resourced and coordinated administration at all levels.

Hydrogen import strategy: Furthermore, since the beginning of the legislative period, the Federal Government has been working intensively to secure the availability of hydrogen through imports from partner countries, in addition to ramping up domestic production. To this end, it is supporting and supervising privately operated cross-border hydrogen pipeline projects for importing gaseous hydrogen via various import corridors within Europe and neighbouring countries. These pipeline projects connect to the core network through border crossing points (GÜP) and interconnectors, and are prioritised by the European Commission and Member States under IPCEI (Important Project of Common European Interest) and PCI (Project of Common Interest) status. They are linked to non-European hydrogen production and value chains. In parallel, an import strategy for hydrogen and its derivatives has been developed. This strategy also takes into account sustainability criteria in line with global sustainable development goals. The import strategy sends a signal to partner countries that Germany is committed to global cooperation, that it is enabling reliable supply chains to Germany, establishing ecological standards, and positioning itself as a technology partner. These actions are intended to make a joint contribution to global decarbonisation efforts. The Federal Government has already reached agreements with Norway, among others, regarding the long-term supply of hydrogen.

Hydrogen storage strategy

The Federal Ministry for Economic Affairs and Climate Action is working on a hydrogen storage strategy. In September 2023, a green paper (discussion paper) on hydrogen storage was discussed with industry stakeholders. Initial feedback from the industry on the green paper will need to be substantiated more clearly. An expert report will be commissioned before the storage strategy is

developed to address various open questions, with the aim of finalising the strategy within this year. The report is expected to address: (1) demand assessment for storage facilities for hydrogen and hydrogen derivatives, (2) transformation strategy from natural gas to hydrogen storage, (3) development of an operator model and financing concept for storage facilities for hydrogen and hydrogen derivatives and (4) support for other issues relating to the development and financing of storage facilities for hydrogen and hydrogen derivatives. At the same time, legal adjustments are being reviewed in relation to various relevant laws to accelerate the development of hydrogen storage facilities.

Sector coupling

The direct use of electricity generated from renewable energy sources allows the potential for energy efficiency to be harnessed and reliance on fossil fuels to be reduced. Even in applications where other options for reducing greenhouse gas emissions are difficult to implement through the direct use of electricity - such as in aviation, maritime, inland shipping, or certain industrial processes - electricity-based technologies powered by renewable energy are an important option for achieving energy and climate targets. Sector coupling is the focus of a wide range of funding measures, projects and programmes. Detailed descriptions of these measures can be found in the corresponding chapters, such as heating network systems in Chapter 3.1.2.iv, low-emission mobility in Chapter 3.1.3, federal funding for efficient buildings in Chapter 3.2.iii, market integration in Chapter 3.4.3.i, real-world laboratories and SINTEG in Chapter 3.5.1.

Heat Planning Act

The Federal Act on Heat Planning and the Decarbonisation of Heating Networks (Heat Planning Act) introduced heat planning as a key strategic instrument for the heat transition. The act ensures that municipalities with more than 100,000 inhabitants will develop comprehensive heat plans, with the participation of all relevant local stakeholders, by 30 June 2026. Municipalities with up to 100,000 inhabitants must complete these plans by 30 June 2028. The heating plans should outline the development of a greenhouse gas-neutral heat supply by 2045 and identify sub-areas that are suitable, for example, for a grid-bound or decentralised heat supply. Sub-areas with high energy-saving potential will also be identified.

Heat planning supports building owners, energy service providers, and energy supply companies in making investment decisions to

decarbonise the heat supply. It also provides a framework for coordinated development of local energy infrastructure through public participation.

Furthermore, the law contains binding requirements for the ramp-up of renewable energy and use of unavoidable waste heat in heating networks, leading up to full decarbonisation by 2045.

3.1.3.iv. Policies and measures to achieve low emission mobility (including electrification of transport)

The Federal Government wants to make mobility as safe, affordable and climate-friendly as possible. The most important pillars of climate-neutral mobility are the expansion of electric vehicles based on renewable electricity, as well as the use of CO2-free or CO2-neutral fuels.

Putting CO_2-neutral cars on the road

At least 15 million fully electric vehicles are expected to be registered in Germany by 2030. In addition to fleet regulations, further measures are necessary to significantly increase the share of electric vehicles among new registrations and to significantly reduce the carbon emissions of passenger car traffic. These measures should greatly reduce the cost differential between electric cars and cars with internal combustion engines while making the charging and refuelling infrastructure more attractive from a customer perspective. In this way, such measures will stimulate both the supply of and demand for electric drives. With the law on the fiscal promotion of electric mobility, the company car regulation for the use of battery electric vehicles or plug-in hybrid vehicles has been extended until 2030, among other measures. The private use of purely electric vehicles with a gross list price of up to €70,000 will no longer be assessed at half the taxable base, but at a quarter of the taxable base. In addition, the tax exemption for first-time registrations under section 3d of the German Motor Vehicle Tax Act has been extended until 31 December 2025. The maximum 10-year period for tax exemption will be limited to 31 December 2030. The Federal Government has also aligned vehicle tax more closely with carbon emissions. For new registrations as of 1 January 2021, the taxable base is tied, among other factors, to CO2 test values per kilometre and progressively increased for vehicles emitting more than 95 g CO2/km. The Federal Government has also campaigned at European level for the CO_2 fleet limits for new passenger cars and new light commercial vehicles to allow new registrations of internal

combustion engine vehicles beyond 2035, provided they are powered exclusively by CO_2-neutral fuels. The detailed framework of this regulation is being finalised at European level.

Expanding refuelling and charging infrastructure ("Passenger cars" action field)

The development of a nationwide, demand-oriented, and user-friendly charging infrastructure is essential for increasing public acceptance and supporting the growth of electric mobility. The Federal Government aims to further expand the publicly accessible charging infrastructure, with a target of providing a total of 1 million publicly accessible charging points in Germany by 2030.

After the first Charging Infrastructure Master Plan was adopted by the Cabinet in 2019, the Federal Government followed up on 19 October 2022 with the Charging Infrastructure Master Plan II. As an overall strategy, it outlines the Federal Government's goals and measures for further expanding charging infrastructure. The measures focus on ensuring land availability, empowering local authorities, and integrating charging infrastructure with grid and electricity expansion. To coordinate the ramp-up of public charging infrastructure at all levels (federal, state and local), the "National Charging Infrastructure Coordination Office" was established in 2019.

Through tenders for the "*Deutschlandnetz*," the Federal Government is ensuring the construction of fast-charging infrastructure at approximately 1,000 new locations across Germany. The Federal Ministry for Digital and Transport is overseeing contract awards for "regional lots" for 900 locations in rural and urban areas. Autobahn GmbH is responsible for awarding contracts for "autobahn lots" at 200 locations in non-staffed service areas along the Autobahn.

As a further measure, in May 2024 the Federal Government approved a refuelling station supply obligation in the cabinet. The aim is to equip a significant proportion of public refuelling stations with fast-charging infrastructure to accelerate the nationwide expansion of the charging infrastructure and build trust in electric mobility.

Funding is a central pillar in supporting the development of charging infrastructure. A wide range of use cases is covered with the funding guidelines:

- "Charging infrastructure at residential buildings" (published on 24 November 2020),
- “On-site charging infrastructure" (published on 24 March 2021)
- "Publicly accessible charging infrastructure for electric vehicles" (published on 21 July 2021),
- "Charging infrastructure for electric vehicles - companies and municipalities" (published on 17 November 2021),
- "Solar power for electric vehicles" (published on 4 September 2023)

along with the funding call for the construction of commercial fast-charging infrastructure for cars and trucks based on the Electric Mobility Funding Guideline (published on 18 September 2023).

Promoting a public refuelling infrastructure is a key focus of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP) Thanks in part to funding provided by the Federal Ministry for Digital and Transport under the NIP, Germany has developed one of the most advanced networks in Europe, with almost 90 hydrogen refuelling stations for cars and light commercial vehicles in particular. The pressure level of these stations, mainly at 700 bar, meets the requirement of the EU regulation for the development of infrastructure for alternative fuels (AFIR), and 35 of these stations also provide an additional 350 bar for heavy commercial vehicles (trucks and buses) (as of June 2024). The BMDV is now focussing on the expansion of a publicly accessible refuelling network for heavy goods vehicles (trucks and buses) and is evaluating, based on the availability of budget funds, how further support can be provided. The main focus is on the development of a basic network of publicly accessible hydrogen refuelling stations for heavy goods vehicles (trucks and buses) in accordance with Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR), which can also be used by light commercial vehicles and passenger cars.

With the exception of funding for non-publicly accessible fast-charging infrastructure for SMEs and large companies, no other support schemes are currently (18 June 2024) open for applications.

Putting low-carbon trucks on the road ("Commercial vehicles" action field)

The Federal Government is funding the development of necessary charging and hydrogen infrastructure. The goal is for electric vehicles to account for approximately one-third of the mileage in

heavy road freight transport by 2030. A CO_2 surcharge has been levied on the truck toll since 1 December 2023. Emission-free vehicles are exempt from the toll until 31 December 2025 and will benefit from significantly reduced toll rates starting in 2026. Emission-free vehicles with a technically permissible gross vehicle weight of up to 4.25 tonnes are permanently exempt from tolls in line with the Eurovignette Directive. At European level, the CO_2 fleet regulation for commercial vehicles has already played a role as an important regulatory instrument since 2019. With the amendment of the regulation for CO_2 fleet limits for new heavy goods vehicles, electrification of the fleet as a climate-neutral drive option in the commercial vehicle sector is becoming increasingly important. The entry into force of the regulation in early June 2024 increased the CO2 reduction target for 2030 by 45% compared to 2019. It also introduced new targets of 65% and 90% CO2 reduction for 2035 and 2040 respectively for newly registered heavy goods vehicles. The ramp-up of climate-friendly vehicles must be supported by accompanying measures, in particular the development of charging and hydrogen refuelling infrastructure. Additional measures target the higher costs associated with commercial vehicles with alternative drive systems. The development of market-ready commercial vehicles with hydrogen fuel cells, for example, will continue to be promoted across all segments as part of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP), with the goal of ensuring that vehicles with this technology will be available by the mid-2020s at the latest.

Developing refuelling and charging infrastructure ("Commercial vehicles" action field)

The development of a refuelling and charging infrastructure for alternative drives must be geared towards transport and logistics applications. This means adopting a systematic approach that considers everything from the use of renewable energy to customer needs, with the goal of enabling emission-free logistics. In 2024, a tender will be published for an initial charging network along the motorways and major roads. In line with the National Hydrogen Strategy, updated in 2023, a master plan for hydrogen and fuel cell technology in transport will also be developed. This plan will focus, among other things, on scaling the necessary infrastructure in a targeted manner. Additionally, in the context of implementing the EU regulation on the development of alternative fuel infrastructure (AFIR), the National Strategic Framework for hydrogen refuelling is to outline indicative expansion targets for 2027 and the achievement of EU objectives for 2030. For truck charging

infrastructure, targets for 2025, 2027, and 2030 must also be defined.

Support for the climate-friendly conversion of ground power systems at airports

Aircraft also need electricity while they are being serviced, loaded, and refuelled on the ground. This electricity often comes from auxiliary power units in the aircraft or is generated by diesel-powered generators at remote sites. By using direct electricity, batteries or hydrogen, aircraft can be supplied with electricity in a way that is more efficient, emission-free, and much quieter than before. At EU level, the AFIR (Alternative Fuel Infrastructure Regulation), published in the Official Journal of the European Union on 22 September 2023, stipulates that Member States must ensure that by 31 December 2029, stationary aircraft at all airports in the TEN-T core and TEN-T comprehensive networks are provided with power, at all positions used for commercial air traffic, for passenger boarding or disembarking, loading or unloading of goods. To support airports in this task, the Federal Government has launched a funding programme to provide investment grants for the procurement of mobile and stationary, environmentally friendly ground power systems for supplying aircraft and the charging or refuelling infrastructure needed for their operation. These grants will be available until the end of 2026.

Increasing the share of electrically powered vehicles in the federal administration vehicle fleet

The procurement of vehicles for the federal administration is subject to the regulations of the Clean Vehicles Procurement Act (*SaubFahrzeugBeschG*), which came into force in 2021, as well as the Administrative Regulation on Clean Vehicles (*AVV Saubere Fahrzeuge*). The SaubFahrzeugBeschG and the AVV Saubere Fahrzeuge established statutory minimum targets for the public procurement of low- and zero-emission vehicles, which must also be explicitly adhered to by the federal administration.

Automating, networking and optimising traffic flow, enabling innovative forms of mobility

Digitalisation can significantly improve existing traffic routines, such as traffic flow and parking management, through automation, connectivity, and artificial intelligence. Digitalisation can also create entirely new possibilities: for example, enabling digital services with user-friendly, app-based interfaces that simplify

shared transport options for cars as well as bicycles, electric scooters, and e-scooters, while also allowing integration with public transportation services. Additionally, digital networking facilitates carpooling and offers the ability to choose the vehicle size best suited for an individual trip. The Federal Government will not only continue but intensify the practical testing of automation, connectivity, and the use of artificial intelligence for mobility on digital test fields and demonstration projects, as well as support their transition to regular operations. Experimentation clauses are helping to create a more favourable environment for these innovations. The goal of the Federal Government's Gigabit Strategy is to ensure nationwide, energy- and resource-efficient access to fibre-optic connections to homes and the latest mobile communication standards, available everywhere people live, work, and travel – including in rural areas. Considering the emerging trends in digital mobility applications, there is a growing need to treat computing infrastructure as a key component of digital networks for the Gigabit Society. In addition, digital working models (e.g. increased use of home offices and video conferencing) are helping to reduce the need for travel.

Tax incentives for electric mobility (Act on the Further Fiscal Promotion of Electricmobility and on the Amendment of Further Fiscal Regulations)

Company car taxation - extension of the current special provision for electric vehicles:

If a company car is also used privately, this benefit is generally taxed at 1% of the domestic list price (list price method). In 2018, the taxable base for electric and externally rechargeable hybrid electric vehicles was halved. In order to create a long-term, legally secure planning framework for the market ramp-up of electric mobility, this special provision was extended until 31 December 2030 (section 6 (1) no. 4 sentence 2 nos. 3 and 4 and sentence 3 nos. 3 and 4 EStG). To ensure appropriate consideration of the Federal Government's environmental policy goals in the long term, the technical requirements of the special provision were raised in two stages: From 1 January 2022 to 31 December 2024, a minimum range (using only the electric drive unit) of 60 km applies. From 1 January 2025 to 31 December 2030, a minimum range (using only the electric drive unit) of 80 km applies. The maximum CO_2 emissions of 50g/km remain unchanged for the entire period. When using vehicles that have no CO_2 emissions/km and whose gross list price does not exceed €70,000, only a quarter of the taxable base is taken into account.

Relief on trade tax for the rental and leasing of electric vehicles:

According to section 8 no. 1 letter d sentence 1 of the German Trade Tax Act (*Gewerbesteuergesetz*, *GewStG*), rental and leasing expenses for movable assets of the company are added back to the profit for trade tax purposes. This add-back amounts to 5% of the expenses. However, rental and leasing expenses for electric vehicles and externally rechargeable hybrid electric vehicles that meet specific pollutant emission or range criteria, as well as for rented bicycles that are not motor vehicles, are added back at only 2.5% if they are based on contracts concluded after 31 December 2019 (section 8 no. 1 letter d sentence 2 *GewStG*). The measure is limited until 2030.

Extension of the tax exemption for charging current and the flat-rate taxation for the transfer of ownership of a charging device:

Benefits provided by the employer for the charging of an electric vehicle or hybrid electric vehicle at the employer's premises, or an affiliated company, and for the temporary private use of a company charging device are tax-exempt under section 3 No. 46 of the German Income Tax Act (EStG). The tax exemption was initially limited until 31 December 2020. The employer also has the option to apply a flat-rate wage tax of 25% for the aforementioned non-cash benefits (section 40 (2) sentence 1 no. 6 EStG). This flat-rate taxation was also limited until 31 December 2020. To further promote electric mobility, both measures have been extended until 31 December 2030.

Tax-exempt "Jobticket" commuter pass and introduction of flat-rate taxation for commuter passes:

According to section 3 No. 15 of the German Income Tax Act (EStG), employer-provided benefits, apart from salary, for employee transportation expenses incurred by commuting with public transportation in scheduled services between home and the primary place of employment have been tax-free since 2019 (e.g. "Jobticket" commuter passes). The tax-free benefits must be offset against the distance allowance; the deduction for work-related expenses is accordingly reduced. This regulation is valid indefinitely. By introducing a new option for flat-rate taxation at 25%, while allowing employees to keep the full distance allowance deduction for their commuting expenses, the goal is to increase the

acceptance of “Jobtickets” among employees who might otherwise not be able to use public transportation or could only use it to a

limited extent (section 40 (2) sentences 2 to 4 EStG). This also applies to the compensation mentioned in section 3 no. 15 EStG, which is not provided in addition to the salary owed (but rather through renumeration conversion) and therefore does not meet the requirements for tax exemption. This regulation is valid indefinitely.

Extension of the tax exemption for the provision of a company bicycle or electric bicycle to the employee:

If the employer provides the employee with a company bicycle either free of charge or at a reduced price, the monetary benefit from private use has been tax-free since 2019 (section 3 no. 37 EStG). The condition is that the bicycle must be provided in addition to the salary owed. This is intended to reward employers for providing a genuine additional benefit, rather than lowering the employee's gross salary instead. The tax-free monetary benefit does not need to be offset against the distance allowance; the deduction for work-related expenses remains unchanged. The measure, originally limited to 31 December 2021, has been extended to 31 December 2030.

Extension of the tax exemption for the private use of a company bicycle or electric bicycle:

If the business owner uses a company bicycle for private purposes, this is not considered in profit determination (section 6 (1) no. 4 sentence 6 EStG). The benefit does not need to be taxed. The measure, originally limited to 31 December 2021, has been extended to 31 December 2030.

Industrial production for mobile and stationary energy storage ("battery cell production")

The demand for mobile and stationary energy storage systems is growing internationally at a rapid pace. It is the goal of the Federal Government to tap into the major value-creation potential of this key technology in both Germany and Europe. To this end, the Federal Ministry for Economic Affairs and Climate Action has been supporting the establishment of efficient battery cell production in Germany since 2020 as part of two IPCEI (Important Projects of Common European Interest). For these two IPCEIs, around €1.5

billion will be provided by 2030 under KTF Title 893 04 "Industrial production for mobile and stationary energy storage".

National Strategic Framework for the Development of Alternative Fuels Infrastructure (NSR)

The strategic framework includes the charging infrastructure for electric vehicles, the infrastructure for natural gas supply (compressed and liquefied natural gas), and the infrastructure for hydrogen supply for fuel cell vehicles. In implementing Directive 2014/94/EU, the NSR sets targets for publicly accessible refuelling and charging infrastructure and supports these with corresponding measures. A new NSR is being prepared to implement Regulation (EU) 2023/1804, which repealed Directive 2014/94/EU in April 2024.

National Innovation Program for Hydrogen and Fuel Cell Technology (NIP 2)

As part of the National Innovation Programme for Hydrogen and Fuel Cell Technology, the Federal Ministry for Digital and Transport supports research and development for all transport applications, as well as the procurement of vehicles, necessary refuelling infrastructure, and electrolysis systems for hydrogen production for use in mobility. The second phase of the NIP (2016–2026) increasingly focuses on scaling hydrogen and fuel cell technologies, optimising the technology, and addressing remaining market gaps. Over €1 billion have already been provided since 2016 for this purpose.

The “HyLand – Hydrogen Regions in Germany” programme adopts a comprehensive approach under the NIP (National Innovation Programme for Hydrogen and Fuel Cell Technology) to promote the regional implementation of hydrogen applications in transport. The first use cases, in addition to vehicle applications, also include the necessary refuelling infrastructure and, where applicable, hydrogen production. Regions are supported through a three-stage approach in developing integrated regional hydrogen concepts: from networking and conceptualisation to concrete implementation.

Promotion of alternative drives in rail transport

Through the "Guideline for the Promotion of Alternative Drives in Rail Transport," the Federal Ministry for Digital and Transport is supporting the conversion of rail vehicles to alternative drives and

the development of the necessary infrastructure. This guideline was in effect for three calls for funding, which ran until 31 December 2023. The funding was technology-neutral, ensuring that the appropriate technological options were provided for each application scenario. The focus was on battery-electric and fuel cell-based trains. The guideline helps to close gaps in the rail network where overhead lines are lacking and contributes to achieving climate targets in the rail transport sector.

Promotion of alternative drives for buses in local public transport (RL Bus - Bus Guideline)

Until 2023, the Federal Government, within the framework of the relevant funding guidelines of the Federal Ministry for Economic Affairs and Climate Action (previously Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) and the Federal Ministry for Digital and Transport, supported numerous projects for the technological development and procurement of electric, hybrid, and biogas-powered buses. Since 2021, the Federal Ministry for Digital and Transport has been promoting the market development of alternative drives for buses through an independent, technology-neutral funding guideline. This is currently valid until 2025. In terms of funding, details are as follows: RL Bus of BMWK (2018–2021/22), approx. €500 million, completed; RL Bus of BMDV (2021–2025), approx. €1,300 million, ongoing.

Development of electricity-based fuels

Fuel cells are also likely to be involved in the mobility of the future, especially for trucks and other heavy vehicles. In the longer term, Power-to-X (PtX) fuels will also play an increasingly important role in certain areas of transport. The Federal Government will establish the framework conditions for the development and large-scale expansion of electrolysis and refining processes to produce electricity-based greenhouse gas-neutral gases and fuels. This will enable the use of climate-friendly raw materials and fuels, particularly in industry, chemicals, aviation, heavy-duty transport, and shipping, as well as for special applications, such as in the military sector. In addition, the European Union is launching an industrial policy initiative to develop an efficient e-fuel supply system. With regard to the medium-term quotas for renewable fuels of non-biological origin for aviation and shipping, it must be examined whether supporting measures are needed to implement RED III in the transport sector.

Support for advanced biofuels

The use of biofuels in the fuel mix reduces the fossil content of the fuel, thereby also lowering the level of carbon pricing of the fuel. Efforts are underway to develop liquid and gaseous renewable fuels from biomass, as well as their large-scale production in biogas and synthesis plants, with the goal of enabling their medium- to long-term use in specific segments of the transport sector. First-generation biofuels based on food and feed crops will not receive additional support. In the future, bioenergy production should rely more on waste and residual materials, making it essential to fully account for these resources. An expansion of the area under cultivation for bioenergy is not expected and will not be considered suitable due to land use restrictions. The sustainability criteria of RED II must also be applied to imports, whether from within the EU internal market or from third countries. As part of the national implementation of RED III, the existing sub-quota for advanced biofuels will be updated, taking into account ecological and economic aspects as well as technical feasibility. Advanced biofuels are already on the market and are contributing to reductions in transport sector greenhouse gas emissions. Current research and development gaps in innovative advanced biofuels (e.g. fuels made from straw) are being addressed through projects and demonstration initiatives in order to enable large-scale production in the medium term.

Promotion of natural gas mobility

Natural gas will continue to be subsidised as a fuel until 2026. By using biomethane gas and, in future, renewable synthetic methane, natural gas vehicles can contribute to reducing carbon emissions.

Boosting rail passenger transport

At the heart of this package of measures is the reduction of carbon emissions by shifting traffic onto the rail transport sector, which is to be significantly strengthened for this purpose. In addition, decarbonisation can be further advanced through the electrification of further rail routes and the use of alternative drives (hydrogen, battery).

The Federal Government and Deutsche Bahn will invest in rail infrastructure with a historic increase in funding by 2030, aimed at enhancing the performance of the rail network. The introduction of digital control and safety technology on central axes, as well as the digitalisation of signal boxes, will also significantly increase capacity. Capacity bottlenecks in the rail network are being systematically expanded. These measures lay the groundwork for

the gradual implementation of the "*Deutschlandtakt*" timetable. The electrified network is also set to be expanded and densified.

The development and introduction of further technologies for digital rail operations will also lead to efficiency improvements in the rail system. Likewise, capacity increases can be achieved by optimising the existing infrastructure, allowing trains to run at shorter intervals without compromising safety.

This additional capacity expansion places high demands on planning and construction capacities, especially given the need for concurrent replacement investment measures. The funding for this comes from the Performance and Financing Agreement, which has been in effect since 2020 for a period of ten years. It is being reviewed how increased planning and investment security can be ensured through capacity expansion and the introduction of digital control and safety technology, as well as the digitalisation of signal boxes. The Federal Government will provide considerable additional federal funding to strengthen the railway network until 2030. Moreover, additional equity increases at Deutsche Bahn AG are planned for the upgrading and modernisation of the rail infrastructure, The sum of €20 billion is to be made available to Deutsche Bahn AG from 2024 to 2029. This will enable the company to invest additional capital in the modernisation, expansion, and electrification of the rail network and the rail system.

Before the COVID-19 pandemic, it was sometimes cheaper to take a flight rather than taking the train to the same destination. From a climate protection perspective, this creates the wrong incentives. Therefore, as of 1 January 2020, the VAT on long-distance train tickets was cut from 19% to the reduced rate of 7%.

Comprehensive renovation of the high-performance corridors in the rail network

The Federal Government and DB InfraGO AG are undertaking a targeted and comprehensive renovation of selected high-performance corridors in order to strengthen the rail network, improve the quality and reliability of rail transport, and achieve long-term modal shift goals. While these high-performance corridors are being renovated, highly frequented and heavily used routes will be completely closed for a short, concentrated work intervention and fully upgraded. The Federal Government is also emphasising the need for advance upgrades to bypass routes during the renovation period, in order to minimise disruption and

ensure the most stable operation possible on these routes. Once the comprehensive renovation is complete, these routes will be available for both passenger and freight transport in improved condition.

Establishment of the rail infrastructure company under the name DB InfraGO AG

Rail plays a key role in ensuring safe, affordable, and climate-friendly mobility. For this reason, the Federal Government is implementing the biggest reform of the railway sector since the reform of the railways carried out in Germany 30 years ago. A rail infrastructure company committed to serving the public interest was established as a central transport policy measure, which this Federal Government has set out to implement. The merger of DB Station&Service AG with DB Netz AG, along with the simultaneous rebranding to DB InfraGO AG, took place on 27 December 2023. While DB InfraGO AG remains a commercial enterprise, it is now also required to give equal importance to goals of public interest, particularly those related to transport and climate policy. In this way, infrastructure projects and investments can be aligned more closely with the objectives and strategies of the Federal Government.

Increasing the attractiveness of public transport

The objective of this measure package is to strengthen local public transport, for which responsibility lies with regional and local authorities. Public transport, particularly rail, is associated with significantly lower greenhouse gas (GHG) emissions per passenger kilometre due to a high level of electrification and energy efficiency. This stands in stark contrast to motorised individual transport (MIV). The focus of this area of action is therefore on reducing carbon emissions through a modal shift from MIV to public transport and transforming public transport systems with the integration of alternative drives. The deployment of these technologies in buses and rail networks offers immediate climate benefits, compared to conventional technologies. It also contributes to reducing air pollution and noise in electric-powered transport. Furthermore, decarbonisation can be accelerated in public transport, for example through the use of alternative drive systems in buses and local rail transport.

Various measures, which differ from region to region, are required to enhance the attractiveness of public transport. These include network expansion and upgrades for suburban trains, underground, and trams, improvements in service quality and reliability, as well as increasing the frequency of services, comfort, and safety. Full-scale digitalisation of public transport and a stronger focus on user needs and demand are other vital prerequisites.

In recent years, the Federal Government has repeatedly increased regionalisation funds to implement the Federal Government's climate protection package, to support the sector in dealing with financial setbacks caused by the COVID-19 pandemic, and to offset rising costs. In 2024, the "regular" regionalisation funds will amount to approximately €11.2 billion. An additional €1.5 billion will be allocated for the *Deutschlandticket*, which was introduced on 1 May 2023.

With the increase in federal funding under the Municipal Transport Financing Act (GVFG) for the expansion of public transport to €1 billion annually starting in 2021, the Federal Government has created the conditions necessary to improve the attractiveness of public transport. This will enable the expansion of the rail-based local transport network. The provisions of the GVFG have been further aligned with the goals of making public transport more climate-friendly. To ensure that additional expansion measures can be planned and implemented concretely in the coming years, the funding will be increased to €2 billion annually starting in 2025 and adjusted dynamically by 1.8% starting in 2026.

The modernisation and electrification of bus fleets will continue to be promoted through existing support for buses with electric and hydrogen-based drives, as well as buses powered by biogas. By 2030, up to 50% of city buses should be electric. The Federal Government is further supporting local transport through the funding programme "Model Projects to Strengthen Public Transport", which was launched at the beginning of 2021. Currently, 19 model projects are being supported through two calls for proposals, with a total of around €320 million in funding.

Extending cycle paths and bicycle parking facilities and improving general conditions

The Federal Government will increase the attractiveness of cycling by improving conditions in road traffic and further enhancing road safety. With the National Cycling Plan 3.0 (NRVP 3.0) - the cycling

strategy for Germany up to 2030 - cycling has been strategically aligned with climate action goals. The target is To have more, better, and safer cycling routes in cities and rural areas across Germany (e.g., doubling the number of kilometres cycled by 2030). The Federal Government is providing extensive funds through various programmes for both investment and non-investment promotion and financing of cycling infrastructure, which falls under the responsibility of the *Länder* and municipalities. These programmes include funding for:

- everyday cycling infrastructure (special programme for urban and rural areas)
- tourist cycling routes (Germany's national cycle route network)
- flagship projects (investment model projects)
- bicycle parking at train stations
- research and communication (non-investment model projects for the implementation of the NRVP)
- equipping heavy-duty vehicles with cornering assist systems
- upgrading structures at intersections between railway lines and roads to benefit cycling traffic (funding according to railway crossing laws), and
- upgrading service roads along federal waterways to make them suitable for cycling.

The expansion of cycling paths along federal roads is also being continued. A particular focus is placed on closing gaps in the cycling network. The Federal Government has provided funds for the construction and maintenance of cycle paths along federal roads. By granting financial assistance for high-speed cycle routes, the Federal Government supports *Länder*, municipalities, and local authorities in developing a sustainable cycling network designed for high-speed cycling and subject to minimal delays. The aim is to promote the shift to cycling.

Existing shortages of skilled labour in local municipalities are being addressed through a training initiative, the course "Planning and implementing inviting cycling networks," as well as further training and networking events for civil engineers, transport and urban planners at the Mobility Forum of the Federal Government. The seven endowed professorships dedicated to cycling are also a key pillar in ensuring long-term education and research in sustainable mobility.

In addition, cycling benefits from the creation of more bicycle-friendly framework conditions. The Road Traffic Act has been amended through the Tenth Act to Amend the Road Traffic Act to ensure that, alongside the flow and safety of traffic, the goals of climate and environmental protection, health, and urban development are also considered. This change gives *Länder* and municipalities greater flexibility in making decisions and helps make road traffic more compatible with these broader goals. Regulations based on the Road Traffic Act and related ordinances issued by local authorities may now independently aim to improve environmental protection, including climate protection, and to safeguard health or support urban development. The smooth flow of traffic must still be considered, and traffic safety, as the law expressly states, must not be compromised. This new legal framework is already being used in a parallel process to amend the Road Traffic Regulations.

Boosting rail freight transport

To further shift freight transport to rail, the Federal Government is implementing measures in three key areas: providing efficient infrastructure and network access, improving competitiveness, and modernising rail freight transport, particularly through innovations such as digital automatic coupling (DAC). Since 2020, there has also been investment support for single-wagon transport. Currently, the European standard for freight train lengths is 740 metres, but access to 740-metre tracks is not yet available across all freight routes in Germany. By expanding the 740-metre network for goods trains, the Federal Government aims to address this issue and thus improve capacity, quality and cost efficiency. In addition, modern control and safety technologies will also contribute to these improvements. In combined transport, the package of measures focuses on increasing efficiency and reducing costs (e.g. by reducing process and waiting times, optimising resource utilisation in terminals and during the pre-carriage and post-carriage stages), by digitising operational processes and processing information, and by digitally controlling transshipment facilities. Additionally, the goal is to expand and densify the electrified freight network. The "Electric Freight Train" expansion programme is further supporting the electrification of rail freight transport routes. Alternative drive technologies for freight rail vehicles are also being promoted.

Modernisation of inland navigation and the use of shore-side electricity in ports

Increasing the share of inland waterway transport in freight traffic is a key objective of the climate action measures in the Master Plan for Inland Navigation (May 2019). The funding programme for the modernisation of inland navigation vessels is being further developed. Infrastructure improvements to eliminate bottlenecks (as outlined in priority measures for eliminating critical bottlenecks (VB-E)) are being expedited, and a framework law is being prepared to identify projects for future legislative measures. In addition, the abolition of shipping duties, which has already been in effect since 1 January 2019, is to remain in place. To enable a shift to electricity and low-emission fuels, charges for shore power in seaports will be reduced, and low-emission fuels will be temporarily promoted. In the long term, regulatory measures will also need to be enforced here. The EU's Fueller Maritime Regulation has introduced a requirement for the use of shore power by passenger and container ships.

3.1.3.iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

Abolition of fossil fuel subsidies in G20/G7

In 2009, the G20 states agreed to phase out inefficient subsidies for fossil fuels in the medium term. The states reaffirmed this commitment in 2023. The G7 set the target of abolishing inefficient fossil fuel subsidies by 2025 and again reiterated this goal in 2023. Additionally, at COP28 in Dubai in 2023, all signatory states agreed on the quickest possible phase-out of inefficient subsidies for fossil energy carriers, in line with the Paris Agreement. Germany will conduct more intensive and regular reviews of subsidies, particularly with respect to their climate impact (e.g., within the framework of spending reviews), and further develop reporting on climate-damaging subsidies.

Subsidy report of the Federal Government

As part of the subsidy reporting process of the Federal Government, a sustainability review of all subsidies is conducted every two years. This review examines the long-term economic, ecological, and social impacts of each subsidy, such as in relation to economic prosperity and future preparedness, climate protection and resource conservation, or job security, and documents the results in the subsidy report. The current 29th Subsidy Report, covering the years 2021 to 2024, was adopted by the Federal Government on 30 August 2023. The latter points out that with the draft of the 2023

climate protection programme, the Federal Government has agreed to present a reform concept to reduce climate-damaging subsidies or to restructure them to have a less harmful impact on the climate. As part of this process, the Federal Government also intends to establish a unified framework for defining climate-damaging subsidies. It plans to conduct more intensive and regular reviews of subsidies, focusing on their climate impact (e.g. as part of spending reviews), and to further develop reporting on climate-damaging subsidies. As a first step, the Federal Government, as part of the 2023 Climate Protection Report, has introduced an initial working definition for state benefits that have a harmful climate impact, along with a list of the first instances that fall under this definition.

Measures for the rational use of energy and the utilisation of energy from renewable sources are presented in detail in Chapter 5.2.2.

Comprehensive evaluation of tax benefits

In accordance with subsidy policy guidelines, all subsidies considered in the subsidy report are regularly evaluated in terms of their goal achievement, efficiency, and transparency. Most recently, the Federal Government had a systematic evaluation carried out on 33 tax benefits listed in the subsidy report, specifically examining them with regard to goal achievement, efficiency, instrumental suitability, and, for the first time, sustainability. This research project thus made an important contribution to evidence-based fiscal and tax policy. A key focus of the evaluation was on the energy and electricity sector. The evaluation results reflect the opinion of the independent experts and were published on 30 October 2019. In their recommendations, the experts point out that arguments both for and against changes to tax benefits frequently diverge, and that it is up to the legislature to weigh the pros and cons of potential reforms. In this context, the Federal Government will review the results of the report with regard to the need for action and optimisation of individual measures.

Phasing out subsidies for hard coal

The most significant measure in Germany in relation to phasing out subsidies for fossil fuels was the discontinuation of subsidies for hard coal mining. German hard coal mining had become uncompetitive, mainly due to high extraction costs caused by geological factors. To facilitate a socially responsible exit from the industry, Germany provided subsidies for domestically produced hard coal to help cover the necessary decommissioning measures

and provide transitional assistance to displaced workers. Subsidies for the sale of domestically produced hard coal were paid for the last time in 2018, after which hard coal mining operations ceased. Ongoing decommissioning measures were subsidised until 2022. Subsidies for early retirement for workers leaving the hard coal mining industry (adjustment benefit) will remain in place until the end of 2027.

3.2. Dimension "Energy Efficiency"

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions by 2030 and other objectives referred to in point 2.2, including planned measures and instruments (as well as financing instruments) to promote the energy performance of buildings, in particular with regard to the following: 3.2.i – 3.2.viii

The revised EU Energy Efficiency Directive (EED) aims to significantly increase energy efficiency and reduce energy consumption. Towards this end, national energy efficiency policies were aligned with the new goals and targets. The Energy Efficiency Act (EnEfG), which came into force on 18 November 2023, created a cross-sector framework for increasing energy efficiency nationally.

The Federal Government's energy efficiency policy is based on a broad mix of instruments for all sectors, which builds on the principle of 'advice and information, funding, incentives and research'. The current key measures are listed in detail below.

The 2024 projections report for Germany demonstrates that there is still a gap to be closed if the German indicative national energy efficiency contributions are to be achieved by 2030. Based on the additional measures scenario of the 2024 projection report, final energy consumption of 2501 TWh or 9004 PJ is forecast for 2030. In order to achieve the target, a further 249 TWh or 896 PJ of reductions must thus be achieved. Based on the additional measures scenario of the 2024 projection report, final energy consumption of 2069 TWh or 7448 PJ is forecast for 2030. To achieve the target, a further 260 TWh or 936 PJ of reductions must, therefore, be attained.

3.2.i. Policies and measures related to the elements provided for in point 2.3

To implement the former Article 7 of the EU Energy Efficiency Directive, the Federal Government has used strategic measures and thus a broad package of measures in the initial savings period from 2014 to 2020. This approach will also be retained for the second savings period from 2021 to 2030 for implementing Article 8 (1) sentence 1 letter b of the Energy Efficiency Directive. An overview of the measures planned by Germany to date to achieve end-use energy savings in accordance with Article 8 of the Energy Efficiency Directive can be found in the appendix to this National Energy and Climate Plan in compliance with Article 3(2)(h) of Regulation (EU) 2018/1999. These measures are expected to achieve cumulative final energy savings of 4878.25 PJ or 116.52 Mtoe. This corresponds to 84.73% of the cumulative savings requirement of 5,757.1 PJ or 137.51 Mtoe. Further measures are thus necessary in order to achieve the remaining final energy savings.

Energy Efficiency Act

The Energy Efficiency Act (EnEfG), which came into force on 18 November 2023, serves to implement the revised European Energy Efficiency Directive (EED). It sets out a cross-sectoral framework for improving energy efficiency and contains energy consumption reduction targets for Germany. The law also includes specific savings measures relating to the exemplary role of the public sector and the increased use of energy and environmental management systems. The Act also specifies energy efficiency and waste heat targets for data centres and requirements for the improved avoidance of waste heat recovery and its use if not possible.

Energy Efficiency First principle

The overriding principle in all sectors is “Efficiency First!” This is now also established as a principle in Article 3 of the revised EED. The Energy Efficiency Act has also highlighted the political significance of the issue in Germany.

In the building sector, the Energy Efficiency First principle is taken into account by, among other things, the German Buildings Energy Act, including its amendments that came into force on 1 January 2023 and 1 January 2024. The aim of the Act is to promote the economical use of energy in buildings along with the increasing use of renewable energy sources (for more details, see further below in this chapter). In addition to the primary energy demand, the

efficiency requirement ensures that energy is used efficiently. The Act is supported by a wide range of funding opportunities that can be used to increase the energy efficiency of the respective buildings, in particular the federal funding for efficient buildings (see further below in this chapter for more details).

In the heating sector, the Heat Planning Act (WPG), which came into force on 1 January 2024 (for more details, see also Chapter 3.1.3), is an expression of the Energy Efficiency First principle in that it creates system gains from heating planning and forms the basis for an efficient heating supply. In the course of heat planning, energy savings are to be estimated as a matter of principle. Furthermore, the presentation of planned sub-areas with increased energy-saving potential (section 18(5) WPG), as prescribed as part of the potential analysis, means that demand-side solutions are also included in the heat planning in line with the Energy Efficiency First principle. In addition, the Heat Planning Act (section 21 (1)) explicitly refers to the fact that a heat plan for a municipal area in which more than 45,000 inhabitants are registered as of 1 January 2024 "should be in line with the 'energy efficiency first' principle in accordance with Article 3 of Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast) (OJ L 231, 20.09.2023, p. 1)". Section 17 EnEfG provides for the establishment of a platform for waste heat, which is intended to facilitate the feed-in of unavoidable waste heat by companies, for example, into the heat network.

In the network development plan (as a planning decision within the meaning of Article 3 (1) of Directive EU 2023/955), for example, increases in efficiency on the side of consumers along with an efficient shift in energy demand towards electrical energy are assumed. Demand-side resources and flexibilities that can result in more efficient use of energy and networks are also incorporated into the fundamentals of network development planning (development of electromobility, power-to-heat/heat pumps, electrolysis, battery storage, demand-side management in industry and trade). Moreover, the current amendment to the Energy Industry Act (Third Act Amending the Energy Industry Act) provides for requirements for a System Development Strategy and for the coordination of scenario frameworks and network development plans in the area of future energy infrastructure. The efficiency principle can also be incorporated into the overarching System Development Strategy. Aligning the scenario framework and the network development plans ensures a stringent and standardised consideration of energy efficiency in energy

infrastructure planning. To summarise, it can thus be said that the network development planning processes are designed to be flexible enough to take appropriate account of the aspect of energy efficiency in the respective planning decision.

Climate Action Programme 2023

The Climate Action Programme 2023 also contains numerous measures that, in addition to decarbonisation, will lead to a reduction in primary and end energy consumption (see Chapter 3.1.).

3.2.ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies and measures to stimulate cost-effective deep renovation, as well as policies and measures to target the worst-performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU.

The Federal Government has submitted a Long-Term Renovation Strategy (LTRS) to the EU Commission as required by Article 2a of the EU Energy Performance of Buildings Directive. The LTRS requires that each Member State sets out a roadmap of measures and nationally measurable progress indicators to achieve long-term climate targets, as well as pathways and incentives for renovating the national building stock The amended EU Buildings Directive came into force at the end of May 2024 and has to be implemented by 29 May 2026. It outlines the goal of achieving highly energy-efficient and decarbonised buildings by 2050 and transforming existing buildings into zero-emission buildings (EPBD, Directive (EU) 2024/1275). The following principle basically applies to the building sector: in order to significantly reduce non-renewable primary energy consumption, the energy demand for heating and cooling must be significantly reduced by means of efficiency measures and the share of renewable sources of energy in meeting the remaining demand must be significantly increased. The potential for enhancing efficiency can be increased by carrying out measures such as insulating the building envelope, installing efficient windows or other façade components, making buildings airtight, as well as using highly efficient technical systems for heating, cooling and lighting and illumination technology. The measures implemented to date with the aim of achieving the energy and climate targets have led to significant progress in climate action and energy efficiency; greenhouse gas emissions in the building sector – decoupled from economic growth and despite the sharp

increase in living space – were reduced by around 51% to 102 Mt CO_2 equivalents between 1990 and 2023 (1990: 210 Mt CO_2-eq). The share of renewable sources of energy in end energy consumption for heating and cooling was successfully increased by around 15 percentage points over the same period, to 17.4% in 2022. In the buildings sector, federal funding for efficient buildings (and its predecessors, the CO_2 Building Renovation Programme, the Market Incentive Programme (MAP), the "Energy Efficiency" incentive programme (APEE) and the Heating Optimisation Programme (HZO)) provided a noticeable impetus to boosting energy efficiency and to increasing share of renewable sources of energy in the buildings sector, making a significant contribution to these positive developments. Nevertheless, scientific analyses show that these developments need to be accelerated if the 2030 targets are to be achieved. In order to achieve the required progress in improving overall energy efficiency and reducing CO_2 emissions in the building sector, an emergency programme for the building sector was developed in 2022. It was developed further and has been incorporated into the 2023 Climate Action Programme.

Measures in the building sector must be designed in such a way that is practical, technology neutral and economically viable; they should be interlinked across trades so that obstacles are addressed, funding measures are widely implemented, the high quality of renovation measures is ensured and the potential opportunities for enhancing energy efficiency and the use of renewable sources of energy in buildings is considered holistically.

The NECP update does not include a comprehensive revision of the LTRS. Nevertheless, measures have been further developed and added. This further development is presented below.

Energy advice

The federal funding for energy advice for residential buildings (EBW) is aimed at owners of residential buildings (private homeowners, housing associations and homeowners' associations). Federal funding In this process, a qualified energy consultant from the list of energy efficiency experts (https://www.energie-effizienz-experten.de/) inspects the entire property and then draws up a comprehensive energy advice report, known as the individual renovation roadmap (iSFP). Besides any potential opportunities for saving energy, the report outlines the options for using renewable sources of energy, estimates the amount of investment required, and shows how much money could be saved on heating costs as well as the potential reduction in CO_2 emissions. The energy

consultation thus helps to include energy efficiency and renewable sources of energy in the planning and decision-making process of property owners and so exploit the potential for enhancing efficiency at the most favourable time for the individual. This will help to ensure that building owners are better informed about the added value of energy-efficient modernisation measures, because investments are most effective when they are coupled with any maintenance or modernisation measures that are pending.

Since January 2021, the Energy Advice for Non-Residential Buildings, Facilities and Systems (EBN) has combined energy advice for medium-sized companies (EBM) and Energy Advice for Non-Residential Buildings Owned by Municipalities and Non-profit Organisations (EBK), including a contracting check. The funding is aimed at municipalities, small and medium-sized enterprises (SMEs), municipal companies and non-profit organisations, as well as other potential funding recipients. Advice is provided on the renovation of schools, kindergartens and administrative buildings, for example, as well as on the energy-efficient optimisation of operational processes.

The individual and independent energy advice funded by the Federal Ministry for Economic Affairs and Climate Action regarding energy saving options, questions of energy efficiency, the use of renewable sources of energy and other energy-related topics for private consumers is organised by the Federation of German Consumer Organisations (vzbv) and carried out with the participation of the consumer advice centres of the *Länder*. Energy advice is currently offered at around 1,000 advice centres throughout the country. These centres provide in-person consultations, telephone consultations, online consultations or energy checks and on-site consultations on various topics in people's own homes (e.g. regarding electricity and heat consumption, heating technology, and the use of renewable sources of energy, e.g. solar heating or photovoltaics). Private consumers can also take part in of the webinars that regularly organised.

National Energy Efficiency Label for Old Heating Installations

Since 2017, the National Efficiency Label for Old Heating Systems has been informing consumers about the efficiency status of their boilers that are more than 15 years old; the measure is intended to encourage them to replace inefficient boilers. The chimney sweeps assigned to a particular residential district are legally obliged to affix the label in accordance with section 17 Energy Consumption Labelling Act (EnVKG) and are compensated for their efforts. The

measure is to be abolished at the end of 2024, due, among other things, to evaluation results, the changed legal situation (including the Building Energy Act) and alternative means of communication.

Building Energy Act (GEG)

The standard for new-builds as regards permissible primary energy demand was raised to the Efficiency House 55 standard in an initial amendment to the GEG. The amendment to the Building Energy Act came into force on 1 January 2023.

On 1 January 2024, amendments to the Building Energy Act (GEG) came into force at the same time as the Heat Planning Act (WPG). The second amendment to the GEG stipulates that, in principle, all newly installed heating systems should initially only use at least 65% renewable sources of energy in new developments as of 1 January 2024 (see section 71(1), (8) sentences 1 and 2 of the GEG (new)). Newly installed heating systems in old building stock and in new buildings outside new development areas, i.e. in gaps between buildings, are only subject to this obligation after the deadlines that are congruent with those of the heat planning in line with the Heat Planning Act. This means as of 1 July 2026 for buildings in municipal areas with more than 100,000 inhabitants and as of 1 July 2028 for buildings in all other municipalities. This deadline can be brought forward if a (separate) decision is taken, on the basis of a heat plan, to designate an area for the construction or expansion of heat networks or as a hydrogen network expansion area. Heating systems fuelled by fossil fuels that are installed after 1 January 2024 and before the 65% renewable energy requirement comes into force must use climate-friendly fuels on a pro-rata basis as of 2029 (see section 71(9) of the Buildings Energy Act (GEG) new).. Should a heating system that runs on solid, liquid or gaseous fuels be installed before these dates, advice is required that highlights any possible effects of the designation of an area for the new construction or expansion of heat networks or as a hydrogen network expansion area as a result of the heat planning and a possible uneconomic operation, in particular due to rising carbon pricing. Furthermore, oil and gas heating systems installed during the transition phase will have to use gradually increasing proportions of green gases and so-called green heating oil from 2029 onwards. Existing heating systems are not affected by the regulations and can continue to be used. Even if a repair is needed, it is not necessary to replace the heating system. The transition to renewable sources of energy will be done in a technology-neutral manner.

As with the Building Energy Act, the Heat Planning Act takes into account (carbon-neutral) gases that are not yet available today. In addition, in the event of the designation of an area for the construction or expansion of heat networks or as a hydrogen network expansion area, existing heat plans must be examined to determine whether they need to be adapted with regard to the designation of one or more hydrogen network expansion areas. This is done to ensure that a realistic option for conversion to a hydrogen network is also available for existing heat plans or those in the process of being set up.

The Building Energy Act contains further transitional provisions, such as when there is the prospect of a connection to a heat network, and a general hardship clause that allows for exemptions from the obligation upon request.

Ordinance on Securing Energy Supply via Measures Effective in the Short Term (EnSikuMaV)/Ordinance on Securing Energy Supply via Measures Effective in the Medium Term (EnSimiMaV)

The Federal Government has adopted several measures to specifically prevent a gas shortage. On the basis of the Energy Security of Supply Act (EnSiG), they include the Ordinance on Securing Energy Supply via Measures Effective in the Short Term (EnSikuMaV), which is limited until April 2023, and the Ordinance on Securing Energy Supply via Measures Effective in the Medium Term, which is limited until autumn 2024; they rare meant to cut the consumption of natural gas by industry and domestic households to a level that would be sufficient to cope with a crisis. The temporary short-term energy-saving measures targeted the following areas, among others: requirements regarding minimum room temperature, information obligations and bans on heating public common areas and operating illuminated advertising at night. The measures of the EnSiMiMaV defined an obligation for building owners to optimise the heating systems of their buildings. After the time limit of the ordinance has expired, paragraphs 2 and 3 of the EnSiMiMaV for heating optimisation and hydraulic balancing will be transferred to the Building Energy Act (sections 60b and 60c) as measures to increase the energy efficiency of heating systems. The corresponding regulations have been adopted in the amended Building Energy Act and will enter into force on 1 October 2024, unlike the other regulations of the Building Energy Act.

Federal Funding for Efficient Buildings (BEG) – existing building stock

The Federal Funding for Efficient Buildings (BEG) programme supports measures aimed at increasing energy efficiency in residential and non-residential buildings, as well as replacing old fossil-fuel heating systems with heating systems that run on renewable sources of energy. Funding is available for the complete renovation of buildings so that they comply with the efficiency house standard through low-interest loans from the KfW with repayment bonuses, as well as for individual measures, especially on the building envelope, through grants from the Federal Office for Economic Affairs and Export Control. What is new since January 2024 is that subsidies for renewable heat generators can be applied for from the KfW. There are special funding incentives (bonuses) for the refurbishment of buildings with poor energy efficiency, for carrying out serial refurbishment work, and for heat pumps that are particularly efficient or use natural refrigerants.

The following investment cost subsidies have been available for heating replacements since January 2024:

- a basic subsidy of 30% for all residential and non-residential buildings for all groups of applicants; an efficiency bonus of an additional 5% is also available for heat pumps that use water, soil or waste water as a heat source or use a natural refrigerant;
- a "climate speed bonus" of 20% until the end of 2028 for the early replacement of old fossil-fuel heating systems (as well as night storage heaters and old biomass heating systems) for owner-occupiers;
- as well as a 30% income bonus for owner-occupiers with up to €40,000 of taxable household income per year.
- The bonuses can be accumulated up to a maximum funding rate of 70%.

A new supplementary loan is also available – with an interest-rate reduction of up to €90,000 of taxable annual household income – for replacing heating systems and other individual efficiency measures.

Federal Funding for Efficient Buildings (BEG) – climate-friendly new builds

The ambitious and holistic "'Climate-friendly New Builds" (KFN) funding programme was launched on 1 March 2023, followed by

the “Home Ownership for Families” (WEF) funding programme on 1 June 2023. The buildings erected under the New Building Subsidy programme – both residential and non-residential – typically have low gas emissions over their life cycle, high energy efficiency, low operating costs and a high proportion of renewable energy sources for the generation of heat and electricity. The building’s entire life cycle is taken into account: from its initial construction and operation to its potential demolition in the distant future.

Funding programme for climate-friendly new builds in the low-cost segment

A new programme called “Climate-friendly new construction in the low-cost segment” (working title), with a total funding volume of €2 billionm is also planned for 2024 and 2025. This programme aims to promote new buildings that not only exceed the legally prescribed energy efficiency standard (EH 55) but also achieve savings over their life cycle that are at least equivalent to the CO_2 savings of EH40.

Support for serial refurbishment

The Federal Government is using federal funding to support the industrial prefabrication of façade and roof elements as well as the standardised installation of system technology. Feasibility studies, pilot projects and the development of production capacities are thereby supported.

Besides that, the Federal Government has introduced a bonus of 15 percentage points for serial refurbishment within the federal funding programme for efficient buildings. The aim here is to apply the approaches developed in the pilot projects. The objective is to refurbish buildings to a high standard of quality and to shorten time it takes to carry out such refurbishment work.

Act on Heat Planning and the Decarbonisation of the Heat Networks

With the Act on Heat Planning and the Decarbonisation of the Heat Networks (Heat Planning Act), heat planning has been introduced as a key strategic instrument of the heating transition nationwide as of 1 January 2024 (see also 3.1.2.1.c), 3.1.2.vi. and 3.1.3.ii.). The law comprises requirements for the decarbonisation of heat networks by 2045.

Federal Funding for Efficient Heat Networks (BEW)

Since September 2022, the expansion and conversion of heat networks to achieve a climate-neutral heating supply has been supported financially by the Federal Funding for Efficient Heat Networks (BEW) (cf. 3.1.2.iii.).

Heat pump roll-out

In view of the increasing significance of CO_2 prices, heat pumps are one of several technologies that can be used to fulfil the requirements of the Building Energy Act. In all of the known scenarios, heat pumps form a key technology for decarbonising the building sector. In the spring of 2022 and based on a decision by the Federal Government, Germany launched a heat pump initiative together with stakeholders, with the aim of installing at least 500,000 heat pumps annually from 2024 onwards. All stakeholders have expressed their willingness to take the necessary implementation steps in their respective areas of responsibility and have affirmed this at three heat pump summits to date. The stakeholders have agreed on certain measures: the further development of heat pumps in terms of efficiency; natural refrigerants; and the improvement of the framework conditions for heat pumps in existing buildings.

Tax incentives for energy-efficient building renovation

On 1 January 2020, tax incentives for energy-efficient building refurbishment were introduced for owner-occupied properties. Since then, the instrument has been supplementing the existing funding landscape in the building sector and can be used as an alternative to investment funding programmes. The tax relief is designed to be tax deductible. To benefit from the tax relief, the costs incurred must be claimed from the tax office when the income tax return is submitted. The measures carried must be certified by a specialist company and this certificate must also be submitted to the tax authorities. Funding is available for individual refurbishment measures for owner-occupied residential properties that are also eligible for funding under the funding programmes for existing building stock. They include individual measures such as replacing heating systems, fitting new windows or insulating roofs and exterior walls. A total of 20% of the investment costs is eligible for funding (up to a maximum of €40,000 per residential property); for tax purposes, this sum can be spread over three years.

Energy-efficient urban redevelopment

Since 2011, the KfW Energy-efficient Urban Redevelopment programme has been funding climate action and climate adaptation measures through neighbourhood concepts and their support by a refurbishment management team by means of grants (KfW 432). Selected neighbourhood infrastructure measures were supported with low-interest development loans (KfW 201/202).

The programme supports neighbourhood-based climate protection measures and links it to other urban planning aspects. Integrated neighbourhood concepts demonstrate energy-saving potential and options for using renewable sources of energy. The programme expired at the end of 2023.

Further development of the Zukunft Bau innovation programme

The construction industry faces particular challenges: the objective is to shape the transition to climate and greenhouse gas neutrality by 2045, to conserve existing resources, and to meet the demand for ecological and affordable housing. At the same time, unstable supply chains, shortages in materials and increased prices are making it increasingly difficult to reduce the current backlog of building permits at an acceptable cost and within a reasonable time frame.

In order to do justice to these tasks, all those involved in building research – the Federal Government and other institutions as sponsors, research and building practice – have to bear a share of the responsibility. New stimuli for sustainably transforming the entire construction sector are to be set through application-oriented research into construction.

Energy Transition Construction Research Network

The research initiative Energiewendebauen (Energy Transition Construction Research Network**)** combines funding for research into as well as the development and demonstration of energy-efficient buildings and districts, contributes to the networking of the broad range of research fields, and increases awareness of energy innovations through targeted PR work. It is thus an element of energy research funding and does not constitute an independent funding programme.

The building sector plays a key role in the heating transition when it comes to tapping the potential for enhancing efficiency and integrating renewable energy sources. The systemic interaction of buildings, neighbourhoods and energy infrastructure is becoming increasingly important. The accompanying research for the energy transition in the construction sector evaluates the results of the research and demonstration projects and then goes on to process them in such a way that they can be permanently incorporated into planning and decision-making practice.

The "EnEff.Gebäude.2050" funding programme is part of the 7th Energy Research Programme of the Federal Ministry of Education and Research under the designation "Climate-neutral building stock 2050". The funding programme complements the R&D and demonstration projects in the Energy Transition Construction research initiative. The aim of the measure is to achieve a significant reduction in non-renewable primary energy demand by accelerating the introduction of available but as yet still novel technologies and processes. The intention is to seize innovations and results from long-term research work and to focus on removing obstacles so as to enable the exemplary realisation of ambitious projects on the way to achieving climate-neutral buildings.

Exemplary role of federal buildings

In order to set an example, the energy efficiency requirements for climate-neutral new buildings or extensions as well as renovation of buildings belonging to the Federal Government (EEFB) are implemented as minimum structural requirements for new buildings and renovation projects (buildings of the direct and parts of the indirect federal administration) in line with the cabinet decision of 25 August 2021.

The EEFB define the current energy standards for federal buildings so that they can serve as role models and achieve the climate policy goals for federal buildings.

The key points for the energy efficiency requirements were set out in the Climate Action Programme 2030. Accordingly, the efficiency building standards EGB 40 for new buildings and EGB 55 for building renovations were specified in the EEFB, based on the system used for the Federal Funding for Efficient Buildings (BEG). The corresponding EEFB requirements go beyond the legal requirements of the Building Energy Act with regard to the annual primary energy demand (use of renewable sources of energy) and the thermal insulation of the building (building envelope).

In order to achieve the specified climate protection targets for federal buildings, annual refurbishment rates have also been planned for the period up to 2045. The aim is to refurbish the entire building stock by 2045, taking into account a corresponding lead time for the refurbishment work.

The EEFB thus represent one step towards achieving the goal of greenhouse gas neutrality for Federal Government buildings.

Further development of the Urban Development Support Programme (StBauF)

Since 1971, the joint programme of the Federal Government and the individual *Länder* has been helping cities and municipalities to eliminate urban planning deficits, thus sustainably improving their attractiveness as business and residential locations. In the process, solution strategies for dealing with the challenges of climate change must also be taken into consideration. In the course of the further development of Urban Development Support Programme in 2020, measures for climate protection and for adapting to climate change have, therefore, been better addressed. They are now a mandatory funding requirement and, at the same time, eligible for funding in all sub-programmes of urban development funding. The funding can be used in particular to improve green infrastructure, such as the creation, preservation or expansion of green spaces and open spaces, as well as the linking up of green and open spaces. Measures for energy-efficient building renovation, soil unsealing, land recycling, climate-friendly mobility, the use of climate-friendly building materials, the greening of building surfaces or increasing biodiversity are also eligible for funding.

Refurbishment of municipal sports, youth and cultural facilities

The federal programme “Refurbishment of municipal sports, youth and cultural facilities” aims to support municipalities that are facing the challenging task of refurbishing and modernising their social infrastructure facilities in order to make them more energy efficient. By doing so, the Federal Government is helping to reduce the existing backlog of refurbishment work at these facilities, particularly swimming pools and sports centres.

Since the 2022 funding round, the projects to be funded must contribute to achieving the goals of the Climate Change Act in the buildings sector and meet high energy requirements with the aim of significantly reducing GHG emissions. In exceptional cases

(economic efficiency and a more effective option in terms of climate action), new builds to replace old stock are also eligible for funding. Furthermore, measures relating to outdoor swimming pools, including their structural ancillary facilities, are also eligible for funding.

After the renovation work has been done or the replacement building has been completed, buildings must initially meet the specified efficiency building levels. In the case of outdoor pools, funding is prioritised for measures that achieve a climate-neutral heat supply or increase the share of energy from renewable sources.

3.2.iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

The Federal Government has taken extensive strategic measures to remove barriers impeding the uptake of energy services in the public sector. They range from providing information and funding programmes right through to training options.

Promotion of advice on energy-efficiency contracting as part of the Energy Advice for Non-Residential Buildings, Facilities and Systems

As part of the afore-mentioned advisory programme "Energy Advice for Non-Residential Buildings, Facilities and Systems" (EBN, see Chapter 3.2.ii.), funding is also provided for "Contracting Orientation Advice" for the benefit of municipalities, among other things.

Federal and State Government Dialogue Contracting

This project provides a platform to enable an intensive dialogue to take place between representatives of the Federal Government and the governments of the individual *Länder* on energy-efficiency contracting. The project aims to remove barriers to the realisation of energy-efficiency contracting and to develop regional expertise in this area. To this end, annual plenary meetings and workshops

are offered, along with a mentoring programme and the exchange of best practices. The development of regional centres of excellence also receives support.

Information on model contracts and guides

The Federal Energy Efficiency Centre provides details on its website on free model contracts and guides to energy-efficiency contracting. Among them are offers specifically targeted towards public properties or municipalities.

Municipal energy and resource efficiency networks

Municipalities can join together to form a network under the Municipal Guidelines of the National Climate Initiative (NKI) funding programme to improve their energy and/or resource efficiency. Together, with the support of a network team, they can identify opportunities where savings can be made and carry them out.

3.2.iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote en ergy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency

Without claiming to be complete, the following list provides an overview of measures aimed at increasing energy efficiency. Additional measures are required if the ambitious savings targets are to be achieved.

Carbon pricing

Carbon pricing in the heating and transport sectors (BEHG)

Carbon pricing for the transport and heating sectors is becoming an increasingly important core instrument in the midst of an efficient mix of instruments. In addition to its significance for decarbonisation, it is also a key instrument for increasing energy efficiency. Please refer to Chapter 3.1.1.i.

Carbon Dioxide Cost Allocation Act

For the first time ever, the Carbon Dioxide Cost Allocation Act provides for the allocation of carbon dioxide costs to be divided between landlord and tenant, i.e. landlords will share in the additional costs incurred. Before the law came into force on 1 January 2023, landlords were able to pass on the costs incurred by the CO_2 tax in full to tenants. As a result, the carbon dioxide price did not have the desired incentive effect. This is because the incentive effect of the carbon dioxide price only affected tenants, encouraging them to use heating more sparingly. The Carbon Dioxide Cost Allocation Act now stipulates that the carbon dioxide costs incurred for residential buildings be allocated on the basis of how climate-friendly the building is: the less climate-friendly, the higher the costs for the landlord in the future (see Chapter 3.1.1.i.). For non-residential buildings, the costs are split evenly.

Product efficiency

Minimum efficiency standards – EU Ecodesign Directive

Regulatory measure: the expansion of minimum standards for certain product groups in order to regulate the efficiency level of technologies. Altogether, there are currently around 30 Ecodesign Regulations and two voluntary agreements.

Promoting the exemplary role of the public sector

Exemplary function in public buildings

The exemplary role of public bodies (Article 6 of the new EED)

A significant proportion of the EU's energy savings are to be achieved by means of energy-efficient renovations. To achieve this, 3% of the total floor area of heated and/or cooled buildings owned by public institutions (of the Federal Government, the *Länder*, the municipalities) must be refurbished every year to at least the standard of nearly zero-energy buildings (NZEB) or zero-emission buildings (ZEB). In order to document the respective progress, Germany, in coordination with its *Länder*, is developing a public inventory of buildings. Germany has notified the EU of its use of the alternative approach provided for in Article 6 of the EED. The corresponding estimated savings will be submitted at a later date. Due to the difficult data situation, the creation of a inventory of building stock covering public facilities at federal, state and

municipal level is required in order to provide an exact figure for the expected amount of energy savings.

For federal buildings, see also Chapter 3.2.ii. on the Long-Term Renovation Strategy and function as a role model.

Energy-efficient public procurement

The biggest consumer of goods and services in Germany is the public sector, with a total procurement volume amounting to hundreds of billions. Article 6 EED (Art. 7 in the new version that will apply from October 2023) requires Member States – except in narrowly defined exceptions – to procure only products, services and buildings with high energy efficiency. The German Regulation on the Award of Public Contracts (VgV), which must be observed by all public clients in the event of Europe-wide calls for tender, stipulates in its implementation of the EED in section 67 (procurement of energy-related goods or services) that the highest level of energy efficiency and, if available, the highest energy efficiency class should be demanded when energy-related goods are procured or when they are an essential prerequisite for the performance of a service. Energy efficiency must also be taken into consideration as an evaluation criterion when determining the most economically advantageous tender. For the awarding of construction contracts, section 8c of the EU VOB/A (German Construction Tendering and Contract Regulations) contains a provision that is essentially identical in content. The standards will be aligned with the new version of the EED by October 2025.

Beyond this obligation, the Act against Restraints of Competition (GWB), the German Regulation on the Award of Public Contracts (VgV), the German Construction Tendering and Contract Regulations, Part A (VOB/A), and the Regulation on the Award of Public Security and Defence Contracts (VSVgV) promote such procurements. The Federal Energy Efficiency Centre also publishes lists of energy efficiency criteria for various product categories as additional guidance for clients.

On 1 January 2022, the General Administrative Regulation on the Procurement of Climate-friendly Services (AVV Klima), which applies to federal procurement, replaced the Administrative Regulation on the Procurement of Energy-Efficient Services (AVV EnEff), which had been in force since 2008, in order to continue to ensure a high level of energy efficiency in all federal procurement processes. In doing so, AVV Klima not only carries forward the AVV EnEff specifications, but also supplements them with ambitious

regulations aimed at procuring products and services that are particularly relevant to the climate. The AVV Klima thus specifically stipulates how aspects of climate protection must be regularly taken into account, not only during the preparation of the procurement, but also in the subsequent award procedure itself. In order to avoid or cause greenhouse gas emissions, a carbon price must be used as the basis for calculation in procurement processes (so-called shadow carbon price). This means that the amount of CO_2 emitted over an entire life cycle is already taken into account as a cost factor when purchasing.

For easier orientation in practice, the AVV Klima also includes a "negative list" of services that are generally not to be procured. These particularly climate-relevant products include, for example, patio heaters and many products that use fluorinated greenhouse gases as refrigerants. Likewise, certain products are no longer allowed for reasons of resource and climate protection, e.g. drinks in disposable packaging or disposable tableware in canteens and at major events.

The importance of the secured accelerated procurement procedure must be taken into account when applying the General Administrative Regulation on the Procurement of Climate-friendly Services and when implementing the measures in accordance with the Sustainability Action Programme – Further Development 2021 (see Chapter 3.1.3.ii).

In the future, the General Administrative Regulation on the Procurement of Climate-friendly Services is to be developed into a General Administrative Regulation for environmentally and climate-friendly procurement, taking into account relevant environmental aspects, in particular the protection of resources.

Energy audits/energy management system

Energy audit requirement for non-SMEs

The focus here is on the obligation for companies to carry out energy audits, as regulated in sections 8 *et seq*. of the Energy Services Act (EDL-G). According to this, large companies (non-SMEs, i.e. companies that do not fall under the European Commission's definition of SMEs [<250 employees and/or turnover <€50 million or an annual balance sheet total <€43 million]) are obliged to have an energy audit carried out in accordance with DIN EN 16247-1 by 5 December 2015, followed by a further audit at least every four years. Firms that have an energy management

system certified according to DIN EN ISO 50001 or an EMAS environmental management system are exempt from the requirement to conduct such energy audits.

As part of the 2019 amendment, a de minimis threshold of 500 MWh of total energy consumption was introduced. Below this threshold, a simplified energy audit can be carried out by submitting a declaration of energy consumption and energy costs to the Federal Office for Economic Affairs and Export Control. Furthermore, an online energy audit declaration has been introduced. It encompasses information about the company, the energy auditor, energy consumption, any energy efficiency measures proposed and the costs of an energy audit.

The obligation to carry out energy audits is based on the requirements of the Energy Efficiency Directive (Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955, or EED for short), the new version of which came into force on 10 October 2023. In particular, significant changes in the area of mandatory energy audits for companies have been made. According to the old legal situation (Art. 8 EED of the old version), the obligation to carry out energy audits was based on the size of the company (see above). In the future, under Article 11 in the new version, all companies with high energy consumption levels will be obliged to carry out energy audits, regardless of the size of the company.

The evaluation of the audit requirement under the Energy Services Act (EDL-G) (adelphi and IREES 2017) is used to assess the impact of each measure. As part of this evaluation, a sample of the companies required to register under the EDL-G was surveyed. The survey asked them about the potential identified in the audits and EMS, as well as the measures implemented. The estimated impact of the measures addresses only those measures that have not yet been implemented and that were identified during the audit or by the EMS. The effect of the EMS is attributed to the “peak balancing” and “special equalisation scheme” measures.

Obligation to introduce energy management systems

According to section 8 paragraph 1 of the Energy Efficiency Act (EnEfG), which came into force in November 2023, all companies with an annual average end energy consumption of more than 7.5 GWh are obliged to set up a certified energy management system (EMS) according to DIN ISO 50.0001 or a certified environmental

management system according to EMAS. The Energy Efficiency Act is currently being revised as part of the draft of a law to amend the law on energy services and other efficiency measures, to amend the Energy Efficiency Act, and to amend the Energy Labelling Act. In the future, the threshold is to be raised to 2.77 GHw. The obligation is based on the requirements of the Energy Efficiency Directive (Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955, or EED for short), the new version of which came into force on 10 October 2023. Companies that have an energy management system certified according to DIN EN ISO 50001 or an EMAS environmental management system are exempt from the obligation to carry out energy audits according to the EDL-G (see above).

The "Energy and Resource Efficiency in Industry" funding programme also supports the procurement and installation of measurement, control and regulation technology and sensor technology for monitoring and efficiently controlling energy flows for integration into an energy management system. The procurement and installation of energy management software and the third-party training of staff in how to use the software are also subsidised. In addition, the possibility of setting up an energy management system is also considered as part of the Energy Advice for Non-Residential Buildings, Facilities and Systems.

List of providers from the Federal Energy Efficiency Centre (BfEE)

The Federal Energy Efficiency Centre (BfEE) maintains a free public list of providers of energy services, energy audits and other energy efficiency measures operating throughout Germany. End customers can make use of this list to search for providers of certain energy efficiency services within their postcode area and compare the providers on the basis of various criteria. Providers can present their energy services in this list of providers.

Energy efficiency and climate protection networks

In Energy Efficiency Networks (EEN), companies join forces to set themselves common energy efficiency and CO_2 reduction targets and to learn from each other. Following a successful pilot phase of the EEN concept (including the LEEN (Learning Energy Efficiency Networks) project), the Federal Government made a decision in 2014 to implement EEN as a main pillar of the National Action Plan on Energy Efficiency (NAPE). Up to 500 new networks are to be established by 2020. To this end, a voluntary agreement to

introduce EEN entitled “Energy Efficiency Network Initiative” was signed in 2014 by the Federal Government (BMWi and BMU, now BMWK and BMUV) and, in the meantime, 22 business associations and organisations. Overall, this should save 75 PJ of primary energy and avoid 5 Mt CO_2-eq. emissions. On 14 September 2020, it was agreed that the Energy Efficiency Networks initiative should be continued and developed further. The aim is to establish 300 to 350 additional networks by 2025, which should save 9-11 TWh of final energy and a further 5-6 Mt CO_2-eq.

The networks should fulfil minimum requirements. This includes conducting an energy audit at company level, setting a savings target at network level based on individual company goals, and achieving the identified savings potential in line with the network goal. The networks are supported by a qualified energy consultant. The implemented measures are recorded as part of an annual monitoring process. As of 4 August 2023, a total of 387 networks had been registered. According to the initiative, the targeted savings will probably be achieved. This measure is quantified from the bottom up, based on parameters from the monitoring of the networks and the number and size of the networks.

On 14 September 2020, the former Federal Ministry for Economic Affairs and Energy (BMWi) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), together with 21 business associations and organisations, agreed to uphold and further develop the Energy Efficiency Networks Initiative (IEEKN 2020). The initiative, which has been further developed into an energy efficiency and climate protection network, started in January 2021. A total of 418 networks have now registered (as of 27 May 2024).

Consumer information/training programme

Unabhängige Beratung beim Verbraucherzentrale Bundesverband e. V. (vzbv)

See Chapter 3.2.ii. regarding the Long-Term Renovation Strategy.

Federal funding for energy advice for residential buildings (individual renovation roadmap)

See Chapter 3.2.ii. regarding the Long-Term Renovation Strategy.

Federal funding for Energy Advice for Non-Residential Buildings, Facilities and Systems (EBN)

See Chapter 3.2.ii. regarding the Long-Term Renovation Strategy.

SME Initiative for Energy Reforms and Climate Change Mitigation

The SME Initiative for Energy Reforms and Climate Change Mitigation (MIE), launched in 2013 as a joint initiative of the BMWi (Federal Ministry for Economic Affairs and Energy) (now BMWK, the Federal Ministry for Economic Affairs and Climate Action), the BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) (now BMUV, the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection), the Association of German Chambers of Industry and Commerce (DIHK) and the German Confederation of Skilled Crafts (ZDH), aims to strengthen the dialogue between politics and small and medium-sized enterprises in industry, trade and skilled crafts and to support SMEs in increasing energy efficiency.

The aim is to provide support for carrying out energy-saving and climate protection measures in the skilled trades, as is already the case in industry. The 1 million skilled crafts enterprises with their 5.62 million employees and 363,000 apprentices are extensively affected by the transformation process as regards energy and climate policy. The MIE offers companies a tailored, customised mix of instruments and target group-specific support. The instruments are disseminated through a partner network (seven environmental centres for skilled crafts and trades and 55 transfer partners (chambers of skilled crafts and trades, associations, guilds; energy agencies).

Industry

EU ETS Innovation Fund: Further development of the NER300 programme

The programme's main focus is on reducing emissions. However, this also has an impact on the reduction of primary energy consumption. Please refer to Chapter 3.5.

National decarbonisation programme

The programme's main focus is on reducing emissions. However, this also has an impact on the reduction of primary energy consumption. Please refer to Chapter 3.5.

Programme for the Avoidance and Utilisation of CO_2 in Primary Industries

The programme's main focus is on reducing emissions. However, this also has an impact on the reduction of primary energy consumption. Please refer to Chapter 3.5.

Further development of efficiency networks

The establishment of energy efficiency networks is to be accelerated. To this end, the recommendations from statutory energy audits or environmental management systems will be carried out more quickly in conjunction with the measure to introduce a voluntary commitment by industry. A continuation of the energy efficiency networks initiative is being sought in order to increase the transfer of expertise between companies.

Resource efficiency and substitution

The measure is only partially new. It is based on the approaches mentioned in the German Resource Efficiency Programme. The objective of increased resource efficiency and substitution is to firmly establish the principle of recycling and the circular economy in production processes and thus to tap into any emission reduction potential that has not yet been fully exploited. The three central areas of "Guidance and Information", "Support" and "Further Education and Vocational Training" are described below.

Guidance and Information

In addition to information and advice on energy efficiency, companies should also receive information and advice on developing and applying innovations with a focus on resource efficiency and substitution. The advice should be based on the existing services of the Centre for Resource Efficiency (ZRE) and should, as far as possible, be linked to advice on energy efficiency. The focus of the company-specific advice should be on SMEs, as with the overarching advisory services of the ZRE, since SMEs often have neither the time nor the HR capacity to review resource efficiency in their own company. The use of environmental management systems is to be increased (ProgRess II). To date, energy audits have only measured energy consumption; ProgRess II proposes that an explicit resource efficiency audit could be integrated into this.

Support

Financial means are necessary to enable companies to carry out more comprehensive investment measures, especially in order to successfully integrate and increase resource efficiency within and along the value chains by means of digitalisation and Industry 4.0. Other possibilities include the increased use of CO_2-neutral raw materials and more secondary materials. In this context, special consideration should be given to SMEs, since investment costs represent a greater economic burden for them than for larger companies. What is required to verify the material and associated greenhouse gas savings is a resource efficiency concept that lists the savings and describes any possible secondary effects. The funding priority is the use of resource-efficient processes and materials, as well as resource substitution for lightweight construction (further details on the funding programme for lightweight construction can be found in Chapter 3.5.iii).

KfW Energy Efficiency Programme – Production Facilities and Processes

The KfW Energy Efficiency Programme promotes energy efficiency measures in the area of production facilities and processes in commercial enterprises with low-interest loans.

All investment measures that achieve an energy saving of at least 10% (entry standard) are eligible for funding. Funding is available for both modernisation and new investments in the areas of machinery, equipment or process technology; compressed air, vacuum or suction technology; electric drives or pumps; process heating or cooling; heat recovery or waste heat utilisation; measurement and control technology; information and communication technology, and CHP plants. The maximum loan amount is generally up to €25 million per project. Credit periods of 5, 10 or 20 years can be selected.

Further Education and Vocational Training

In order to incentivise innovation and implement investments appropriately, employees also require specific further training. The training should be based on the offers already available at the Centre for Resource Efficiency (ZRE). For the counselling services according to item i., use can be made of the nationwide pool of qualified advisors (according to VDI Guideline 4801) that has already been established by the ZRE in co-operation with the *Länder*.

Energy and electricity tax relief

The Federal Government will examine, on a case-by-case basis, to what extent existing energy or electricity tax relief should be aligned more closely with the Federal Government's climate policy goals. This review must take into account the votes on the draft of a new Energy Taxation Directive (ETD) presented by the European Commission as part of the Fit-for-55 package.

The tax relief for the manufacturing industry under energy and electricity tax law is designed to prevent companies that compete on the international market from experiencing any disadvantages due to high electricity and energy costs. In addition to full tax relief for certain energy and electricity-intensive processes (e.g. electrolysis, metal processing, glassware and ceramic products manufacturing), manufacturing companies can claim general energy tax relief of 25% if they meet all the requirements. The general relief in the Electricity Tax Act was also temporarily extended to the EU minimum tax rate as part of the electricity price package. Furthermore, the exemptions from the electricity tax for electricity generated from renewable energy sources and with highly efficient cogeneration plants provide an incentive for the electrification of processes and the decentralised generation and use of electricity.

Transport

Boosting rail passenger transport

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Increasing the attractiveness of public transport

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Extending cycle paths and bicycle parking facilities and improving the general conditions

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Boosting rail freight transport

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Modernisation of inland navigation and the use of shore-side electricity in ports

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Expansion of refuelling and charging infrastructure

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Funding of low-carbon lorries

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Refuelling, charging and overhead line infrastructure

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Automating, networking and optimising traffic flow, enabling innovative forms of mobility

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Tax incentives for electric mobility (Act on the Further Fiscal Promotion of Electromobility and on the Amendment of Further Fiscal Regulations)

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.3.

Agriculture

Energy efficiency in agriculture

The programme's main focus is on reducing emissions. At the same time, the programme also has the effect of reducing primary energy consumption. Please refer to Chapter 3.1.1.i.

3.2.v. Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv

Please refer to Chapter 3.1.2.v. for details of the regulatory framework for developing renewable energy communities.

3.2.vi. Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure

Please refer to the System Development Strategy in Chapter 3.4.3.i.

3.2.vii. Regional cooperation in this area, where applicable

Franco-German Energy Platform

Germany is working closely with France on energy efficiency on the basis of the "Joint Declaration on Energy" issued on 31 March 2015. The Franco-German Energy Platform created by the German Energy Agency (dena) and the French Agency for Ecological Transition (ADEME) as part of the implementation of the energy declaration includes two efficiency projects. The projects aim, on the one hand, at the preparation and transnational exchange of best practice examples in the field of building renovation and, on the other, at cooperation to promote energy efficiency in industry.

German-Polish Energy Platform

As part of the German-Polish Energy Platform, the German Energy Agency (dena) and the Polish Energy Agency (KAPE) are working together on a cross-border project for a climate-neutral heat supply and the transnational exchange of best practices in the German-Polish border area.

3.2.viii. Financing measures, including Union support and the use of Union funds, in the area at national level

Financing measures in the form of intensive funding or price and incentive mechanisms are key components of the measures in the

field of efficiency. They supplement other measures with targeted financial incentives aimed at facilitating the execution of energy efficiency measures in the various fields of application. This enables energy consumers to reduce their energy costs in the long term. For companies, investing in energy efficiency not only results in cost advantages, but also opens up new opportunities in international markets.

Support

The Federal Government has created the framework conditions for boosting the development and dissemination of innovative energy technologies from Germany, among other things, by promoting efficiency measures and initiatives for the use of renewable heat. Thus, investment funding programmes supplement the advisory and information services with targeted financial incentives to enable the implementation of energy efficiency measures in the various fields of application. This will enable energy consumers to reduce their energy costs in the long term (see "Long-Term Renovation Strategy"). For companies, investing in energy efficiency not only results in cost advantages, but also opens up new opportunities in international markets. Germany exports a significant volume of goods that are used in connection with efficiency measures and renewable heat in the field of rational energy use and conversion, such as energy-efficient electrical appliances, insulation materials, building systems technology and components for production processes. For the building sector, the measures for applying the Energy Efficiency Strategy for Buildings are set out in the "Long-Term Renovation Strategy" in Chapter 3.2.ii.

Federal Funding for Energy and Resource Efficiency

The programme Federal Funding for Energy and Resource Efficiency (EEW) is the broad-based funding programme for the decarbonisation of industry and commerce. Besides funding through classic (repayment) grants and low-interest loans under the Federal Funding for Energy and Resource Efficiency in the Economy – Grants and Loans guideline, which comprises a total of six different funding modules, funding competition is also offered under the Federal Funding for Energy and Resource Efficiency in the Economy – Funding Competition guideline. In view of the difficult economic situation and the ambitious climate targets, both guidelines were revised in February 2024. It is not only the funding of the total investment costs rather than the additional investment costs that is new; a graduated model has also been added. For

predefined technologies such as machine tools, there is now a relatively unbureaucratic "Basic subsidy" (Level 1). The funding share for projects that reduce greenhouse gases by at least 30% (Level 2) is higher. An additional decarbonisation bonus (Level 3) is available for electrification with electricity generated by renewable sources of energy, for the external use of waste heat as well as for the production and use of green hydrogen. The amendment also includes an increase in the maximum funding amount from €15 million to €20 million per project in funding modules 2, 3, 4 and in the funding competition, as well as an adjustment of the funding quotas in modules 1 to 4.

The EEW comprises the following funding modules:

Module 1: Cross-cutting technologies

Module 2: Process heat from renewable sources of energy

Module 3: Measurement, sensor and control technology, sensor technology and energy management software

Module 4: Optimisation of systems and processes with regard to energy and resources

Module 5: Transformation plan

Module 6: The electrification of small businesses

Funding competition

3.3. Dimension "Energy Security"

3.3.i. Policies and measures related to the elements set out in point 2.3

Natural gas: Measures to maintain and, where necessary, improve the security of Germany's gas supply

Preventive Action Plan for Gas

Measures to maintain – and where need be – improve supply security in Germany are described in the Preventive Action Plan for Gas for the Federal Republic of Germany. This is to be drawn up in line with Articles 8 and 9 of Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and

repealing Regulation (EU) No 994/2010 and is based on the results of the national risk assessment that each Member State is required to carry out in accordance with Article 7 of Regulation (EU) 2017/1938. The Federal Network Agency carries out the national risk assessment on behalf of the Federal Government. The preventive action plan specifies measures for preventing a supply shortage in the natural gas sector that meet the infrastructure and supply standard, reduce the likelihood of supply crises, avoid regional supply shortages and increase resilience to supply crises. The regular updating of the Preventive Action Plan for Gas is still pending (as of May 2024).

Network Development Plan (NEP) – Gas and Hydrogen

Pursuant to section 15a of the German Energy Industry Act (EnWG), the transmission system operators are obliged to jointly develop the NEP Gas every two years. In it, they jointly determine the infrastructure requirements for the next decade. The distribution network operators provide the requisite information to do so. A "Security of Supply Scenario" is always modelled in the NEP Gas, in which assumptions are made about the effects of any conceivable disruptions to supply (section 15a (1) EnWG). After approval by the BNetzA, the NEP Gas is binding on the TSOs.

In the draft of the Network Development Plan Gas 2022-2032 of 31 March 2023, the network expansion proposal comprises a total of 140 measures with an investment volume of approximately €4.4 billion. A total of 82 new measures have been added to the 2020-2030 Network Development Plan Gas. Compared to the previous Network Development Plan, the additional measures proposed are largely related to the changed flow situation in the transmission network on account of the loss of Russian natural gas volumes. Against this backdrop and in order to ensure the long-term security of supply, the network expansion measures for the future transport of LNG play a decisive role. Moreover, further expansion measures are required for the future demand made by gas-fired power plants and the conversion from low-calorific gas to high-calorific gas.

As part of the legal regulations for the second stage of the accelerated hydrogen network rollout, the Network Development Plan for Gas and Hydrogen is to be integrated in the future. The parliamentary process for this legislative amendment was finalised in the spring of 2024. As part of this future ongoing Network Development Plan for Gas and Hydrogen, a draft scenario framework for a Network Development Plan was presented on 1 July 2024; among other things, it is based on assumptions about the

development of the extraction or production, supply and consumption of gas and hydrogen. It is to be used as the basis for the first integrated Network Development Plan for Gas and Hydrogen, which is to be drawn up and approved by the regulatory body by 30 June 2026. This recurring planning process offers the possibility of demand and scenario-oriented further development of the hydrogen core network, for example, based on updated demand forecasts for different regions.

The provision of information

In order to ensure the security of the gas supply, the TSOs/DSOs are obliged, in line with section 15, paragraph 2 of the EnWG, to provide any other operator of gas supply networks that are connected to their own network with the information they require. This obligation also applies to the operators of storage facilities.

Capacities for load flows in both directions ("reverse flows")

The transmission system operators are responsible for creating permanent bi-directional capacities for load flows in all cross-border interconnectors. To this end, they cooperate with the transmission system operator adjacent to them. Of the 36 physical border interconnection points, 15 border points currently have bi-directional physical flow capacities (not including cross-border gas storage connections). These capacities are available on a permanent basis.

Storage facilities

Sufficient availability of storage capacity with high withdrawal rates is essential for safeguarding the gas supply, especially in the event of supply bottlenecks, and for covering seasonal fluctuations in consumption. In Germany, natural gas storage facilities with a total capacity of roughly 23 billion cubic metres are currently being operated commercially at 41 locations. This means that Germany has the largest storage capacity for natural gas in the European Union. The spatial distribution of the storage facilities covers almost all of Germany, with a regional focus in the northwest on account of geological conditions. Pursuant to their obligations for supply security, responsibility for the use of commercial storage facilities lies with the traders: they have to store sufficient quantities in the natural gas storage facilities, in particular, to cover the cold period and in the event of unexpected supply disruptions, so as to ensure the supply of their customers.

Measures to eliminate or mitigate the consequences of any disruption to the gas supply

Even though the natural gas supply situation in Germany is highly secure and reliable, the requisite national framework and organisational rights are in place for companies and authorities to take appropriate precautions and ensure the necessary amount of cooperation among all parties involved and the availability of appropriate measures in the event of any deterioration in the supply situation. The legal bases for implementing crisis and emergency planning in Germany are, in particular, the following national provisions, which implement Regulation (EU) 2017/1938 and EU regulations issued in the context of crisis management: The Electricity and Gas Supply Act (Energy Industry Act, EnWG), the Energy Security Act (Energy Security of Supply Act, EnSiG) and the Ordinance to Ensure the Supply of Gas in a Supply Crisis (Gas Supply Security Ordinance, GasSV). Measures to eliminate or mitigate the consequences of a disruption in the gas supply as defined in Article 10 of Regulation (EU) 2017/1938 are outlined in the Emergency Plan for Gas Supply for the Federal Republic of Germany.

Electricity and Gas Supply Act (Energy Industry Act, EnWG)

According to its section 1, paragraph 1, the purpose of the EnWG is "to ensure the safest possible, lowest-priced, consumer-friendly, efficient and greenhouse gas-neutral grid-based supply of [...] natural gas to the general public, which is increasingly based on renewable energy sources." In this context, the supply of protected customers is given special priority in Regulation (EU) 2017/1938. In Germany, protected customers as defined in Article 6(1) of Regulation (EU) 2017/1938 are defined in section 53a of the Energy Industry Act (EnWG) and include households, essential social services and district heating installations that are unable to switch to a different fuel source, insofar as they supply residential customers, standard load profile customers and customers that provide essential social services. The gas supply companies also have to supply this customer group with natural gas should there be a partial interruption of the gas supply or in the event of an exceptionally high demand for gas. This requirement is reflected in section 53a of the German Energy Industry Act (EnWG). In doing so, gas supply companies can resort to market-based measures (network or market-related, non-regulatory) .

Protected customers can only be supplied if the gas supply network is secure and reliable. Thus, the transmission and distribution

system operators play a pivotal role in ensuring the gas supply as part of their system responsibility on the basis of sections 15, 16 and 16a of the German Energy Industry Act (EnWG). Insofar as the network operators are unable to eliminate a disruption or threat to the security and reliability of the gas supply system in a timely manner through network or market-related measures (section 16, paragraph 1 of the Energy Industry Act), this is to be established by the network operators using the measures pursuant to section 16, paragraph 2 of the Energy Industry Act.

In particular, in the event of a risk of gas shortages, network operations and the allocation and planning of capacities, including transit capacities, must be carried out in such a way so as to preserve the supply of gas to protected customers and to customers in other Member States who are protected by solidarity. The gas supply companies perform these tasks on their own responsibility.

Act to Safeguard the Energy Supply (Energy Security of Supply Act, EnSiG)

In combination with the Gas Safety Regulation (GasSV), the EnSiG instrument is only used in emergencies to ensure the vital supply of natural gas in the event that the natural gas supply is directly endangered or disrupted and the endangerment or disruption of the supply cannot be remedied by market-based measures, cannot be remedied in time, or can only be remedied with disproportionate measures. The need to fulfil public duties and international obligations as defined in the EnSiG is also considered to be essential. The EnSiG instruments will be put into effect by the Federal Government issuing an ordinance stating that the energy supply is at risk or has been disrupted. The consent of the Bundesrat is not required in this case. So as to achieve the above-mentioned objectives in an emergency, provisions can be issued by statutory order in line with section 1 (1) of the EnSiG, including, among other things, provisions on "the production, transport, storage, distribution, supply, purchase, use and maximum prices of [...] gaseous energy sources [...]" as well as "accounting, verification and reporting obligations with regard to [...] the economic processes mentioned, quantities and prices as well as other market conditions for these goods".

Pursuant to subsection (3), the statutory instrument may, in particular, stipulate that "the supply, purchase or use of the goods may be restricted in terms of time, place or quantity or may only be undertaken for certain priority supply purposes". The period of validity of such statutory instruments shall not extend beyond a

period of six months. Their period of validity may only be extended with the consent of the Bundesrat.

The Gas Supply Security Ordinance was issued on the basis of the Energy Industry Act. While market-based instruments and measures taken by gas supply companies in Germany are legally enshrined in the EnWG in particular, the EnSiG and GasSV establish sovereign powers of intervention.

Ordinance to Ensure the Supply of Gas in a Supply Crisis (Gas Supply Security Ordinance – GasSV)

The GasSV was issued on the basis of the EnSiG. It regulates the transfer of load distribution or sovereign measures to the responsible government agencies in the event of an emergency. The responsible state authorities are the BNetzA (Federal Network Agency) in the event of a national supply shortage and the *Länder* in the event of a regional supply shortage. In order to meet the "vital need" for natural gas, with particular consideration for protected customers and the minimisation of any consequential damage, these competent bodies can issue orders in their role as load distributors in accordance with section 1 GasSV.

When intervention is required in the national interest, or when a balance needs to be struck between electricity and gas industry concerns, or the use of gas storage facilities and other gas supply installations with national significance needs to be regulated, then, as the competent state authority, the Federal Network Agency assumes its role as the federal load distributor. If an intervention has no cross-regional impact, the regionally affected *Land* takes over the distribution of the load. Since it can be assumed that, in most cases, any gas shortage will have transregional effects, the BNetzA plays the central role as load distributor at the emergency level.

Emergency Plan for Gas Supply

The Emergency Plan for Gas Supply is to be drawn up in keeping with Articles 8 and 10 of Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply; it categorises the measures into three crisis levels (early warning level, alert level and emergency level). The respective crisis level depends on the severity of the disruption, the expected economic and technical impact, and the urgency of troubleshooting at national level. The regular updating of the emergency plan was last carried out in 2023.

Securing the supply of protected customers in a gas shortage situation/at the emergency stage.

Protected customers can only be supplied if the gas supply network is secure and reliable. The TSOs and DSOs thus have a central role to play as part of their system responsibility for securing the gas supply on the basis of sections 15, 16 and 16a EnWG. In particular, in the event of a risk of gas shortages, network operations and the allocation and planning of capacities, including transit capacities, must be carried out in such a way so as to preserve the supply of gas to protected customers and to customers in other Member States who are protected by solidarity. The gas supply companies perform these tasks on their own responsibility.

Possible measures within the framework of the orders pursuant to section 1 GasSV

The Security Platform Gas (SiPla) is used as a digital platform for communication and the exchange data of data in order to handle a wide range of processes for managing crisis situations at the gas emergency level and in response to requests for solidarity from EU Member States associated with Germany. The Security Platform Gas was developed by the BNetzA and the market area manager for gas, Trading Hub Europe GmbH (THE), on the basis of section 1 (1) no. 4 EnSiG in conjunction with section 1a GasSV. It has been made available by the market area manager since October 2022.

In its role as federal load distributor, the BNetzA can issue decrees to firms and businesses that produce, procure, transport or distribute natural gas or operate gas storage facilities, as well as to consumers, regarding the allocation, purchase and use of gas and the exclusion from the purchase of gas via the Security Platform Gas in accordance with section 1 GasSV. Such orders constitute predetermined, non-market-based measures within the meaning of Regulation (EU) 2017/1938. According to section 1 GasSV, they may include, for example, orders to increase the withdrawal of natural gas, to substitute natural gas with petroleum or other fuels, to use power not generated by means of gas, to restrict electricity production in natural gas-fired power plants, to increase the production level of natural gas, to heat public buildings, to reduce of natural gas consumption by large or other final customers, the reduction of industrial customers, the use of stocks of alternative fuels, the restriction of cross-border natural gas flows (taking into consideration the requirements of Article 10(4) and Article 11(6) of Regulation (EU) 2017/1938).

Rapid expansion of the LNG infrastructure

As of the winter of 2022, Germany had no import infrastructure for liquefied natural gas (LNG). Starting in 2022, the Federal Government pushed for the rapid construction of so-called floating LNG terminals to prevent future gas shortages, initially in the winter of 2022-23 but also for the more distant future. Firstly, it has secured four special ships (Floating Storage Regasification Units, or FSRUs) on which liquefied natural gas can be converted back into natural gas. Secondly, it has brought about the legal conditions to accelerate the construction of the necessary onshore connections with the introduction of the LNG Acceleration Act. This means that two FSRUs will be able to enter into operation as early as the winter of 2022-23, feeding LNG into the German gas supply network. Two more FSRU locations will commence operations by the summer of 2024. In addition, a private FSRU has already been operating at a location on the Baltic Sea since the beginning of 2023. A further FSRU in the Baltic Sea will soon be supplying gas. The successive commissioning of a total of three private, land-based terminals in Brunsbüttel, Stade and Wilhelmshaven is planned from 2027 onward. The federal FSRUs at these locations will then cease operations.

Petroleum

Energy Security of Supply Act (EnSiG) – Petroleum

The scope of the Energy Security Act embraces, *inter alia*, petroleum and petroleum products. Provisions may be issued by statutory instrument, including, but not limited to, the production, transport, storage, distribution and purchase of energy sources, including petroleum. In particular, it may provide for measures to restrict consumption, such as speed limits or driving bans, up to and including the possible rationing of oil supplies. In the event of any oil supply disruptions that market participants cannot absorb on their own, or at least not in the short term, the release of oil reserves in line with the Petroleum Stockpiling Act is the first and primary means of dealing with the situation. Measures such as speed restrictions and (partial) driving bans are only to be considered in the event of very severe and very long-lasting supply crises.

Petroleum Stockpiling Act (ErdölBevG)

Since 1966, there has been a legal requirement in Germany to stockpile petroleum and petroleum products. It was introduced

with the aim of safeguarding the energy supply against any short-term interruptions to imports, in view of the growing dependence on petroleum imports. The Petroleum Stockpiling Act has since been amended several times, not least due to European requirements and international developments. The ErdölBevG comprehensively regulates the stockpiling of petroleum and petroleum products for the purpose of preventing crises. The Federal Government then established the Erdölbevorratungsverband (EBV), a federal public-law corporation headquartered in Hamburg, and tasked it with maintaining the emergency reserves. It holds 90 days' net imports of mineral oil stocks of crude oil, petrol, diesel, heating oil and JET A-1. In the event of a supply crisis, the Federal Ministry for Economic Affairs and Climate Action (BMWK) issues a release order to compensate for the supply shortfall with stocks from the EBV.

Mineral Oil Data Act (MinÖlDatG)

The MinÖlDatG forms the legal basis for collecting data on petroleum products from all major companies trading in petroleum products. The petroleum data serve as the basis for the regular monitoring of Germany's petroleum supply, but also for measures in the event of an emergency. For this purpose, the Federal Office for Economic Affairs and Export Control (BAFA) collects monthly data from reporting companies regarding the import and export, stocks and domestic sales of crude oil and petroleum products. The data collected are used to prevent national and international crises and, in particular, to provide information on current developments on the German oil market.

Transport Services Act (VerkLG)

There may be a need to requisition transport capacity in the event of a severe oil supply crisis, in which the Federal Government has determined, in line with the Energy Security Act, that there is an interruption to the energy supply that cannot be remedied by market-based means, cannot be remedied in time, or can only be remedied by disproportionate means. As the "authority entitled to make demands" within the meaning of section 7 of the Transport Services Act, the BAFA has to commission transport services for the BMWK's area of responsibility from the "coordinating authority" (Federal Office for Goods Transport) in the event of an emergency.

Fuel Supply Restrictions Regulation (KraftstoffLBV)

The KraftstoffLBV regulates the possible rationing of fuel using ration cards. The basis for this is the Energy Security Act and the determination of the Federal Government that the energy supply has been disrupted.

Heating Oil Supply Restriction Regulation (HeizölLBV)

The heating *HeizölLBV* regulates the possible rationing of light heating oil based on a reference quantity during a previous period. The basis for this is the Energy Security Act and the determination of the Federal Government that the energy supply has been disrupted.

Mineral Oil Equalisation Regulation (MinölAV)

The MinölAV enables the supply equalisation ("fair sharing") between over-supplied and under-supplied companies in the petroleum industry. At the same time, market structures should be maintained as far as possible, and the mineral oil should be sold at market prices. The Regulation may be applied in a similar manner to fulfil international obligations under the International Energy Agency's International Energy Programme. The basis for this is the Energy Security Act and the determination of the Federal Government that the energy supply has been disrupted.

Petroleum Resource Management Ordinance (MinölBewV)

The MinölBewV regulates the possible rationing of motor and heating fuels, as well as their production, distribution and use for the benefit of the population, the Federal Armed Forces and the allied armed forces on the basis of the Economic Security Act (WiSiG) in the case of Article 80a of the Basic Law. The ultima ratio principle applies here, too.

National Emergency Strategy Organization (NESO)

The National Emergency Strategy Organization (NESO) was set up as a measure under the IEA's International Energy Program (IEP). NESO is the umbrella term for the authorities, institutions and companies that are actively involved in handling any oil crisis, from assessing the situation to deciding on and carrying out response measures. NESO is based on close co-operation between the authorities and companies, including their associations. The secretariat of the German NESO coordinates the activities of the NESO participants. It supports the Crisis Supply Council and the Supply Coordination Group in carrying out their tasks and,

alongside and in coordination with the BMWK, maintains contact with the IEA. The NESO manual (a crisis management manual) has just been revised.

Electricity market

In Germany, a series of stakeholders, including all power supply companies, are responsible for supplying the general public with electricity; they perform these tasks under their own responsibility. Before presenting the measures in the electricity sector, the central stakeholders will be briefly discussed:

Transmission system operators (TSOs): Responsible for the operation, maintenance and, if need be, the expansion of the grids used to transport electricity via an extra-high and high-voltage integrated grid, including cross-border interconnectors (cf. section 3 no. 10 and no. 32 of the Energy Industry Act – EnWG).

Distribution system operators (DSOs) – electricity: They distribute electricity, that is to say that they transport electricity at high, medium and low voltage (see section 3, nos. 3 and 37 of the EnWG).

Balance responsible party (BRPs) – electricity: The BRP is responsible for ensuring a balance between feed-ins and withdrawals in a balancing group in each quarter of an hour; in his role as the interface between network users and transmission system operators, the BRP assumes economic responsibility for any deviations between feed-ins and withdrawals in a balancing group (see section 4 (2) StromNZV).

Since a secure and reliable grid is essential for the supply of power, the TSOs and DSOs play a central role. They have to ensure the security and reliability of the electricity supply system by taking appropriate measures in accordance with sections 13 and 14 of the Energy Industry Act. The network operators have to work closely together in order to meet their supply obligations.

Measures to maintain and, where necessary, improve the security of Germany's electricity supply

A functioning European internal electricity market with free pricing generally ensures the right investments in generation and flexibility. The Federal Government's strategies and measures to ensure the adequacy of resources and the flexibility of the energy system also create stronger incentives for market players to secure their electricity supplies (see Chapter 3.4.3.ii.). Nevertheless,

markets are not always sufficiently prepared for events that only have a very low probability of occurring. In order to make the German and European electricity systems more resilient to unforeseeable developments and crises, Germany currently considers the maintenance of reserves to be essential. This is especially true in view of the phase-out of nuclear energy and coal-fired power generation in Germany. The volume of reserves is regularly reviewed, for example as part of the Federal Network Agency's security of supply monitoring, with a view to the system-beneficial expansion of power plants under the Power Plant Safety Act and the creation of a capacity mechanism. Security of supply must be jointly ensured in Europe, too.

Moreover, the Federal Government is taking further steps to maintain and further improve the security of the electricity supply.

Power Plant Safety Act (Power Station Strategy)

The Federal Government has also agreed on the Power Station Strategy as part of the growth initiative that was adopted together with the budget. In anticipation of the capacity mechanism, additional power plant capacities are to be quickly developed within the framework of a Power Plant Safety Act. The Power Plant Safety Act will be implemented in two ways.

The first pillar will be a tender for 5 GW of H2-ready gas-fired power plants, which will run entirely on hydrogen from the eighth year of operation onwards for the purposes of decarbonisation.

Added to this are 500 MW of hydrogen power plants that run on hydrogen from the outset (so-called "hydrogen sprinter power plants"). This ensures that CO_2 emissions are reduced as quickly as possible and that the ramp-up of the hydrogen economy (power plant technology, hydrogen demand) is incentivised.

The subsidy is to be paid for 800 full hours of use per year. On the one hand, this is intended to ensure refinancing through a sufficient number of eligible hours, but on the other, it is also intended to limit the funding costs that are to be expected according to the measure as a whole.

Furthermore, tenders are to be invited for 500 MW of long-term electricity storage so as to foster the development of technologies

for converting electricity from a storage medium and feeding it into the grid for a longer period at a time.

As a second step, 5 GW of new controllable capacity will be put out to tender with high investment sums and long refinancing periods to ensure security of supply.

All power plants for which support is granted in advance will be integrated into the new capacity mechanism from 2028 in an appropriate manner and without any duplication of financial assistance. The calls for tenders will ensure that power plants are built in locations that serve the system. The capacity mechanism is designed to be technology-neutral in order, for example, to also include storage facilities and loads.

Operation of energy supply networks

According to section 11 of the German Energy Industry Act (EnWG), energy supply network operators are obliged to operate, maintain and, as far as is economically reasonable, optimise, reinforce and expand a secure, reliable and efficient energy supply network in a non-discriminatory manner.

In response to the fundamental transformation of the electricity system towards electricity generated 100% from renewable sources of energy as well as sector coupling technologies (e-mobility, heating, hydrogen), the Federal Government has worked with the industry to develop a Roadmap for System Stability, which was adopted at the end of 2023. The Roadmap contains a schedule for the safe and robust operation of a grid that uses electricity generated 100% from renewable sources of energy. In the process, the need for action was identified and processes and responsibilities were clearly defined in order to address this need for action. The requisite measures are also to be implemented and monitored in cooperation with the industry. As one building block for this, transmission system operators are to regularly prepare a System Stability Report in the future, which will contain the required measures and requirements as well as options for action towards the stable operation of a grid that uses electricity generated 100% from renewable energy sources. The Federal Network Agency will monitor its implementation.

The provision of information

Pursuant to section 12, paragraph 2 of the EnWG, transmission system operators must provide operators of other systems with

which their own transmission systems are connected technically with the information required to ensure secure and efficient operation, coordinated expansion and interconnection.

Grid reserve

In accordance with section 13d EnWG, the TSOs maintain facilities for the purpose of ensuring the security and reliability of the electricity supply system, in particular for managing network congestion and for voltage maintenance and to ensure any possible ssupply restoration (grid reserve). The grid reserve will be 4.6 GW in winter 2023-2024.

Capacity reserve

The capacity reserve serves as an additional safeguard for the electricity market and is regulated by section 13e of the German Energy Industry Act (EnWG) and the Capacity Reserve Ordinance. It is held outside the electricity markets and is designed in such a way that investment incentives and the competitive situation on the electricity markets are not distorted. Once they have been included in the capacity reserve, generation plants are no longer allowed to return to the electricity and balancing energy markets. For a plant to be included in the capacity reserve, it must satisfy certain requirements with regard to its location and technical characteristics. Among other things, a plant must be connected to the German power grid and meet certain flexibility requirements. The procurement of capacities is carried out in a transparent, competitive and non-discriminatory manner. The reserve capacity to be procured (max. 2 GW) is put out to tender every two years and the TSOs select the permissible bids according to the bid value in ascending order. The capacity reserve plants are activated by the TSOs when demand on the electricity market is not expected to be fully met by normal supply. The reserve will be called upon if the secure and reliable operation of the German transmission grid is jeopardised and all grid-related measures (e.g. grid switching) and market-related measures (e.g. use of balancing energy) have been exhausted. The balancing groups that are responsible for a call but have insufficient cover are involved in the costs of the capacity reserve: they have to pay an increased balancing energy price (currently at least approx. €20,000/MW) while the call is being made. The capacity reserve has, to date, not been utilised.

Regular monitoring of the security of electricity supply

Pursuant to section 63, paragraph 2 of the German Energy Industry Act (EnWG), the Federal Network Agency draws up a monitoring report on the status and development of security of supply in the electricity sector at least every two years. The purpose of this report is to ensure that the security of supply is closely monitored and, if need be, that sufficient time is allowed for possible measures to ensure supply security.

The last report on the monitoring of electricity supply security was published in February 2023 and shows that, based on the Federal Government's current plans, the supply of electricity will continue to be guaranteed at a high level in the period from 2025 to 2031 (even if coal is phased out by 2030). In the short term, the Federal Government will also consider scenarios with conservative and crisis-related assumptions as part of an electricity security analysis; these scenarios will depict critical situations and uncertain developments in the medium term as of 2030 (including delayed grid expansion, fewer renewable sources of energy, less expansion of controllable loads).

The reliability standard is not exceeded in any of the scenarios and sensitivities that were examined in the monitoring. To achieve this, a series of developments on the generation and grid sides must be realised, and the corresponding efforts continued. They include, for example, the construction of new power plants, the realisation of flexibility potentials and the implementation of cross-border redispatch. A secure supply for consumers applies, both in terms of sufficient generation capacities and sufficient grid capacities: The results on the market side show that, in the period up to 2030-31, demand can be met at all times, at every hour of the year. The grid-related investigations demonstrate that, if the current grid expansion targets are met and the potential available for congestion management is utilised, congestion-free grid operation can be guaranteed.

The Federal Network Agency has based its analysis on the Federal Government's ongoing plans for restructuring the electricity system. They include the following: energy from renewable sources will be expanded in line with the targets of the Renewable Energy Sources Act and the amended Offshore Wind Energy Act. By 2030, the generation capacities of onshore and offshore wind and photovoltaics will be increased to 360 GW. The transmission and distribution grids are being expanded in line with the Network Development Plan.

On the basis of the report, the Federal Government has developed and adopted recommendations for action that will ensure the security of supply analysed in the report. They include the following, among others

- expanding the use of renewable energy sources,
- activating untapped potential through local incentives and flexibility
- accelerating the planning and approval procedures for grid expansion and
- further developing reserve instruments.

The above-mentioned rules and measures for the gas sector in the event of a disruption to the gas supply apply in a very similar way to the electricity sector. In the first place, according to section 13 of the Energy Industry Act, the TSOs are authorised to take network-related and market-related measures and to use the network reserve and the capacity reserve in order to eliminate hazards to or disruptions of the electricity supply system. Should these instruments be insufficient, the TSOs are authorised and obliged to adjust all electricity inputs, transits and offtakes. If this is also insufficient and if there is an immediate risk of disruption to the energy supply that would jeopardise the coverage of vital energy needs, the instruments of the Energy Security of Supply Actand accompanying ordinances then come into play:

Energy Security of Supply Act (EnSiG)

The Energy Security of Supply Act (EnSiG) contains provisions for avoiding an energy crisis and for dealing with any impending or acute energy crisis. It aims to prevent or rectify supply disruptions, initiate countermeasures and ensure the supply of essential energy needs. It encompasses petroleum and petroleum products, other solid, liquid and gaseous fuels, electric power and other forms of energy (commodities). What characterises the EnSiG is its comprehensive scope of authorisation. This concerns, among other things, the authorisation to take certain measures to avert any immediate threat to or disruption of the energy supply and to take the measures needed to ensure the supply of vital energy needs in the event of an immediate threat or disruption. On the basis of the EnSiG, the Ordinance on Securing Electricity Supply in a Supply Crisis (Security of Electricity Supply Ordinance – EltSV) was issued, among other things, for the electricity sector.

Ordinance on Securing Electricity Supply in a Supply Crisis *(Security of Electricity Supply Ordinance – EltSV)*

The Security of Electricity Supply Ordinance (EltSV) authorises the load distributor, which becomes active in the event of a crisis, to take measures at all levels of the energy industry value chain on the basis of the EnSiG. It can, for example, issue directives to companies and consumers regarding the allocation, procurement and use of electrical energy. The EltSV is in force but will only be actually applied when it is determined by means of a further statutory instrument that there is a risk or disruption to the energy supply within the meaning of the Energy Security Act and that the EltSV applies.

Ordinance on the Security of Electricity Supply (Electricity Load Distribution Ordinance – EltLastV) and General Administrative Regulation for the Electricity Load Distribution Ordinance (EltLastVwV)

In the event of an emergency or a state of defence, special regulations apply to remedy or contain the consequences of any disruption to the power supply. If the Bundestag has declared a state of tension or a state of defence or it has given its special consent to such a measure, the Federal Government can regulate the supply of electricity for defence purposes by ordinance under the Act on the Maintenance of Economic Activity (WiSiG). The Electricity Load Distribution Ordinance (EltLastV) was issued on the basis of the WiSiG. The aim of the EltLastV is to maintain the power supply in the event of a state of tension or a state of defence with the aid of state management measures. In accordance with the general administrative regulation on the Electricity Load Distribution Ordinance (EltLastVwV), it covers the entire area of electricity generation, distribution and use. In a similar way to the EltSV, the EltLastV cannot be applied without further ado. One prerequisite for applying the EltLastV is that another statutory instrument must establish that it applies. As with the EltLastV, the EltSV also authorises the load distributor to take measures at all levels of the energy industry value chain.

Measures in the event of an energy shortage

The transmission system operators are responsible for ensuring the security and reliability of the electricity supply system. Should they determine that the measures taken in accordance with section 13, paragraph 2 of the EnWG are insufficient to avert a supply disruption for vital needs within the meaning of section 1 of the EnSiG, they must immediately inform the regulatory authority, i.e. the Federal Network Agency. If the energy supply to meet vital energy requirements is in immediate danger or disrupted and the

danger or disruption to the energy supply cannot be remedied by market-based measures, cannot be remedied in good time or can only be remedied by disproportionate means, the powers of the EnSiG apply.

3.3.ii. Regional cooperation in this area

Natural gas

Risk groups

With the entry into force of Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply, a regional chapter is to be added to each national preventive action plan and each emergency plan. Risk groupsThese chapters are being drafted jointly by the EU Member States in so-called risk groups. Germany has taken over the chair of the "Baltic Sea" risk group and is involved in a further six risk groups (Ukraine, Belarus, Northeast, L-Gas, Denmark and the North Sea (consisting of the former risk groups of Norway and the UK)).

Consultations on the prevention and emergency plan

As part of the crisis preparedness measures under Regulation (EU) 2017/1938, the above-mentioned national prevention plan and the national emergency plan for crisis preparedness are drawn up along with the national risk analyses. In Germany, these plans are discussed with the departments of the Federal Government, the relevant authorities of the 16 German *Länder*, and with professional and industry associations. At the European level, the competent authorities of all nine EU Member States directly or indirectly connected via Switzerland are consulted in accordance with Article 8 (6) of Regulation (EU) 2017/1938. Furthermore, consultations are also held with a further 15 EU Member States in the risk groups to which Germany belongs, as well as with Switzerland and the United Kingdom.

Mechanisms for working together in the event of a crisis

In principle, the European Commission is responsible for coordinating the flow of information between the Member States at all three crisis levels. The Federal Ministry for Economic Affairs and Climate Action is the central point of contact for the Member States connected by gas infrastructure, the EU Commission and beyond, and it ensures the appropriate flow of information.

Since congestion situations can vary greatly and require reactions based on comprehensive information, the fundamental and overriding concern of the risk groups is to ensure the flow of information between the Member States and relevant stakeholders of the risk group in an emergency situation. The cooperation mechanism within the risk group is subject to the coordination procedures between the Member States, transmission system operators, regulatory authorities and other authorised recipients of information at the various crisis levels. The goal is to provide the relevant authorised recipients with detailed information on the cause and effects of a crisis situation and to coordinate any potential, mutually agreed solutions to prevent or mitigate the negative effects of a supply crisis.

In general, the transmission system operators work closely with the TSOs of the other Member States of the group, in particular within the framework of the regional coordination system for gas (ReCo), established by the European Network of Transmission System Operators for Gas (ENTSO-G) in line with Article 3(6) of Regulation (EU) 2017/1938. At Member State level, this exchange takes place within the Gas Coordination Group (GCG) in accordance with Article 4 of Regulation (EU) 2017/1938. If a shortage in supply is foreseeable, the TSOs shall contact their counterparts in the other Member States belonging to the risk group. Where possible, they shall agree on the cross-border coordination of measures, including the exchange of information on necessary market-based measures with cross-border effects.

The ReCo team is activated by the 24-hour operational response teams of the transmission system operators and ENTSO-G. After the meetings, ENTSO-G informs the European Union Agency for the Cooperation of Energy Regulators (ACER) and the EU Commission.

If a declaration of the state of emergency has become necessary and has been carried out, the load distributors of the Member States belonging to the risk groups and beyond remain in close contact with each other; in particular, the provide information on the expected extent of necessary cross-border load flow restrictions.

Solidarity between Member States in an acute shortage situation

According to Article 13 of Regulation (EU) 2017/1938, in the event of a severe gas shortage, Germany is obliged to provide gas to neighbouring EU countries with an infrastructure connection, including Italy, on a market-based and non-market-based basis, in a

spirit of “solidarity”. At the same time, these Member States also have obligations towards Germany.

In the unlikely event of a gas shortage and the associated fulfilment of European obligations in line with section 2a(2) EnSiG, the Federal Government will provide the market area manager with the necessary financial resources within the framework of budgetary law, if necessary at short notice within the framework of the emergency authorisation right in accordance with section 37 of the Federal Budget Code (BHO). The Federal Government is aware that the Trading Hub Europe (THE) will not be able to enter into any transactions within the meaning of section 2a (2) of the Energy Security of Supply Act that trigger a payment obligation unless these funds are provided.

The obligation to provide solidarity applies independently of any fundamental financial, procedural and technical understanding in bilateral solidarity agreements. To date (as of August 2023), Germany has concluded bilateral solidarity agreements with Denmark (14 December 2020) and Austria (1 December 2021) in accordance with Article 13 of Regulation (EU) 2017/1938.

Germany has prepared and carried out all the processes to enable its neighbouring countries with infrastructure links to Germany, including Italy, to request and adequately handle gas solidarity in the event of a severe gas shortage. All neighbouring EU countries with infrastructure connections to Germany, including Italy, have been informed about how Germany will apply the principle of solidarity in accordance with Article 13 of Regulation (EU) 2017/1938 and how Germany will fulfil its solidarity obligations towards these EU Member States in accordance with Article 13 of Regulation (EU) 2017/1938. Moreover, Germany has asked its neighbouring countries, including Italy, to provide the technical requirements that Germany has to meet for Germany to be able to request gas solidarity from its neighbouring countries, including Italy.

Petroleum

Germany’s provisions for an oil crisis are embedded in international structures, both within the European Union (EU) and at the supranational level of the International Energy Agency (IEA). The IEA’s specialised group is the Standing Group on Emergency Questions (SEQ) and that of the EU is the Oil Coordination Group (OCG). A continuous exchange of information takes place at regular intervals between national experts, enabling internationally

coordinated crisis prevention measures to be carried out at an early stage should an emergency arise. Based on the joint work done, a detailed mineral oil data system was developed. The respective petroleum stockholding organisations are involved in the work of the relevant EU and IEA working groups.

Annual Coordinating Meeting Entities Stockholding (ACOMES)

The oil storage associations organise themselves within the framework of ACOMES. They exchange ideas on specific, subject-specific topics and new developments on an annual basis.

Electricity

In the context of crisis prevention, in the future, regional structures will increasingly gain in importance alongside national structures. In accordance with the Risk-Preparedness in the Electricity Sector Regulation, which came into force on 4 July 2019, provisions are to be introduced at the European level for the first time ever in order to support EU Member States in jointly ensuring the security of the power supply, even in extreme situations (see Chapter 2.3.i.).

Cross-border analysis of the security of supply in the electricity market

The security of supply on the electricity market must be considered across borders, since the individual electricity markets are highly interconnected. A mere country-specific view would misrepresent the actual level of the security of supply. In this context, the assessment of supply security should be based on probabilities. The Federal Government bases its analyses of the security of electricity supply on such probability-based approaches and is continuously developing the underlying methods further. The desired target level is set to assess the actual supply security and to determine any measures that may be required. In addition, the Federal Government is exploring adapted approaches for identifying and evaluating specific crisis scenarios that could necessitate the use of strategic reserves for risk prevention and management.

Pentalateral Energy Forum – security of electricity supply

Since 2015, the TSOs of the Penta countries have regularly published a joint regional assessment of security of supply. It is based on the same methodology as the national report (see above) and the European Mid-term Adequacy Forecast. Furthermore, in 2018, the Member States held an initial joint crisis exercise

involving the transmission system operators, the regulatory authorities and the ministries in the region. This exercise aimed to prepare Member States for closer co-operation under the Electricity Risk-preparedness Regulation. For further details, please refer to Chapter 3.4.

3.3.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The electricity grids, together with reserves such as capacity and grid reserves or security standby, make a significant contribution to ensuring the security of energy supply. The electricity grids and reserves are financed by the grid fees.

In the gas sector, supply security is ensured by means of modern and well-developed transmission networks (see Chapter 2.4.2.).

3.4. Dimension "Internal Energy Market"

3.4.1. Electricity infrastructure

3.4.1.i. Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

Network Development Plan (NEP) – Electricity

Pursuant to section 12b of the Energy Industry Act (EnWG), the transmission system operators are obliged to submit a joint NEP every two years. In it, they identify all the measures that are necessary for safe and reliable network operation. The Network Development Plan covers both medium-term developments (the next ten to 15 years) and long-term scenarios up to 2045. The underlying assumptions are defined in the scenario framework according to section 12a EnWG. Among other things, assumptions are made about new electricity exchanges with other countries. Based on this, the NEP also examines the construction of new interconnectors. As provided for in Article 4 (d) (1) of the Governance Regulation, a cost-benefit analysis is carried out. This also ensures that interconnectors to neighbouring countries with which there are large price differences tend to perform better.

The NEP is reviewed and confirmed by the Federal Network Agency. The network expansion measures can then be included in Federal Requirements Plan Act and thus become legally binding.

Interconnectors included in the Power Grid Expansion Act (EnLAG) and the Federal Requirements Plan Act (BBPlG)

The Federal Requirements Plan Act was last amended in 2022 on the basis of the NEP 2021-2035. The current Federal Requirements Plan Act, therefore, already includes many interconnectors that contribute to achieving the electricity interconnection target. The following tables show all interconnectors included in the Power Grid Expansion Act and the Federal Requirements Plan Act.

Table A4: Interconnectors already in place:

Project EnLAG/BBPlG	No. acc. to	TYNDP No.	Start of operation	Europ. Status
DE–NL (Lower Rhine/Wesel – NL Doetinchen)	EnLAG No. 13	113/145	2018	
DE-PL (Uckermark power line, section Vierraden – Krajnik)*	EnLAG No. 3		2018	
DE–DK (Mittelachse line; Kassø – Hamburg North– Dollern)	EnLAG No. 1	39, 251	2020	
DE–DK (Kriegers Flak Combined Grid Solution, P64)	BBPlG No. 29	36/141	2020	
DE–BE (Alegro Oberzier – BE border, P65)	BBPlG No. 30	92	2020	
DE-NO (NordLink, Wilster – Southern Norway)	BBPlG No. 33	37	2021	
DE–DK (West Coast line Niebüll – DK border, P25)	BBPlG No. 8	183	2023 (DE ready for operation)	

*Total commissioning in 2024 (Neuenhagen – Bertikow/Vierraden – Krajnik)

Table A5: Further interconnectors with scheduled commissioning by 2030:

Project EnLAG/BBPlG	No. acc. to	TYNDP No.	Target date acc. to current BNetzA monitoring	Europ. Status
DE-SE (HansaPowerBridge, Güstrow – Sweden)	BBPlG No. 69	176.995	2026 (currently postponed by SE)	
DE-GB (NeuConnect, Fedderwarden – United Kingdom)	BBPlG No. 70	309	2026 (currently: 2028)	
DE-FR (Eichstetten – FR border)	BBPlG No. 72	228	2026 (currently: 2027)	
DE-LU (Trier-Saarburg district – Bofferdange)	BBPlG No. 71	328	2027	

DE–AT (Altheim – AT border, Pleinting – AT border, Simbach – AT border))	BBPlG No. 32	313	2027/2030	PCI 3.1.1
DE-FR (Uchtelfangen – Ensdorf – federal border)	BBPlG No. 97	244	2030 (currently: 2028)	
DE–AT (point of Neuravensburg – AT border)	BBPlG No. 40	3.221.477	2030	

Table A6: Further interconnectors scheduled to be commissioned after 2030:

Project EnLAG/BBPlG	No. acc. to	TYNDP No.	Target date acc. to current BNetzA	Europ. Status
DE-NL (Emden Ost – Eemshaven)	BBPlG No. 86	1047	2034	
DE-BE (Dahlem – federal border)	BBPlG Nr. 95	225	2035	
DE-CH (Waldshut-Tiengen – federal border)	BBPlG No. 99	231	open	
DE–PL (Eisenhüttenstadt – Baczyna)	EnLAG No. 12	229/230	open (postponed by PL)	
DE-SE (HansaPowerBridge II, Sanitz / Gnewitz / Dettmannsdorf / Marlow – Sweden)	BBPlG No. 83	2.671.262	open (postponed by SE)	

The finalised NEP 2023-2037/2045 looks ahead to 2045 for the first time ever and thus reflects an even higher level of ambition. Consequently, the Federal Network Agency has approved additional grid expansion measures that will further increase the level of interconnectivity. These measures, too, should be included in the BBPlG.

3.4.1.ii. Regional cooperation in this area

Regional collaborative projects and collaboration extend beyond the field of electricity infrastructure and are concisely presented in Chapter 3.4.2.ii. for Chapter 3.4., which deals with the dimension of the Internal Energy Market.

3.4.1.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The financing measures at national level and through EU funds are summarised in Chapter 3.4.2.iii.

3.4.2. Energy transmission infrastructure

3.4.2.i Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infra structure projects

Monitoring and controlling the grid expansion project for electricity

Since the start of 2016, the Federal Network Agency has been monitoring the individual EnLAG and BBPlG projects as well as the grid connection lines for offshore wind farms on a quarterly basis and publishing the results (www.netzausbau.de). This means that the general public can obtain information about the progress of the grid expansion at any time. Since 2019, the BMWK network expansion controlling has been available for onshore projects. It complements the network expansion monitoring carried out by the Federal Network Agency. In 2020, the BMWK's controlling was extended to the offshore projects. As part of the controlling of the network expansion, the project sponsors and responsible approval authorities inform the BMWK on a quarterly basis about the current status of and plans for the individual projects. Moreover, one-on-one meetings are held, in particular for the HVDC projects, which are supplemented by regular ad hoc discussions on the other federal, state and offshore projects.

Accelerated expansion of electricity grids

In order to accelerate the expansion of the electricity grid, numerous statutory and non-statutory measures have been taken in recent years.

Amendments to the legal framework as part of the package of immediate energy measures

As part of the package of immediate energy measures, the possibilities for dispensing with federal sectoral planning were expanded in 2022 by bundling projects more closely together and developing so-called preferential areas. The greater degree of bundling also reduced the number of alternatives to be examined. Furthermore, the application documents in the federal sectoral planning have been simplified; the scoping conference in the federal sector planning can now be dispensed with. The requirement for local authorities to inspect overhead power lines for underground cable direct current projects has been abolished and the electronic interpretation of documents in procedures according to NABEG has been stabilised. The acquiescence orders

for preparatory work and their enforceability, as well as the authorisation and enforcement of an early start to construction, have been simplified.

Amendments to the legal framework as part of the Energy Security of Supply Act

Further measures to accelerate grid expansion were taken with the Act Amending the Energy Security Act and other energy industry regulations. In particular, the approval of the early start of construction has been further improved, the notification procedure for conversions, the addition of cables and site-specific mast modifications has been expanded and an isolated plan approval for ancillary facilities has been made possible; hearings are now at the discretion of the authority.

EU Emergency Authorisation Regulation

The EU Emergency Authorisation Regulation further accelerates the procedure for expanding the electricity grids, especially with the rules of application in Article 6. When transposed into German law as part of the amendment of the Spatial Planning Act and other provisions, an environmental impact assessment and a species protection assessment can be waived for a limited period if the grid expansion projects are constructed in areas for which a strategic environmental assessment has already been carried out.

Amendments to the legal framework as part of the Act on the Adaptation of the Energy Industry Act to EU Law and on the Amendment of Other Energy-related Legal Provisions

The Act on the Adaptation of the Energy Industry Act to EU Law and *on the Amendment of Other Energy-related Legal Provisions* (the so-called EnWG Amendment), which came into force at the end of 2023, contains further provisions to accelerate the expansion of the grid: the bundling requirement is being reinforced and the two-stage plan approval procedure of the NABEG is to be a single-stage procedure in the future, like the procedure under the EnWG. It also envisages more efficient public participation and greater digitalisation, as well as easier implementation when the supplement to the plan is being drawn up. Finally, the approval of so-called stopgap solutions is to be facilitated: such solutions are temporary high-voltage lines that are erected, for example, during the construction phase of a permanent high-voltage line in order to enable stable grid operation to continue during this period. Likewise implemented was an obligation on property owners to

tolerate the transport of important network components, as well as a provision for an efficient arrangement of routes and the dismissal of unsuitable alternatives.

Outlook: legislative changes

The draft for transposing RED III into national law is currently in the parliamentary process.

Best practice exchange

On behalf of the BMWK, a Practical Guide to Grid Expansion was drawn up and published in October 2021. It contains more than 100 recommendations for action based on practical experience. The aim of the guide is to provide approval authorities and project sponsors with best practice examples for accelerating and optimising grid expansion. It includes recommendations on project management, resource management, public participation, licensing and project realisation. In addition, the BMWK has already hosted four best practice forums to present the findings compiled in its practical guide and to discuss selected topics in greater depth. The best practice forums are also intended to enable an exchange of experience and knowledge transfer at the technical level between the relevant approval authorities, the Federal Network Agency and the project sponsors. Both are intended to help make the approval and realisation of grid expansion projects more efficient.

Reduction of the scope and depth of testing

Furthermore, the BMWK, the Federal Network Agency and the transmission system operators are engaged in a close dialogue with the aim of reducing the scope and depth of the review in the approval procedure while at the same time complying with the legal requirements, thus shortening the overall duration of the procedure. The aims of the fastest possible, most economical and most straightforward network expansion should be given greater consideration in the planning and approval process.

Optimisation and modernisation of the existing grid

The grid operators are obliged to operate, optimise, reinforce and expand the electricity grid as needed. The so-called NOVA principle prioritises optimisation over grid reinforcement and expansion. Various measures to optimise the existing grids and increase the transmission capacity of the existing electricity grids are planned. They include, among other things, the comprehensive roll-out of

overhead line monitoring (temperature measurement enables higher transmission capacity of the lines depending on the weather); the use of high-temperature conductors; short-term interim measures (in particular phase shifters for targeted load flow control, temporary higher capacity utilisation); the optimisation of redispatch processes and the introduction or further development of modern, digital technologies and system management concepts. In 2023, a large number of ad hoc measures aimed at consistently increasing capacity utilisation and optimising the network infrastructure were identified in the process of the network optimisation action plan; some of these measures have already been implemented, or the legal and regulatory foundations have been laid.

Secure grid operation using electricity based entirely on renewable sources of energy

Besides the rapid expansion of renewable sources of energy and electricity grids, stable grid operation is vital for the continued success of the energy transition on the way to a climate-neutral electricity system. The Federal Government has thus worked with the industry to develop a Roadmap for System Stability, which it adopted at the end of 2023. The Roadmap contains a timetable for the secure and robust operation of a grid that is based 100% on renewable sources of energy. In the process, the need for action was identified and processes and responsibilities were clearly defined in order to address this need for action. The requisite measures are also to be implemented and monitored in cooperation with the industry. As one building block for this, transmission system operators are to regularly draw up a System Stability Report in the future; it should contain necessary measures and requirements as well as options for action towards the stable operation of a grid that is based entirely on renewable sources of energy. The Federal Network Agency will monitor its implementation.

Network Development Plan (NEP) – Gas and Hydrogen

Under section 15a of the EnWG, the TSOs are obliged to jointly draw up the NEP every two years. This must encompass all the effective measures for the demand-oriented optimisation, reinforcement and expansion of the grid and for ensuring supply security that are necessary over the next decade to ensure the secure and reliable operation of the grid. It is the responsibility of the DSOs to provide the necessary information for this, cf. section 15a(4) EnWG. In accordance with section 15a (1) sentence 4 of the

Energy Industry Act, the NEP Gas also includes assumptions about possible disruptions to security of supply. After having been examined by the Federal Network Agency, this plan becomes binding on the TSOs.

In the draft of the Network Development Plan Gas 2022-2032, dated 31 March 2023, the network expansion proposal comprises a total of 140 measures with an investment volume of approximately €4.4 billion. A total of 82 new measures have been added to the 2020-2030 Network Development Plan Gas. Compared to the previous Network Development Plan, the additional measures proposed are largely related to the changed flow situation in the transmission network on account of the loss of Russian natural gas volumes. Against this backdrop and in order to ensure the long-term security of supply, the network expansion measures for the future transport of LNG play a decisive role. Moreover, further expansion measures are required for the future demand made by gas-fired power plants and the conversion from low-calorific gas to high-calorific gas.

As part of the legal regulations for the second stage of the accelerated hydrogen network roll-out, the Network Development Plan Gas and Hydrogen is to be integrated in the future. The parliamentary process for this legislative amendment was finalised in the spring of 2024. As part of this future ongoing Network Development Plan for Gas and Hydrogen, a draft scenario framework for a network development plan is to be presented on 30 June 2024, based, among other things, on assumptions about the development of the production or generation, supply and consumption of gas and hydrogen. It is to be used as the basis for the first integrated Network Development Plan Gas and Hydrogen, which is to be drawn up by 30 June 2026 and approved by the regulatory body. This recurring planning process offers the fundamental possibility of adjusting the dimensioning of the hydrogen network according to demand and scenario, for example, based on updated demand forecasts for different regions.

Monitoring the gas network expansion plans

With regard to the expansion of gas transmission infrastructure, section 15b of the EnWG requires transmission system operators to draw up an implementation report in every odd-numbered calendar year, with the first report falling due on 1 April 2017. This report must include information on the implementation status of the most recently published NEP, and, in the event of delays in carrying out individual projects included in the NEP, the reasons for

any such delays and their possible effects, for example on the provision of capacities. The BNetzA reviews and publishes the implementation report and gives all actual and potential network users the opportunity to comment. The results of this consultation will also be published by the BNetzA and may be incorporated into requirements for the next NEP process or into other regulatory procedures.

3.4.2.ii. Regional cooperation in this area

Pentalateral Energy Forum – internal energy market

The aim of the Pentalateral Energy Forum is to achieve closer coupling of the electricity markets of the participating countries, to test and implement new forms of cooperation and thus to gain experience in cross-border cooperation. Germany is participating in drawing up the regional security of supply report (see also Chapter 3.3.i.).

Stromnachbarn

Stromnachbarn or "electricity neighbours" is a collaborative project that includes all of Germany's neighbouring countries, as well as Norway and Sweden. The group came into being in 2014 and is primarily concerned with making electricity markets more flexible. It also serves to inform our "electricity neighbours" about developments in Germany and to involve them in the national debate on the energy transition.

Cooperation in regional groups within the framework of the Trans-European Networks for Energy (TEN-E regional groups) – internal electricity market

In the area of electricity infrastructure, four priority energy infrastructure corridors have been defined by the TEN-E regional groups; in each of them, Germany is listed as an affected member state and is thus a member of the corresponding regional group. They include the North Sea Offshore Grid (NSOG), north-south electricity interconnections in Western Europe (NSI West Electricity), north-south electricity interconnections in Central Eastern and South Eastern Europe (NSI East Electricity) and the Baltic Energy Market Interconnection Plan in electricity (BEMIP

Electricity), which is to be clearly distinguished from the BEMIP cooperation forum in Chapter 1.4.).

3.4.2.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Investments in the expansion, reinforcement and optimisation of the transmission grids are not only important for the German energy transition. They are also crucial to driving forward the European single market. The refinancing of these costs is regulated by the incentive regulation and the Electricity Network Tariffs Ordinance. The investment measure instrument is a separate refinancing instrument for significant expansion and restructuring investments in the transmission grid. Certain PCI projects can apply for financial support for construction projects and preparatory studies from the Connecting Europe Facility (CEF). In the past, the German electricity grid projects “SuedLink” and “SuedOstLink” have been subsidised with CEF funds.

3.4.3. Market integration

3.4.3.i. Policies and measures related to the elements set out in point 2.4.3

Market integration measures

Phased reduction and termination of coal-fired power generation on the basis of the Act to Reduce and End Coal-Fired Power Generation (by 2038 at the latest) and the law to accelerate the phase-out of lignite in the Rhenish mining region

A gradual reduction and phase-out of coal-fired power generation in Germany is planned. To this end, the Act to Reduce and End Coal-powered Energy and Amend Other Laws (Coal Phase-Out Act) came into force in August 2020. The “Coal Phase-out Act” implements the energy policy recommendations of the Commission on “Growth, Structural Change and Employment”. It contains, among other things, provisions to reduce and end the use of hard coal and lignite for generating power by 2038 at the latest, to continuously monitor the security of supply, to cancel CO_2 certificates that become

available and to provide adjustment benefits for older employees in the coal sector.

The main component of the Coal Phase-out Act (omnibus law) is the Act to Reduce and End Coal-Fired Power Generation (KVBG), which regulates the gradual reduction of coal-fired power generation with fixed target dates for 2022 (15 GW hard coal, lignite), 2030 (8 GW hard coal, 9 GW lignite) and 2038 (0 GW). The phase-out of hard coal-fired power generation will initially be carried out by means of tenders and subsequently by means of legal requirements. The reduction in lignite-based electricity generation will be realised by 2038, at the latest, by means of a legally binding decommissioning path for lignite-fired power plants.

The law to accelerate the lignite phase-out in the Rhenish mining region has brought forward the lignite phase-out in the Rhenish mining region by around eight years, i.e. from 2038 to 2030. The law to accelerate the phase-out of lignite mining in the Rhineland came into force in December 2022.

Sector coupling

Sector coupling, i.e. the efficient, direct and indirect use of electricity generated by renewable sources of energy, is to be promoted in order to replace fossil fuels in the heating, industry and transport sectors. The coupling or electrification of the sectors will lead to a strong increase in electricity demand in Germany (cf. Chapter 2.3.i.). Thus, besides a sufficient supply of electricity from renewable energy sources, stable and well-developed transmission and distribution grids are an important prerequisite to successfully achieve sector coupling. In addition, fair competitive conditions will be created that allow the market to decide which technologies will ultimately prevail and thus be deployed. This, in turn, will stimulate innovation and the launch of modern technologies onto the market. Ideally, efficient sector coupling and the associated CO_2 reduction would be primarily market-driven and would be achieved without any lock-in effects via price signals. In order for sector coupling to make a significant contribution to achieving climate neutrality by 2045, besides the transmission capacities required for electricity at the transmission and distribution grid level, generation capacities must be expanded quickly, too.

Action plan to reduce grid congestion

On 28 December 2019, Germany submitted the “Action Plan Bidding Zone”, based on Article 15 of the European Electricity

Market Regulation, in order to address the issue of structural grid congestion. This plan represents the planned linear increase in the available transmission capacities for cross-zonal electricity trading (minRAM – Minimum Remaining Available Margin) to 70% by 31 December 2025. For the year 2023, the applicable minimum value in the CORE region (cf. Chapter 3.4.3.i) was 40.8%. The transmission system operators (TSOs) concerned are obliged to carry out an annual review of compliance with the minRAM requirements. The TSOs' report implementing this confirms that the requirements were met in 2023. It was necessary to fall below the minimum values for a few hours to ensure system security; this was thus in accordance with the Electricity Market Regulation.

Moreover, the action plan defines national measures designed to accelerate grid expansion (e.g. through shortened approval procedures), to increase electricity transmission capacities (e.g. through weather-dependent overhead line operation), to improve congestion management (e.g. through optimising the integration of RE and CHP plants in redispatch) and to strengthen cross-border redispatch. Germany is also keen to intensify existing cooperation with neighbouring countries and to initiate further collaborative projects.

Cross-border measures in the action plan aimed at reducing grid congestion

Many measures that have a positive impact on grid congestion can only be applied in conjunction with neighbouring countries, because, for example, they require coordinated action. One example of this is the optimisation of cross-border redispatch, which can only be carried out together with neighbouring countries. Recent studies by Consentec and IFHT show that optimising cross-border redispatch can greatly reduce redispatch costs for the entire region and help meet European targets for electricity trading. There are grid bottlenecks within the European electricity grids that cannot be effectively resolved by means of purely national measures. That is why Germany is already cooperating with many neighbouring countries on the issue of redispatch. These mostly bilateral co-operations are to be supplemented by further collaborative activities. In the medium term, cross-border redispatch is to be optimised across the entire region. To this end, the transmission system operators are currently developing a methodology that will then be approved by the national regulatory authorities. To bridge

the interim period, the existing redispatch arrangements are to be continued and expanded as far as possible.

Measures for improved market coupling

Creation of a Central and Eastern European Capacity Calculation Region (CORE)

Following a decision by the Agency for the Cooperation of Energy Regulators (ACER) in November 2016, a single Central Eastern European capacity calculation region was created when the CORE region went live on 8 June 2022. It comprises a total of 13 states: Austria, Belgium, Croatia, the Czech Republic, France, Germany, Hungary, Luxembourg, the Netherlands, Poland, Romania, Slovakia, Slovenia. The flow-based market coupling (FBMC) used, in which an algorithm based on day-ahead electricity trading and a network model carries out welfare-optimising capacity distribution, makes it possible to use the scarce transmission capacities between bidding zones much more efficiently. This also strengthens the integration of renewable sources of energy into the internal electricity market. The next step will be to introduce flow-based market coupling for intraday power trading.

Coupling of intraday power trading

Alongside the cross-border day-ahead market, the importance of cross-border intraday trading is also growing. Two parallel processes for optimising intraday trading capacities support this process: on the one hand, there is the so-called XBID project (Cross-Border Intraday), which has been connecting the intraday markets in Northern, Western and Southern Europe since June 2018, initially on the basis of conventional capacity allocation. Work is also already underway to expand this market coupling towards Eastern Europe. And on the other hand, there is the expansion of load flow-based market coupling to include intraday trading. Both measures help to ensure that cross-border electricity markets can exchange flexibilities at short notice, i.e. until shortly before real time, and thus jointly respond to short-term changes in generation and demand.

System development strategy

Coordinated planning in the various sectors (electricity, gas and, in the future, hydrogen) is essential to ensure an efficient energy infrastructure. In this context, the BMWK is developing a System Development Strategy that addresses key issues relating to the decarbonisation of all sectors, thus providing an overarching image of the future requirements for the various energy infrastructures. The system development strategy can thus set guidelines for infrastructure planning that all processes can use as a guideline. This ensures efficient and consistent planning in the areas of electricity, gas and hydrogen.

3.4.3.ii. Measures to increase the flexibility of the energy system with regard to the production of energy from renewable sources such as smart grids, aggregation, demand-side management, storage, distributed generation, mechanisms for dispatching, re-dispatching and input restriction of power plants as well s real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

Integrating European electricity markets further and making them more flexible

A European electricity system makes it easier to respond to both increasingly flexible generation and fluctuating consumption, thereby reducing the overall costs of electricity production and the need for capacity. The planned implementation of flow-based market coupling in the intraday market within the CORE region is a step that will further the integration of the European power markets (details on flow-based market coupling and the CORE region are provided in Chapter 3.4.3.i.). Moreover, the Network Code on Capacity Allocation and Congestion Management (NC CACM) establishes a method for carrying out coordinated cross-border redispatch. Two new NCs are currently in the design phase. The NC on Cybersecurity is intended to define a harmonised European standard to ensure the cyber security of cross-border electricity flows. The aim of the NC on Demand Response is to develop the participation of flexibility providers in European electricity markets.

Optimisation measures relating to redispatch

The question of how the interaction between the power market and the electricity grid can be organised in such a way that the overall system can be operated safely and cost-effectively is becoming increasingly important for a growing share of renewable sources of

energy in the generation of electricity and for ongoing sector coupling. The measures currently envisaged include the following:

- Higher utilisation of the existing network so as to increase the transport capacity of the grids (see 3.4.2.i).
- The more efficient organisation of redispatch for the gradual phase-in of a plannable process with a balanced outcome in terms of the grid and energy has been implemented by law. The aim of introducing Redispatch 2.0 is to increase efficiency by optimising the redispatch system across the entire grid. The grid operators are currently in the process of implementing the requirements in practice. Cross-border redispatch should be transferred to a European regime to strengthen cross-border trade (see also 3.4.3.i.).

Monitoring obstacles to flexibility and identifying potential for flexibility

The act of integrating renewable sources of energy into the electricity market requires, among other things, demand-side flexibility. Flexibility (both market and grid-related) is thus becoming increasingly significant. The aim is to take a holistic, systematic view of the numerous technological, market-related, regulatory and other aspects and interdependencies so as to make flexibility requirements and potential usable in a way that benefits the system.

The Expansion and Integration of Flexibility Options working group of the Platform for a Climate-Neutral Electricity System (PKNS) has discussed how flexibility options can be used to balance the system and how they can be integrated into the electricity system, as well as which hurdles and barriers need to be removed to achieve this. Solution options with a focus on demand-side flexibility options were also discussed with the stakeholders. They will be summarised in more detail in an "options paper", which will serve as a basis for political decision-making following a written consultation.

There are still regulations in place that make it difficult for market players to act flexibly, i.e. so-called flexibility barriers. If all technologies are to receive the same market access, then this will mean removing these barriers to flexibility. According to the recently adopted reform of the EU electricity market regulation, Member States must submit a report on flexibility requirements (after ENTSO-E/ACER have defined a methodology). This report should analyse the various flexibility needs and potentials with a

focus on ensuring supply security and supporting the decarbonisation of the electricity sector. Germany will then derive an indicative target for non-fossil flexibility and show how load flexibility and storage facilities contribute to the overall target.

It is particularly cost-effective when the various options for flexibility – expanded electricity grids, flexible power plants and consumers, storage facilities, electricity exchange with European neighbours – all compete against each other. Care should be taken not to favour certain technologies by providing one-sided support and making exceptions. This is something that the market can determine better.

Electricity Storage Strategy

Electricity storage systems can do more than just provide short-term flexibility to balance out volatile energy generation from solar and wind sources. They also offer grid and ancillary services and can provide controllable capacities. Over the next few years, electricity storage systems, in particular battery storage systems, will play an increasingly significant role in Germany's energy supply, purely as a result of market forces. This is already evident from the effects of the strong photovoltaic (PV) ramp-up: the more solar modules that are installed, the lower the market value of solar power becomes. In situations with a particularly high feed-in, the exchange prices even become negative. Without a corresponding level of battery storage, solar energy threatens to "cannibalise" itself. For this reason, it can already be observed that battery storage systems are often planned at the same time as new solar parks.

Furthermore, the strong increase in private rooftop photovoltaics (PV) is leading to an almost equally strong increase in home storage systems (80% of private PV is combined with battery storage), so that the electricity generated from renewable sources of energy can be consumed by the owners themselves rather than being fed into the public grid.

Currently (as of May 2024), stationary battery storage systems with a total capacity of 13.4 GWh have already been installed in Germany, which is more than double the figure for January 2023.

In view of this great practical relevance, the Federal Ministry for Economic Affairs and Climate Action presented an electricity storage strategy in December 2023. It identifies fields of action to further support the market launch and system integration. The

fields of action include, among other things, the consideration of electricity storage systems in the context of the Renewable Energy Sources Act, licensing issues, grid usage fees, construction cost subsidies, grid connection acceleration, ensuring system stability, bidirectional charging and other topics.

Heat Storage Strategy

The Heat Storage Strategy will address the storage capacities in buildings and the ensuing flexibility options for the electricity grid. What will also be dealt with are the issues of short-term and seasonal storage facilities in heat networks and the storage requirements for process heat. The demand for cooling in the individual sectors is also to be taken into account.

Heat stores should ultimately also help to make energy demand, and in particular electricity demand, more flexible in terms of time and location. In the building sector, they can, among other things, increase the rate at which they use the electricity they generate themselves, thus helping to avoid grid congestion.

3.4.3.iii. Where applicable, measures to ensure the non-discriminatory participation of renewable sources of energy, demand-side management and storage, including via aggregation, on all energy markets

3.4.3.iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy-poor consumers, and to improve the competitiveness and contestability of the retail energy market

In Germany, there is strong competition among providers in the energy retail sector. There are already more active stakeholders on the German electricity market than in almost any other country in the EU. According to the 2022 Market Power Report by the Federal Cartel Office, only RWE was clearly above the threshold set for presuming market dominance. LEAG and EnBW are approaching this threshold. The number of electricity and gas suppliers in Germany has increased continuously in recent years. In 2022, there were over 1,400 electricity providers and over 1,000 gas providers active on the German retail market. Added to this is the fact that the end customer prices for electricity and gas are not subject to state regulation. They emerge independently on a competitive basis. In most distribution grid areas, more than 100 different providers offer to supply residential customers. Competitive pricing and market liberalisation should continue to form the basis for

maintaining a high level of competitiveness on the electricity and gas retail market.

Protection of energy consumers and competitiveness/market integration at national and European level

In Germany, there are many different consumer protection measures in place. Examples include the existing transparency requirements. The option for consumers to call on the Energy Arbitration Service to settle disputes regarding grid connection, energy supply and energy metering out of court should also be mentioned here. The conciliation procedure, which is usually free of charge for consumers and in which the energy supply companies must participate (subject to a fee), should not take longer than three months and should end with a recommendation from the conciliator. Even though the conciliation recommendation is not binding, many suppliers do comply with it. The Federal Association of Consumer Organisations and the consumer advice centres use Marktwächter Energie, an early warning system, to specifically monitor the energy market from the consumer's perspective. An overall picture can be pieced together from individual complaints. This helps consumer advocates to identify undesirable developments at an early stage and to draw attention to them in good time, thus preventing any harm to consumers. In this way, the market watchdog also contributes to the cost-efficient and socially just energy transition for consumers. The internal electricity market directive has introduced a wide range of measures to protect consumers and strengthen consumer rights. They are aimed primarily at increasing transparency for consumers and include, among other things, additional, free-of-charge billing information during the fiscal year, the minimum requirements for utility bills and billing information, and the introduction of standards for electricity comparison portals. Where they did not already exist, Germany has transposed the measures into national law.

Concept of basic and fallback supply

The existing concept of basic and fallback supply also serves to protect residential customers. This ensures that, in principle, every residential customer has a legal right to be supplied with power or natural gas by the respective default supplier at its published general terms and conditions and general prices. This is done by imposing a unilateral contracting obligation on the energy supply company at the expense of the respective company with the universal service obligation, within the bounds of economic reasonableness. For example, the law restricts the right of the

utility company to immediately interrupt supply in the event of late payment or to terminate the contract with the customer. Furthermore, there is no minimum contractual term for the provision of basic services; it can be terminated by the customer at short notice at any time and without cause.

Protection against supply disruptions

There are several levels of protection against supply disruptions, which particularly benefit customers with poor payment records and avoid rapid supply disruptions in the event of payment arrears.

A threshold of payment arrears must be reached before customers are threatened with being disconnected (at least two monthly invoices and at least €100). A notice of disconnection must then give the customer a minimum period of four weeks. A specific interruption must be announced with a notice period of eight days and, at the same time, the conclusion of an avoidance agreement must be offered, which, besides an interest-free instalment payment agreement, provides for continued supply on a prepaid basis.

It follows from the deadlines that a disconnection can only be imposed more than three months after the first non-payment of the invoice, even if an attempt to reach an out-of-court settlement has failed. This period is extended even further in the case of instalment payments (because at least two monthly instalments in arrears are required before the disconnection is announced).

Most recently, in the face of rising electricity and gas prices, legal adjustments have been made to strengthen protection against supply disruptions due to non-payment of the bill.

The conclusion of an "debt settlement agreement" for consumers has also been made much easier overall and has been extended to energy supply contracts beyond the provision of basic services. The fulfilment of the obligations arising from the debt settlement agreement should be facilitated in particular by the fact that, in the case of higher debts, the debt settlement agreements must be concluded for a longer period of time so that the instalments do not overburden the parties concerned. In addition, it was stipulated that consumers can request a suspension of the monthly instalment payment agreement for up to three months during the period of a debt settlement agreement. Moreover, the protective stages already in place in the provision of basic services, which particularly benefit customers with poor payment records and avoid rapid supply

disruptions in the event of payment arrears, have been strengthened and initially transferred to special contracts for a limited period.

Furthermore, there are a variety of support options available under both the basic security benefits for jobseekers under Book II of the Social Code (Bürgergeld, the basic income scheme) and the social assistance under Book XII of the Social Code to prevent residential consumers from having their power cut off. If customers are unable to meet their energy costs and their energy supply has been disconnected or is at risk of being disconnected, they may be able to get a loan or, in exceptional cases, a grant (see sections 24 (1), 22 (8) of the Second Book of the Social Code (SGB II); sections 37 (1), 36 (1) of the Twelfth Book of the Social Code (SGB XII)). Support under section 36 (1) SGB XII is also possible for persons who would otherwise have no claim to benefits under SGB II or SGB XII (see section 21 sentence 2 SGB XII). For the month in which an annual statement of heating energy costs or the expenses for an appropriate stockpile of heating supplies is due, benefits can also be obtained under SGB II by persons who would otherwise have no claim to the basic income scheme known as “Bürgergeld” (cf. Section 37 (2) sentence 3 SGB II; one-off “Bürgergeld”). The same applies to persons who are not or no longer capable of working and who receive social assistance (section 35 (5) of the German Social Security Code XII). In addition, both basic security benefits for jobseekers and social assistance can be paid directly to the energy supplier so as to prevent, in advance, the risk of a power cut (see section 24 (2), section 22 (7) SGB II; section 35 (3) SGB XII).

Change in the distance allowance for long-distance commuters

Commuters who have to travel long distances to work, especially in rural areas, often have no access to a well-developed public transport system, nor is there, at present, a sufficient charging infrastructure and a sufficient number of vehicles with the appropriate range for commuters to switch to electric mobility in the short term. This will change in the coming years. Therefore, to ease the burden on them, the commuter allowance was increased from the 21st kilometre to 35 cents as of 2021 and again to 38 cents as of 2022, for a limited period until 31 December 2026.

Changes to housing benefit, tenancy law and energy law

To avoid social hardship due to rising heating costs, housing benefit recipients will be supported by an increase in housing benefit as a result of the 2020 Climate Action Programme. The CO_2 component

of the housing benefit, which came into force in 2021, is a supplement to the rent that is to be taken into account and results in a higher level of housing benefit when calculating the housing benefit. In addition, the law on the allocation of carbon dioxide costs has created a fairer distribution of CO_2 costs between tenants and landlords, based on their influence on the energy consumption of the building. This gives rise to a twofold incentive effect: for tenants, this means using energy efficiently, and for landlords, investing in climate-friendly heating systems and energy-efficient renovations. The law came into force on 1 January 2023 and is to be applied to new billing periods for heating and hot water costs as of 1 January 2023.

With the entry into force of the Housing Benefit Plus Act on 1 January 2023, the Federal Government has also implemented the most comprehensive improvement in housing benefit to date. The Federal Government has thus created the legal basis for providing even greater relief to lower-income households in Germany than previously with regard to the increased housing and heating costs. The main focus of the reform is on increasing the eligibility criteria for housing benefit and expanding the number of people that receive housing benefit by introducing a heating cost component, a climate component and an increase in the general level of benefits. The climate component in the housing benefit (supplement to the maximum rent of the housing benefit of €0.40 per square meter) acts as a low-bureaucracy cushion against higher rents in energy-efficient housing and new builds. The Housing Benefit Plus reform will more than double the housing benefit of the previous recipient households from around €180 to around €370 per month, and the number of households receiving housing benefit will increase from around 600,000 to around 2 million.

Transfer payments

Increased energy costs are already taken into account in the transfer payments in line with the established procedures. In the case of subsistence benefit systems in accordance with SGB II and SGB XII, this means that reasonable expenses for heating energy do not lead to unreasonably high expenses solely due to rising prices per unit of quantity. The development of prices for household electricity is taken into account when determining the amount of the flat-rate standard requirements and subsequently in the annual updates.

Structural policy support measures in connection with the gradual reduction and termination of coal-fired power generation

The Federal Climate Protection Act stipulates a reduction in German greenhouse gas emissions of at least 65% by 2030 compared to 1990 levels. Phasing out the thermal utilisation of coal (especially lignite) will make a substantial contribution to achieving these goals. However, the phase-out of coal poses structural challenges for the lignite mining areas (and the locations of the plants fired by hard coal). In order to actively shape structural change in these regions, the German Bundestag passed the Structural Development Act for coal mining areas in August 2020 with the approval of the Bundesrat. A new piece of core legislation, the new Coal Regions Investment Act (InvKG), came into force on 14 August 2020. The Federal Government is thus helping the regions affected by the coal phase-out to cope with the structural change. This affects both the lignite mining regions and the locations of power plants fired by hard coal. The so-called first pillar of the InvKG comprises federal financial assistance for particularly significant investments by the *Länder* and their municipalities and municipal associations in the lignite mining areas (cf. Chapter 1 of the InvKG). The selection and implementation of the projects are the responsibility of the *Länder*. A total of up to €14 billion will be available to the *Länder* until 2038. The second pillar of the InvKG comprises measures for which the Federal Government is directly responsible (cf. Chapters 3 and 4 of the InvKG). The lignite regions will receive up to €26 billion in funding by 2038.

The measures of the InvKG include, among other things, the expansion and establishment of federal programmes and initiatives (cf. Article 17 of the InvKG), the STARK federal programme (cf. Article 15 of the InvKG), the establishment of federal institutions in the mining areas (cf. Article 18 of the InvKG) and additional investments in federal trunk roads and railways (cf. Chapter 4 of the InvKG). The goal of the newly created federal programme STARK is to promote non-investment projects in the funding areas of the InvKG. In Article 18 of the InvKG, the Federal Government undertakes to create, by 31 December 2028, at least 5,000 new, additional jobs in federal authorities and other federal institutions in the coal-mining regions.

So that the measures taken by the Federal Government and the *Länder* in which the most lignite is mined can be coordinated as effectively as possible, the InvKG provides for the creation of a

Federal-Länder coordination committee (BLKG). It has been supporting and assisting the Federal Government and the governments of the Länder in implementing and executing the measures since August 2020, in particular through its recommendations (Article 25 (1), sentences 2-5 InvKG). This is to ensure that the money is only used to fund projects that are highly effective in terms of the funding objectives of the InvKG. The BLKG also fulfils an important coordinating function at federal level. Measures under Chapters 3 and 4 of the InvKG are only included in the Federal Government's financial planning once they have been approved by the BLKG. On 10 August 2021, the administrative agreement on structural aid for the sites of power plants fired by hard coal and the former Helmstedt lignite mining area (cf. Chapter 2 InvKG) came into force. A total of up to €1.09 billion in structural aid will be available to the affected Länder until 2038 at the latest. The Free State of Thuringia is to receive up to €90 million from the funds earmarked for the Central German mining area for redeveloping the Altenburg region, an area that used to mine lignite.

The term "structural aid" covers both federal financial aid for particularly significant investments by the *Länder* and their municipalities and municipal associations, as well as other federal measures to promote structural change. With the administrative agreement for structural aid, the *Länder* concerned have essentially opted for financial aid. The selection of projects and their realisation also lie within the responsibility of the *Länder*.

3.4.3.v. Description of measures to enable and develop demand-side management, including those addressing tariffs to support dynamic pricing

Dynamic electricity price contracts and smart meters

According to the Council Directive concerning Common Rules for the Internal Market in Electricity, electricity suppliers should be able to offer dynamic electricity price contracts.

The 2021 amendment to the Energy Industry Act (EnWG) transposed the EU law requirements for electricity supply contracts with dynamic tariffs into German law. In Germany, section 41a(1) of the Energy Industry Act (EnWG) requires suppliers to offer a tariff for the end consumption of electricity that provides an incentive for saving energy or controlling energy consumption, insofar as this is technically feasible and economically reasonable.

The regulation in section 41a (2) of the Energy Industry Act (EnWG), which was last developed with the Act for the Restart of the Digitisation of the Energy Transition (GNDEW) – Article 1 of the Act of 22 May 2023, Federal Law Gazette 2023 I No. 133), applies specifically to customers with smart metering systems.. Accordingly, all electricity suppliers – regardless of how many customers they have – must now offer the customers that have smart metering systems dynamic tariffs from 2025 onwards. At present, only suppliers that supply more than 100,000 end users are required to offer their customers that have an intelligent metering system a dynamic electricity tariff. This requirement is accompanied by the improved data basis for network operators and market players, also introduced with the GNDEW, particularly in the form of values that are measured every quarter of an hour and improved network condition monitoring.

At the same time, thanks to the GNDEW, the roll-out of intelligent measuring systems will be significantly accelerated and red tape cut. In particular, a legal roll-out schedule with binding targets and a concrete timeframewas established; the requirement for a market analysis and market declaration by the Federal Office for Information Security (BSI) is no longer applicable.

Establishment of a core energy market data register

The Federal Network Agency's core energy market data register became operational at the beginning of 2019. The register is used to record the master data of all grid-based energy supply systems in the electricity and gas market in Germany, as well as market players; the data are then stored in a standardised online database. Insofar as data protection regulations allow, the stored data can be accessed on the internet at www.marktstammdatenregister.de .

Acceleration and reduction of bureaucracy in the rollout of smart metering systems, consistent further development towards smart grids

Consistent digitalisation is more essential than ever for the Federal Government if it wishes to achieve its climate and energy transition targets. The huge expansion of renewable energy sources and the increasing sector coupling in the areas of mobility and heating call for accelerated digitalisation. The conversion of the German energy system to more renewable energy sources is increasing the demands made on secure and efficient grid operation. In the future, power generators and consumers will be linked via a smart grid and will be able to communicate with each other digitally. Creating

a platform means that a high degree of resilience and cyber security, synergy effects and the greatest possible system benefits are the strengths of the smart meter gateway (SMGW).

In Germany, the Metering Point Operation Act (MsbG) has provided the legal framework for the installation and operation of smart meters since 2016. The MsbG prescribes the roll-out of certified devices with a certificate from the German Federal Office for Information Security (BSI), which guarantees IT security and privacy by design. Five smart meter gateway manufacturers have currently passed all certifications. To maximise the benefits, the MsbG standardises the smart meter gateway as a communication platform for numerous applications (smart metering, smart grid, smart mobility, smart home, smart services) with the aid of extensive protection profiles and technical guidelines. The technical standards are continuously being developed in line with the requirements of the energy transition.

The Act to Relaunch the Digitisation of the Energy Transition (GNDEW – entry into force 27 May 2023 [Federal Law Gazette 2023 I No. 133]) amended the MsbG in particular, making the installation of smart meters less bureaucratic and more straightforward. Among other things, the smart meter roll-out will no longer require approval from the Federal Office for Information Security (BSI). The focus here is on the secure management and switching of systems and flexible consumer units by grid operators and market players via SMGW, which will be provided nationwide from 2025 onward. Further decisive framework conditions have been set with the specifications of the Federal Network Agency in accordance with section 14a EnWG and the BSI TR-03109-5 “communication adapters” (Technical Directive 5), which came into force at the same time on 1 January 2024. Grid operators and market players also receive the data required to ensure a smart energy system designed for renewable sources of energy in the form of grid status data and values that are measured every quarter of an hour.

The only thing that remains permissible is an efficient roll-out based on a cost-benefit analysis: statutory price caps ensure both public acceptance and economic efficiency. The direct costs (metering charges) for consumers and small plant operators were significantly reduced by the GNDEW thanks to a cap on the costs for a smart metering system of €20 per year (which corresponds to the current price ceiling for the standard modern metering device). At the same time, the network operators will bear a greater share of the costs.

3.4.4. Energy poverty

3.4.4.i. Where appropriate, policies and measures to achieve the objectives set out in point 2.4.4

The Federal Government is pursuing a comprehensive approach to reducing poverty, one that does not focus on individual needs, such as energy. The costs that households incur in purchasing energy are taken into account, as are other elements of essential needs. The existing legal provisions cover both long-term financial support for those in need and support in specific emergency situations, such as the threat of a supply disruption (see Chapter 2.4.4).

3.5. Dimension "Research, Innovation and Competitiveness"

3.5.i. Policies and measures related to the elements set out in point 2.5

Federal Government funding for energy research

The Federal Government's funding of energy research is coordinated by the Energy Research Policy Coordination Platform. The focus of energy research funding is the result of extensive consultation processes with stakeholders from the spheres of science, industry and civil society. For the reporting period, the 7th Energy Research Programme and the 8th Energy Research Programme on applied energy research are particularly noteworthy.

The "regulatory sandboxes of the energy transition" in the 7th Energy Research Programme have established a measure that provides targeted support for projects that systemically test innovations and research results in a real-world environment and on an industrial scale. They enable technology and the innovation transfer to be accelerated by closing the gap between research and energy industry practice: the dress rehearsal before market launch, so to speak. The transfer is supported by networking activities (in particular the energy research networks) and research communication. In addition, start-ups play a crucial role in the transfer process.

Research initiative to avoid process emissions in industry

More than a third of industrial emissions – almost 8% of total German greenhouse gas emissions – can be traced back to production processes in the primary sector. A new research initiative is being launched for the area of industrial process emissions; this should enable the primary sector in Germany to research and develop processes and process combinations that contribute to the direct avoidance of greenhouse gases in key sectors such as iron and steel, cement and lime, chemicals and non-ferrous metals. Besides technological innovations, the funding guideline also focuses on economic framework conditions and the competitiveness of the developed processes, the optimisation of which is to be investigated from a research perspective.

Financial services sector and climate action

The core objective is to develop a strong and effective research community in Germany that is capable of taking action regarding the issue of the financial services and climate action. The research projects and an accompanying scientific project address issues at the interface between the real economy and the financial services sector (products, processes and market mechanisms for financing climate protection; the effect of sustainable financial products; the determination of the needs of investors and private clients as well as the interactions between social developments, climate change and the financial services sector). It is closely linked to the German Sustainable Finance Strategy so as to achieve an in-depth dialogue, the best possible networking and the greatest possible impact of sustainable finance research in Germany.

National Bioeconomy Strategy

The aim here is to develop sustainably produced, bio-based products and bio-based production processes, including by substituting fossil-based products and for the recycling or reuse (reprocessing) of consumer goods for new products (cascading use, circular economy). New measures include future technologies for the industrial bioeconomy (biohybrid technologies: electrobiosynthesis and photobiosynthesis for CO_2utilisation), the third funding phase of the ZeroCarbFP alliance (the use of materials provided by carbonaceous waste streams for the production of functional biomass and for the production or recovery of recyclable materials by means of biotechnological processes) and microbial bio-refineries (CO_2 utilisation in biotechnology).

Zukunft Bau model projects for innovation in the building sector

The Zukunft Bau innovation programme of the BMWSB, with its programme components of departmental research and research funding, is sensibly supplemented by this model project in order to support specific construction and application projects that are of an innovative nature.

The market entry and approval of these solutions is supported by trialling new solutions in the real environment of the construction, modernisation or demolition of buildings (residential and non-residential). This can thus promote the widespread use of innovative solutions and their further diffusion into general planning and construction practice. The aim of the model project is to establish more innovative and previously non-market solutions for climate-neutral, climate-adapted, resource-efficient, healthy and affordable construction in general planning and construction practice, particularly in existing buildings.

The Federal Government's timber construction initiative

Adopted by the cabinet on 21 June 2023, the Federal Government's timber construction initiative is intended to increase the use of wood and other renewable raw materials in the construction sector, thus ensuring greater climate protection, the conservation of resources and faster construction. Eight fields of action show what the relevant federal ministries intend to put into practice within their own jurisdiction by 2030, subject to the budgetary resources being made available. They include the Federal Government acting as a role model, promoting research and innovation, securing a skilled labour force and encouraging the transfer of knowledge, safeguarding the supply of raw materials, and supporting resource-efficient construction that is based on the circular economy. Moreover, barriers are to be removed and a level playing field ensured to encourage the use of a wide range of construction materials.

Research and observation of aerosols, clouds and trace gases as part of the pan-European research network ACTRIS

ACTRIS (Aerosol, Clouds and Trace Gases Research Infrastructure) was established on 25 April 2023 by an implementing decision of the European Commission in the legal form of a European Research Infrastructure Consortium (ERIC). The aim of ACTRIS is to observe and research aerosols, short-lived climate polluters (SLCP), clouds and air pollutants. The particular subject of the investigations is their spatial and temporal distribution. The findings form an important scientific basis for future political decisions on measures

in the areas of climate action and air pollution control. Measures relating to short-lived climate polluters have the advantage that the effects on the climate occur without significant delays due to the short time that the gases remain in the atmosphere. Furthermore, synergies between climate action and air pollution control can be exploited. Research organisations from 16 European countries have joined forces in ACTRIS. Germany is a founding member of ACTRIS at the European level, and numerous German research institutions are involved in the research infrastructure. It is in Germany's interest to reinforce the network of leading European research institutions in the field of air pollutants and short-lived climate polluters that take the form of trace gases. The German Science and Humanities Council has given the ACTRIS project a consistently positive appraisal. The German research institutions involved in ACTRIS typically demonstrate a high level of scientific expertise.

Research on carbon dioxide removal (CDR) from the atmosphere

In addition to reducing emissions, the active removal of CO_2 from the atmosphere (carbon dioxide removal, CDR) and its subsequent permanent storage is necessary if climate targets are to be achieved. The Federal Government is funding land-based CDR methods in the "CDRterra" research programme and different methods of marine CO_2 removal in the "CDRmare" research mission. In CDRterra, terrestrial CDR methods are being researched with regard to their large-scale feasibility, interactions with other sustainability goals, and complex interactions in the Earth and climate system. Additionally, CDRterra aims to provide a comparative analysis and assessment of the various CDR methods and to explore overarching issues relating to political and institutional feasibility, social acceptance and ethics. The CDRmare research mission is investigating the role of the ocean in the removal and storage of CO_2 from the atmosphere. It also considers the interactions with and impacts on the marine environment, the Earth system and society, as well as appropriate approaches for the monitoring, attribution and accounting of marine carbon storage. The long-term goal is to create a marine carbon roadmap.

Innovation and competitiveness

Net-Zero Industry Act (NZIA)

The NZIA was approved by the European Parliament on 25 April 2024 and formally approved by the Council of Ministers on 27 May 2024. It is expected to come into force in July 2024. Since it is an EU

regulation, the NZIA is directly applicable. The Federal Ministry for Economic Affairs and Climate Action is currently working on a national implementation plan that is aligned with the regulation (harmonisation of national law, implementation, coordination between the responsible bodies).

The NZIA aims to simplify and accelerate the ramp-up of production of net-zero technologies (solar, wind, batteries, heat pumps and geothermal energy, electrolysers, biomethane technologies, carbon capture and storage, electricity grid components, etc.). One of the NZIA's targets is for the net-zero manufacturing capacity of the EU to meet at least 40% of the EU's annual supply needs by 2030. In order to achieve this, the following measures, among others, are to be taken:

- Cutting red tape (in particular, approval procedures with time limits; setting up one-stop shops);
- Identifying net-zero strategic projects, which receive particular privileges;
- Designating and establishing "net-zero acceleration valleys" for technology clusters and easier approval procedures;
- Setting up a Net-Zero Industry Platform for exchanging data on, for example, financing issues and for discussing any problems;
- Facilitating market access, particularly through demand-side impulses (criteria in public procurement and in auctions for renewable energy sources).

Energy-intensive industries such as steel, chemicals and cement that manufacture components for these net-zero technologies and invest in decarbonisation can also be supported by the measures available in the legislation.

OECD Guidelines for Multinational Enterprises on Responsible Business Conduct

The Federal Government is a signatory state of the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct (OECD Guidelines) and, as such, promotes the dissemination and implementation of these OECD Guidelines. The OECD Guidelines were revised in 2023, and since then the environmental chapter has also covered climate change and adaptation. By promoting the OECD Guidelines, the Federal Government is supporting sustainable supply chains and an international level playing field in general and on behalf of net-zero technologies.

Further development of possible uses for CO_2 in the context of CCU and CCS

The further development of possible uses for CO_2, i.e. carbon capture and utilisation or CCU, on the basis of renewable sources of energy, is already being extensively promoted in Germany and is the subject of numerous research and development projects. With "Carbon2Chem" and "CO_2-WIN", the Federal Government has set up its own funding programmes for making use of CO_2; they are primarily aimed at expanding the raw material base and boosting raw material independence. Additionally, excellent junior research groups will be funded from the beginning of 2024 as part of the SINATRA funding programme. They will investigate different sub-areas of artificial photosynthesis (sunlight-to-X). As part of this, cooperation with the US Department of Energy (DoE) is being intensified. Germany is also involved in the ERA-Net Cofund ACT (Accelerating CCS Technologies), which funds larger projects as well as the entire range of the CCS and CCU technologies process chain, i.e. the capture, transport, storage or utilisation of CO_2. Germany is participating in the EU-funded SUNERGY initiative and the international Mission Innovation Community on Sunlight-to-X, which, among other things, promote a circular carbon economy (fossil-free fuels and chemical recyclables). The direct-air capture of CO_2 from the atmosphere (DAC) is increasingly coming into focus and is being funded as a CO_2 technology within the framework of the 7th Energy Research Programme. No CO_2 is currently being stored for research purposes in Germany.

Programme for the avoidance and use of CO_2 in extractive industries

The programme's main focus is on reducing emissions in the primary sector.

Carbon Direct Avoidance (CDA):

The programme includes CO_2 avoidance measures that are applied together with CCU or CCS within a single project and are thus an integral part of a CCU or CCS measure. Within this framework, innovative technologies that lead to a significant reduction in greenhouse gas emissions in the primary sector are included.

Carbon Capture and Utilisation (CCU):

Furthermore, approaches and technologies for efficient CO_2 recirculation form part of the programme; they include

technologies used for capture, utilisation, etc. from the field of bioeconomics, but above all, they include approaches that enable recirculation after CO_2 utilisation.

Carbon Capture and Storage (CCS):

According to the Intergovernmental Panel on Climate Change (IPCC), CCS is – alongside immediate, rapid, far-reaching and sustained emission reductions – a component of a large number of scenarios for meeting the Paris climate agreement targets. With the Paris Agreement, the signatory states, including Germany, have committed to keeping the global temperature rise well below 2° C and to pursue efforts to limit it to 1.5° C. The IPCC shows that CCS has a lower potential for reducing emissions by 2030 than renewable sources of energy and increased energy efficiency.

Nevertheless, greenhouse gases will continue to be emitted by certain sectors and processes in the future, including the cement and lime industries, certain areas of the chemical industry and waste incinerators. The Federal Government would also like to enable these sectors to operate in a climate-neutral manner in Germany. To this end, the Carbon Management Strategy (CMS) will bring about the conditions required for the safe use of these technologies and for the transport and storage of CO_2.

The Federal Government has set the following requirements for the further development of the Carbon Management Strategy:

- The barriers to the application of CCS and CCU in Germany that have existed to date are now being removed. At the same time, guidelines for the use of these technologies are being defined.
- The ramp-up of CCS and CCU must be in line with the greenhouse gas reduction targets of the German Climate Change Act (KSG) and the achievement of greenhouse gas (GHG) neutrality in 2045.
- To avoid GHG emissions from power generation, the Federal Government is accelerating the expansion of renewable sources of energy, supplementing it with the capacity mechanism described in the Power Station Strategy and anticipating it with the construction of new gas-fired power plants that can be converted to hydrogen. For power plants that use gaseous energy sources or biomass, the use of CCS or CCU in the context of a technology-neutral transition to a

climate-neutral electricity system also remains legally possible, but will not be subsidised in the case of fossil fuels.

- The phase-out of coal is here to stay: Access to CO_2 pipelines and CO_2 storage facilities will be excluded for emissions resulting from coal-fired energy generation (power and heating plants).
- The state funding for CCS and CCU focuses on emissions that are hard or impossible to avoid.
- Reconnaissance of offshore storage facilities in the German Exclusive Economic Zone (EEZ) is now legally possible. Once safety standards and ecological criteria as well as regional planning regulations have been taken into account, if a site is proven to be suitable, the corresponding storage facilities can be developed for industrial use. In order to comply with the special protection of marine protected areas, there will be a ban on injecting CO_2 in marine protected areas and in a buffer zone of 8 km around them, as well as within a designated area designed to protect coherence. On the other hand, storage under marine protected areas is excluded and noise-intensive activities in the area in which harbour porpoises mainly aggregate in the months of May to August are prohibited.
- The Federal Government will create a legal basis in the Carbon Storage Act (KSpG) that allows individual *Länder* to opt in to onshore storage. Irrespective of this, onshore storage for research purposes will be made possible nationwide.

The key points are currently going through the parliamentary process. At the same time, the Federal Government will continue to develop the comprehensive CMS.

Furthermore, a great many reduction strategies for achieving the global temperature targets of the Paris Agreement rely on so-called "negative emissions". Capturing CO_2 from the atmosphere can be achieved not only through natural methods, such as forests, but also through technologies such as BECCS (Bioenergy and Carbon Capture and Storage) and DACCS (Direct Air Carbon Capture and Storage). For these technologies to be successful, the elements of the entire CCS process chain would have to be made available. The so-called long-term negative emissions strategy (LNe) is currently being developed further so that it can address the handling of unavoidable residual emissions and the role of CO_2 removal for climate action in Germany. Both the CMS as well as the LNe are

embedded in an overall approach to decarbonising the economy and will be closely coordinated with each other.

EU ETS Innovation Fund: Further development of the NER300 programme

The so-called NER300 programme, which promotes investment in innovative low-carbon demonstration projects in the energy sector, has existed since 2011 as part of the European emissions trading scheme. The funding budget was financed by the sale of 300 million EU ETS allowances. When the current EU multi-annual financial framework for 2021-2027 came into force, it was replaced by the EU Innovation Fund. Its aim and purpose is to act as a financing instrument to fulfil the EU's obligations under the Paris Agreement on climate change.

The Innovation Fund focuses on supporting innovative renewable energy technologies and processes in energy-intensive industries, such as carbon capture utilisation and storage technology (CCUS), innovative renewable energy generation and energy storage.

National decarbonisation programme

This measure is a funding programme concerned with the fields of development, demonstration and market launch. To minimise emissions in the industrial sector as much as possible, it is necessary to reduce to a large extent or even completely process-related GHG emissions that cannot be avoided or are hard to avoid using current technology. This will be done by supporting key projects in the area of emission-intensive industries. They should serve both application-oriented R&D and the trialling of mature technologies on an industrial scale as well as their broad market launch; furthermore, they should also focus on their economic viability. The funding programme is designed in particular to promote the greatest possible reduction in greenhouse gas emissions during the production of emission-intensive goods, the optimisation of process chains, the conversion of processes to the use of renewable energy sources and raw materials, and the substitution of emission-intensive goods and technologies for the conversion of hydrogen as well as technologies for using CO_2. The funding programme is being implemented by the Competence Centre on Climate Change Mitigation in Energy-Intensive Industries (KEI) in Cottbus. The KEI also acts as a think tank and cross-industry, international and interdisciplinary knowledge platform on the topic of industrial decarbonisation. 3.5.i.13. "Smart Energy

Showcases – Digital Agenda for the Energy Transition" (SINTEG) programme

In parallel with the energy research programme, the SINTEG programme is developing and demonstrating solutions for technical, economic and regulatory challenges of the energy transition in five large model regions – so-called "showcases" – with over 300 companies and other stakeholders. The particular focus here is on secure, efficient processes that are suitable for bulk business, innovative technologies and market mechanisms for flexible, intelligent networks and markets. The key area is the digitalisation of the energy sector. The programme also aims to gather field-tested experiences for the future development of the legal framework. To this end, the Federal Government has adopted the SINTEG Regulation, which came into force on 21 June 2017, with time-limited "experimental options". The ordinance will enable the SINTEG participants to test new technologies, processes and business models, such as those for digitalisation and sector coupling, without suffering any economic disadvantage.

Research and innovation agenda for the material use of CO_2

This measure is about utilising CO_2 from industrial emissions as a raw material so as to support a CO_2-neutral circular carbon economy. The utilisation of fossil carbon as a raw material is the basis of today's chemical value chain. However, the use of petroleum-derived naphtha, for example, leads to significant CO_2 emissions over the entire life cycle. The efficient use of CO_2 as a source of carbon in combination with electricity from renewables can pave the way to a circular economy and thus significantly shrink the carbon footprint of industries and products. The research and innovation agenda combines promising research approaches, among others by establishing long-term junior research groups on the topics of "artificial photosynthesis" and "the use of alternative raw materials for hydrogen production". This should help to identify future research directions and support the path to industrial application.

Better participation of start-ups in energy research

Cutting energy consumption and greenhouse gas emissions requires us to depart from previous technological paths and develop new and innovative solutions. Start-ups often play a crucial role in the development of innovative ideas and solutions. In the long term, they play a key role in the success of the energy transition. In the past, the traditional instruments and mechanisms

of project funding were rarely tailored to these stakeholders. That is why the Federal Government aims to better address start-ups with new and adapted funding formats as part of its energy research funding and to increase their participation in all areas of energy research. To this end, existing obstacles are being gradually removed: in order to achieve this, existing barriers are being gradually reduced on the one hand by expanding the content of the programme to embrace non-technical innovations (business models, new services) related to technical innovations. On the other hand, it is being achieved by adapting and accelerating administrative procedures (e.g. micro-projects) and by developing new, more agile project formats, as well as by setting up the networking platform Research Network Start-ups. Start-ups with innovative ideas for the energy transition should be able to launch joint projects with partners from the spheres of science and industry more easily, thus providing new impetus for energy research.

Technologisch Souveräne Batterien – the BMBF umbrella concept for battery research

The electrification of industry, transport and other sectors is essential to significantly cut greenhouse gas emissions and achieve net-zero emissions targets, as enshrined in the EU's Net-Zero Industry Act, among others. The key role of battery technologies in achieving these goals is reflected, among other things, in the current ramp-up of battery (cell) production in Europe. The further development of battery technologies and production capacities is progressing rapidly. In light of geopolitical challenges and the still strong dependence on non-European suppliers – on battery materials, for example, but also in the fields of mechanical and plant engineering – further strengthening of Germany's resilience and competitiveness in battery technologies is vital.

For this reason, the Federal Ministry of Education and Research (BMBF) reorganised its strategic framework for research into battery technologies with its umbrella concept for battery research, which it published in January 2023. The funding initiatives and measures of this umbrella concept consider research and development work from the material to the battery cell, from basic research to the scaling-up of industrial production processes, and specifically include aspects of digitalisation and, in particular, the circular economy. Aspects of training and professional development, especially for young scientists, are also actively promoted. The aim is to create the technological basis for developing an environmentally friendly, competitive and

technologically sovereign battery value chain in and for Germany and Europe. This goal is currently at risk because the BMBF's battery research is mainly financed by the Climate and Transformation Fund (KTF). The funds earmarked for this were set to zero for new projects as part of the cost-cutting measures surrounding the KTF.

Key areas of mobility: A) Urban mobility B) Systemic barriers to innovation climate action

This involves the development of effective mobility concepts linked to social and technological innovations on the basis of a systemic perspective The aim is to identify levers for decarbonisation by analysing the interplay between mobility flows, infrastructure networks, value chains, urban and spatial planning, as well as individual and societal requirements. On the one hand, the funding aims to develop and trial climate-friendly mobility innovations in regulatory sandboxes. On the other, the aim is to create a basis for long-term innovation and transformation management. There are two sub-measures:

- urban personal mobility, and
- systemic barriers to innovation for climate action, following on from the results of the National Platform Future of Mobility (NPM).

Digital Innovation Hub for Climate

The initiation and financing of a Digital Innovation Hub for Climate serves to network business, science and politics, to strengthen application-oriented R&D in the field of climate action through the exchange of ideas on digital innovations, as well as the use of digital technologies in climate action and the development of business models.

Green ICT: research and development to reduce the carbon footprint of digital technologies

The aim is to develop technological solutions to reduce the amount of CO_2-consumed by digital technologies. One significant potential for climate action already lies in the reduction of energy consumption by information processing and storage components such as processors or server farms (clouds) and the associated communication technologies (ICT). At present, new digital applications are emerging, particularly in the area of "big data", the Internet of Things and artificial intelligence (AI), which will further increase the demand for computing power for data evaluation. In

view of the rapidly growing use of these technologies in the economy, the development of technological solutions to increase the energy efficiency of ICT is essential. There are joint initiatives with the European Union, such as the European Processor Initiative (EPI), which should be expanded.

Skilled Labour Strategy

The Federal Ministry of Labour and Social Affairs, along with the participation of all departments and numerous federal commissioners, has reorganised the Federal Government's cross-industry Skilled Labour Strategy. At the Skilled Labour Summit on 7 September 2022, the new Skilled Labour Strategy was discussed with the heads of the social partners, chambers, *Länder*, municipalities and the Federal Employment Agency. On 12 October 2022, the Federal Government adopted a new Skilled Labour Strategy.

The aim of the Skilled Labour Strategy is to support the efforts of firms and businesses to attract and retain skilled workers by means of legal and sub-legal measures. To this end, five priority fields of action have been identified:

1. up-to-date vocational training,

2. targeted continuing education and training,

3. using labour force potential and increasing labour force participation

4. improving the quality of work and work culture and

5. modernising immigration policy and curbing emigration

The Skilled Labour Strategy is designed to be both cross-industry and cross-regional. Each industry and each region is called upon to analyse which measures are appropriate in which area and for which occupation. Since this varies greatly from region to region and from company to company, the appropriate solutions must always be found by the local stakeholders on the ground.

The Federal Government has already implemented two key measures from the Skilled Labour Strategy by passing the law to strengthen the promotion of training and continuing education and the law to further develop the immigration of skilled workers in the summer of 2023. This has created further levers for securing skilled workers.

The training and further training programmes of the dual vocational training system are the central basis for allowing the

next generation of skilled workers to gain qualifications. The Federal Government is thus working tirelessly with the social partners to modernise the regulations and adapt them to the current needs of the economy. There is a particular focus on the skills requirements associated with the green and digital transformation. In all training programmes, cross-occupational basic skills, including in the areas of environmental protection and sustainability, as well as the digitalised world of work, are included as a compulsory part of the curriculum. In addition, the ordinances include a varying range and depth of competences relevant to the transformation process, depending on the specific occupation.

Skilled Immigration Act

Combating shortages of skilled labour is vital to ensure competitiveness, which is why, in 2023, the Federal Government passed one of the most forward-thinking immigration laws.

The simplifications and flexibilities created by the regulatory package are not aimed at any specific industries, but are intended to attract immigrants of all nationalities and from all professions and educational backgrounds to the country.

With major research initiatives such as the hydrogen lighthouse projects or the Kopernikus projects, the Federal Ministry of Education and Research (BMBF) is promoting research and innovation for the energy transition as well as the scientific basis for competitiveness. These initiatives go hand in hand with broad-based basic research.

3.5.ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context

European energy research collaborations

Strategic Energy Technology Plan (EU SET Plan)

Germany is actively involved in the design of European energy research as part of the EU's Strategic Energy Technology Plan (SET Plan). Representatives from Germany are taking part in the

thematic working groups and formulating strategies for cooperation in the field of various energy technologies. They are as follows: photovoltaics, concentrated and non-concentrated solar thermal technologies, wind, geothermal energy, marine energy, energy systems, positive energy districts, HVDC & DC, energy-efficient buildings, energy-efficient industry, batteries, renewable fuels and bioenergy, as well as CCS and CCU. Furthermore, a new working group on hydrogen is currently being set up. The results of the working groups are incorporated into the European funding strategy in the field of energy, i.e. in the SET Plan.

The strategy of the SET Plan is incorporated in the national funding programmes of the Member States and was also taken into account in the creation of the 8th Energy Research Programme.

The central aim of the SET Plan is to strengthen co-operation with other Member States in the field of energy research. Under the umbrella of the SET Plan, European cooperation is to be stepped up as part of the 8th Energy Research Programme. The research topics of the SET Plan are implemented at the European level, primarily through the co-funded Clean Energy Transition Partnership (CETPartnership).

(Co-funded) Clean Energy Transition Partnership

The Federal Government is collaborating in European and international research in the field of the energy system transformation through the Clean Energy Transition Partnership (CETPartnership), a consortium of national and regional funders and their funding agencies and the EU, which has been publishing annual joint funding announcements for a variety of technologies and system solutions since 2022. A total of six joint calls for proposals are planned during the scheduled term of the partnership from 2022 to 2027. The annual calls for proposals starting in 2022 will cover all topics under the 8th Energy Research Programme.

In the thematic working groups of the CETPartnership, Germany is driving forward the execution of the SET Plan implementation plans in the various fields of technology.

European Spatial Planning Observation Network (ESPON)

The Federal Government is involved in various European research projects at ESPON, including the ongoing project “Territorial Cooperation for Blue Renewable Energy” (CoBren), which is

investigating how maritime spatial planning can support the expansion of offshore wind energy in various European sea basins.

Regional/bilateral collaborative activities

Alongside the collaborative activities run on the lines of the "Berlin Model" and the CETPartnership, the following individual initiatives exist:

North Seas Energy Cooperation

As part of the North Seas Energy Cooperation, the Federal Government is helping to ensure the rapid expansion of offshore wind energy, among other things, through joint and hybrid projects in which offshore wind farms are connected to at least two Member States via an interconnector.

At the North Sea Summit in Esbjerg, Denmark, in 2022, the EU Commission and the coastal states of Denmark, the Netherlands, Belgium and Germany agreed to work more closely together to generate more offshore wind energy, thus replacing fossil fuels and contributing to the achievement the EU's climate targets.

German-Dutch joint call for proposals on "Electrochemical materials and processes for green hydrogen and green chemistry"

Together, Germany and the Netherlands form one of the strongest industrial clusters in the world. Both countries will require large quantities of renewable hydrogen for their industrial value creation and will have to import substantial portions of it. By pooling their research efforts, the two countries can accelerate the pace towards climate neutrality and exploit synergies as they enter a sustainable hydrogen economy. The call for funding proposals was published in October 2022, the first projects were approved in 2023 and launched in the spring of 2024.

The first step in implementing the Danish-German intergovernmental agreement on the joint project "Bornholm Energy Island" in 2023 was to create a joint framework for generating and transmitting 3 GW of offshore wind energy near the Baltic Sea island of Bornholm to Denmark and Germany.

Cooperation on CCUS with North Sea coastal states

As part of the North Sea Basin Task Force (NSBTF), Germany is working together with other North Sea countries to address the

scientific, technical, legal, economic and political issues surrounding CO_2 storage and utilisation below the North Sea.

Greek-German research co-operation and support for young researchers Research in energy is one of several pillars of the research collaboration between Germany and Greece and was addressed in two consecutive bilateral funding announcements. Funding was provided for projects relating to the generation, storage and efficient use of renewable energy, as well as to the environmentally friendly and efficient supply of heating and cooling. Preparations are under way for a continuation as part of the SRIA activities.

Franco-German Fellowship Programme

With the Fellowship Programme "Make Our Planet Great Again – German Research Initiative" (MOPGA– GRI), the Federal Government has established a funding programme in parallel to the French initiative of the same name. The programme aims to give renowned researchers and promising young scientists from abroad the chance to conduct research at German universities and research institutions. Besides climate and earth system research, energy research is one key area of the initiative. Five fellows with junior research groups were funded until 2022.

Clean Hydrogen Strategic Research and Innovation Agenda(SRIA)

In March 2022, a Strategic Research and Innovation Agenda (SRIA) was published as a result of the European Agenda Process for R&I on green hydrogen; it has identified the most important and pressing research priorities along the entire hydrogen value chain. The Member States and the European Commission are now working together to implement the SRIA. The Federal Ministry of Education and Research is preparing joint research activities with various European countries, including France, Italy and Greece. The aim of the initiatives is to strengthen cooperation in hydrogen research and to stimulate the innovation process in the participating countries.

3.5.iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Research

Funding for energy research

Energy research is to be stepped up in the period 2020-2030. As part of its funding of energy research, the Federal Government provided a total of around €6.2 billion for the research, development, demonstration and trialling of future-oriented technologies and concepts in the years 2018–2022. This corresponds to an increase of around 45% compared to the reference period 2013–2017. The progress of implementation is reported on annually in the Federal Report on Energy Research.

DARP

The BMBF is funding the lighthouse projects on green hydrogen via the German Recovery and Resilience Plan (DARP) and as part of the 7th Energy Research Programme. In the three major industry-led hydrogen pilot projects, solutions are being developed to accelerate and sustain the breakthrough of hydrogen: H2Giga enables the future cost-effective series production of hydrogen components and systems, H2Mare opens up completely new ways of producing hydrogen at sea, and TransHyDE paves the way for hydrogen transport and distribution. Among other things, they will receive European funding from the Recovery and Resilience Facility amounting to around €700 million.

Horizon Europe: the EU's key funding programme for research and innovation

No other country is as involved as Germany in the energy topics of the Climate, Energy and Mobility cluster in Horizon Europe. The Federal Government supports the participation of German researchers in consortia and their applications for EU funding via the National Contact Point Climate, Energy and Mobility (NKS KEM). The information and advisory activities of the NCP KEM help stakeholders from research and industry to make appropriate use of the extensive and complex opportunities offered by Horizon Europe with regard to energy issues. The range of topics for securing Europe's ambitious energy and climate targets extends from applied research options and technology-oriented development topics right through to supporting measures for market launch and expansion. The involvement of citizens as consumers as well as relevant socio-economic aspects are also becoming increasingly important.

Innovation and competitiveness

Boosting Germany's role as a research location for energy storage technology

The Federal Government plans to provide research funds and financial support for storage technologies in order to make Germany a centre for battery cell production. Furthermore, there are also plans for a new Fraunhofer Institute for Storage Technologies.

Carbon savings through resource efficiency and substitution

The funds allocated in KTF title 6092 - 686 15 are used by the Federal Ministry for Economic Affairs and Climate Action to finance research, development and innovation as part of the Technology Transfer Programme for Lightweight Construction (TTP LB). The aim of lightweight construction is to reduce the weight of products, cut the amount of material and energy used, and to increase recyclability – all while maintaining or even improving functionality. From design to the use and recycling of materials and products via production, resources can be saved and carbon emissions reduced.

The Technology Transfer Programme for Lightweight Construction (TTP LB) has been funding politically relevant and application-oriented projects with a high level of industry participation since 2020 and will continue to do so until 2027. This not only supports Germany's standing as an industrial location in the important field of lightweight construction, but also promotes environmental and climate protection. Innovative lightweight construction technologies and materials contribute to the medium and long-term transformation of industry as well as to the resilience of companies in times of raw material supply bottlenecks and rising energy prices.

Research funding for SMEs (resource efficiency and climate action)

SMEs are important drivers of climate action. With KMU-innovativ, the Federal Ministry of Education and Research offers small and medium-sized enterprises (SMEs) the chance to successfully compete on the market with new products and processes for climate action and resource efficiency. Small and medium-sized companies throughout Germany make use of this funding initiative.

Section B:

Analytical basis

4. Current situation and projections with existing policies and measures

The scenario represented here with the policies and measures currently in place will henceforth be referred to as the baseline. Current policies and measures here describes the policies and measures which have come into force or been carried out until October 2023.

The figures of the baseline are primarily based on the results of the WEM scenario of the projections according to Article 18 of Regulation (EU) 2018/1999 (Governance Regulation). The Federal Government presented these projections in 2023 and an updated version in March 2024.

Scenarios extending to the years 2030 and 2040 are characterised by uncertainties: In general, different course developments are estimated for different scenarios depending on assumptions, including assumptions regarding the implementation of current policies and measures, and on the methodology used. These differences lay bare the uncertainties that naturally exist in a forecast period that spans multiple years. The Federal Government will thus take further scenarios beyond the present one into future consideration as needed.

It must also be taken into account that greenhouse gas emissions are divided by sector differently in the EU reporting system than in the reporting system set by the Federal Climate Action Act. This applies similarly to the representation of renewable energy proportions.

4.1. Projected evolution of the main exogenous factors influencing energy system and of GHG emission developments.

4.1.i. Macroeconomic forecasts (GDP and population growth)

The population trend assumed in the projections is based on details from the European Commission. For the creation of the projections in accordance with Article 18 of the Governance Regulation, the

European Commission provides biannual estimates on population trends and other occurrences in the individual member states (EC 2022). These figures indicate that the population of Germany is expected to remain relatively constant at a level of 84 to a little over 85 million people until the middle of the coming decade (Table B1).

Table B1: Estimates on economic and population development, GDP in real prices from 2022

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Population in mil.	83.2	84.4	84.6	84.7	84.9	85.0	85.1	85.2	85.2	85.3	85.3	85.3	85.3	85.2	85.2	85.0	84.6	84.1
GDP in bn EUR$_{2022}$	3816	3885	3868	3917	3977	4002	4028	4053	4080	4108	4138	4174	4213	4255	4302	4591	4887	5203

Sources: EC (2002), Federal Ministry for Economic Affairs and Climate Action/Federal Ministry of Finance (2023), see also Federal Environment Agency (2024)

Macroeconomic development

For the period 2023 to 2028, the projections assume the growth rate indicated in the 2023 autumn projection of the Federal Government, and for the following years until 2050 are based on the growth rates provided by the European Commission (EC 2022).

The gross domestic product will rise from around €3,816 billion in 2021 to €4,108 billion in 2030 and to €4,591 billion in 2040 (Table B1).

The assumptions made here regarding the growth rates do not correspond to the Federal Government's current 2024 spring projection. As work on these analyses had to begin in autumn 2023, this update could not be taken into account.

4.1.ii. Sectoral changes expected to impact the energy system and GHG emissions

The modelling assumes that value creation in non-energy-intensive industrial sectors will grow more quickly than energy-intensive sectors in the medium to long term (Table B2). Through this, the share of German gross value added created by energy-intensive sectors decreases at a steady rate, although value creation in energy-intensive sectors continues to increase. This structural development within the industrial sector does not however allow

direct conclusions to be drawn regarding the absolute amount of energy consumption and GHG emissions. Production volumes and energy efficiency are key factors when it comes to the development of GHG emissions.

Table B2: Structural development – gross value added in the manufacturing industry by sector, in € bn, real prices 2022

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Energy-intensive sectors	78	79	78	78	80	80	80	81	81	81	84	88	92	95
Non-energy-intensive sectors	582	593	591	594	607	613	619	624	629	635	672	723	777	832
Total	**660**	**672**	**669**	**672**	**687**	**693**	**699**	**705**	**710**	**716**	**756**	**811**	**869**	**927**

Source: Fraunhofer Institute for Systems and Innovation Research (2024) based on Federal Statistical Office, 2024 projection data for modelling

4.1.iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

Past years have resulted in volatile pricing situations in international energy markets (Table B3). 2020 and 2021 were affected by the special circumstances posed by the global COVID-19 pandemic: first by the decrease in prices due to reduced demand owing to the reduction in economic activity and motorised traffic (especially in 2020), and then again by the jump in prices in 2021, which can be attributed to pent-up demand and other causes. From autumn 2021, prices in Europe rose during the tense and extremely volatile market situation, and increased again sharply at the beginning of the war of aggression perpetrated by the Russian Federation against Ukraine in February 2022. In 2023, the market situation calmed and signs indicate that prices will return to pre-pandemic and pre-crisis levels.

Table B3: Development of border crossing point prices for crude oil, natural gas, hard coal by time period and carbon dioxide price from 2021 to 2050

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Brent crude oil	10.8	16.1	12.1	11.0	10.1	9.5	8.9	8.5	8.2	7.9	7.9	7.8	7.7	7.6	7.6	7.2	6.8	6.4

degressions are assumed for hydrogen power plants. Costs for electrolysers will decrease significantly.

Table B4: Development of technology costs for electricity generation, Euro2022 per kW

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2050
Natural gas – combined cycle	1047	1047	1047	1047	1047	1047	1047	1047	1047	1047	1047	1047	1047
Natural gas – gas turbine	552	552	552	552	552	552	552	552	552	552	552	552	552
Onshore wind energy	1194	1164	1445	1394	1344	1296	1250	1204	1159	1115	909	723	410
Offshore wind energy	3177	3140	3112	3088	3066	3045	3023	3002	2980	2958	2844	2724	2830
Photovoltaics (freestanding and on roofs)	957	765	913	863	826	790	756	722	690	659	516	395	206
Photovoltaics home storage unit battery (by kWh)	894	869	843	817	792	766	740	714	689	663	573	484	305
Large-scale battery (by kWh)	631	610	588	566	545	523	502	480	458	437	368	300	163
Electrolysers	1376	1301	1227	1152	1078	1003	929	854	779	705	631	558	411
Hydrogen power plants	1152	1152	1152	1152	1152	1152	1152	1152	1152	1152	1152	1152	1152

Source: Model based on projection data from 2024, specific investment costs in EUR_{2022}/kW

The technology costs trends associated with distributed heat generation are described in Table B5. These refer to the time when the installation comes on stream,and the modelling assumes these to be constant over time. The specific investment costs from the reference year 2022 are depicted here (no operating costs).

Table B5: Technology costs for heat generation, euro2022 per kW

Technologies	
a) Small buildings (15 kW)	
Gas calorific value	561
Fuel oil calorific value	724
Biomass (pellet boiler)	927
Heat pumps – air	2,202
Heat pumps – brine	2,331

Technologies	
b) Large buildings (50 kW)	
Gas calorific value	246
Fuel oil calorific value	223
Biomass (pellet boiler)	1,403
Heat pumps – air	1,627
Heat pumps – brine	2,139

Source: Model based on projection data from 2024

The assumed costs per car for the transport sector are described in Table B6. Costs for car engines based on fossil fuel are slightly increasing over time due to upgrades in energy efficiency. Technology costs for electric and hybrid vehicle engines are decreasing, predominantly driven by developments in batteries. Fossil-based and hybrid engines will no longer be considered a viable option in the long term.

Table B6: Development of technology costs in the car sector, vehicle costs in thousand euros, real prices 2022

Technologies	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Diesel	36	35	35	34	34	35	35	35	36	36	0	0	0	0
Gasoline	30	30	30	30	30	30	31	31	31	32	0	0	0	0
Electric	43	44	42	38	36	35	34	34	33	32	33	32	31	31
Hybrid plugin	36	36	35	34	34	34	34	34	34	34	0	0	0	0
Hydrogen	66	64	62	58	56	54	53	51	50	48	46	42	41	40

Source: Model based on projection data from 2024

4.2. Dimension Decarbonisation

4.2.1 GHG emissions and removals

4.2.1.i. Trends in current GHG emissions and reductions in the EU ETS, the EU Effort Sharing Regulation and the LULUCF sectors and different energy sectors

Annual greenhouse gas emissions in the period from 2010 to 2030 are depicted in Table B7. The values and the delineation between sectors are taken from the GHG inventory (Federal Environment Agency 2024). LULUCF emissions and emissions in international aviation and maritime transport are not included in the sum total as per international conventions. A total of 674 Mt CO_2-eq were emitted in 2023. This constitutes a reduction of 46% from the base year 1990.

Table B7: Greenhouse gas emissions by sectors from 2010 to 2023, in Mt CO_2-eq

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Energy-related emissions	**796**	**772**	**785**	**802**	**761**	**771**	**765**	**748**	**724**	**674**	**614**	**642**	**639**	**569**
Energy sector	358	354	365	370	350	338	335	315	302	252	214	241	252	201
Manufacturing	123	120	118	118	117	125	127	129	124	121	119	125	116	108
Transport	152	154	152	156	155	163	165	166	167	166	147	145	149	147
Others*	151	133	138	147	129	134	130	129	124	130	131	127	119	110
Diffuse emissions	12	11	12	11	10	10	9	8	7	5	4	4	4	4
Non-energy-related emissions	**132**	**133**	**129**	**129**	**130**	**129**	**129**	**132**	**128**	**123**	**117**	**117**	**111**	**105**
Industrial processes	62	63	60	60	61	60	61	65	62	59	55	57	52	47
Agriculture	58	58	59	59	60	61	60	59	58	57	56	54	53	52
Waste	12	11	10	10	9	8	8	8	7	7	6	6	6	6
Total	**928**	**904**	**914**	**931**	**891**	**899**	**895**	**880**	**852**	**797**	**732**	**760**	**750**	**674**
For informational purposes: LULUCF	-1	-8	-16	-14	-6	-8	-10	-6	1	-2	6	3	4	4

For informational purposes: International aviation and maritime transport	33	32	33	33	32	32	35	36	35	34	17	22	31	32

Others* includes private households, commerce, trade and services, incl. military.

Source: Greenhouse gas inventory, Federal Environment Agency 2024

Emissions in sectors subject to the European Union Emissions Trading System (ETS) and emissions under the EU Effort Sharing Regulation (ESR) and the preceding EU Effort Sharing Decision (ESD) constitute part of the annual greenhouse gas emissions.

Table B8: Greenhouse gas emissions within ETS and non-ETS sectors from 2010 to 2022, in Mt CO_2-eq

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ETS emissions without international air transport	480	475	476	481	461	456	453	438	423	363	321	354	354
ESD emissions 2013 – 2020 ESR emissions 2021 – 2022				460	437	444	454	467	434	444	407	403	395

Sources: ETS emissions: German Emissions Trading Authority at the Federal Environment Agency (Verified Emissions Table reports 2022), ESD: Emissions: European Union Transaction Log, ESR: Preliminary estimations

Emissions from European air transport are subject to emission allowance trading. These are not shown here because national targets only take domestic air transport into account. There is no data available for 2023 at present. Emissions deriving from Effort Sharing result from the total emissions (without factoring in LULUCF) minus ETS emissions and CO_2 emissions from national air transport as well as ESD emissions minus NF_3 emissions.

4.2.ii. Projections for sector-specific developments based on current national and EU policies and measures until at least 2040 (including for 2030)

The sector-specific projection results for reference development are described in Table B9. The total GHG emissions without international transport types or LULUCF will be reduced to around 455 Mt CO_2-eq by 2030. This represents a reduction of just under 64% compared to 1990.

Table B9: Greenhouse gas emissions by sector from 2024 to 2050, in Mt CO_2-eq

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Energy-related emissions	569	549	503	459	422	393	362	232	140	99	87
Energy sector	208	197	162	132	111	100	88	57	36	35	39
Industry	101	99	97	94	92	88	84	57	42	34	32
Transport	148	145	141	135	128	121	112	68	33	15	6
Others*	109	104	98	93	88	81	75	47	27	13	9
Diffuse emissions	4	4	4	3	3	3	3	2	2	1	1
Non-energy-related emissions	109	109	105	102	100	96	92	74	70	72	75
Industrial processes	50	50	49	47	44	41	38	25	18	18	18
Agriculture	52	52	52	51	51	51	51	49	49	48	48
LULUCF	0	2	0	0	1	0	-1	-3	0	2	5
Waste	5	5	5	5	4	4	4	4	3	3	3
Total without LULUCF	677	655	608	562	522	489	455	309	210	169	157
Total with LULUCF	678	657	608	562	523	489	453	306	209	170	162
For informational purposes: International aviation and maritime transport	35	37	38	40	42	42	42	40	40	40	36

*Commerce, trade, and services; households; agriculture energy, military

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

Projections of annual greenhouse gas emissions can also be subject to emissions in the ETS sectors and in the sectors which fall under the EU Effort Sharing Regulation (Table B10). Conventions apply as described for Table B8.

Table B10: Greenhouse gas emissions in baseline – by ETS and ESR from 2024 to 2050, in Mt CO_2-eq

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
ETS emissions (stationary)	306	293	254	220	194	179	162	101	63	56	57
ESR emissions	371	361	352	341	327	309	292	208	146	112	100

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

Using the baseline projections, Germany will emit a cumulative 126 million more tonnes of CO_2 equivalent in ESR-related areas than is envisaged by the EU Effort Sharing Regulation (ESR). The Federal Government is currently examining the potential for implementation of further measures to counteract this (see Chapter 5.1.ii.).

4.2.2 Renewable energy

4.2.2.i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

The shares of renewable energy in energy consumption are depicted in Table B11. The share of renewable energy in gross final energy consumption rose over 10 percentage points to 22% between 2010 and 2023.

Table B11: Renewable energy - Shares in total sector consumption from 2010 to 2022, by percent

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Gross final energy consumption*	**11.7**	**12.5**	**13.5**	**13.8**	**14.4**	**14.9**	**14.9**	**15.5**	**16.7**	**17.3**	**19.1**	**19.4**	**20.8**	**22.0**
Gross final energy consumption (national statistics)	11.5	12.5	13.7	13.8	14.4	15.2	15.0	16.1	16.9	17.8	19.5	18.8	20.2	22.1
Electricity*	**18.2**	**20.9**	**23.6**	**25.3**	**28.2**	**30.9**	**32.3**	**34.6**	**37.6**	**40.6**	**44.2**	**43.9**	**47.6**	**51.4**
Electricity (national statistics)[1]	17.2	20.6	23.8	25.3	27.5	31.6	31.8	36.2	37.9	42.2	45.5	41.5	46.2	51.8
Onshore wind	6.2	8.1	8.4	8.5	9.6	12.0	11.3	14.6	15.2	17.5	18.8	15.7	18.1	22.5
Offshore wind	0.0	0.1	0.1	0.2	0.2	1.4	2.0	2.9	3.3	4.3	4.9	4.3	4.6	4.5
Photovoltaics	1.9	3.3	4.4	5.0	6.0	6.3	6.3	6.4	7.5	7.8	8.9	8.9	11.0	11.6
Hydropower	3.4	2.9	3.6	3.8	3.3	3.2	3.4	3.3	3.0	3.5	3.4	3.4	3.2	3.7
Biomass	4.9	5.5	6.5	6.9	7.4	7.7	7.8	7.8	7.8	8.0	8.5	8.1	8.4	8.3

Share of organic waste	0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Transport*	**6.4**	**6.5**	**7.3**	**7.3**	**6.9**	**6.6**	**7.0**	**7.0**	**7.9**	**7.6**	**10.0**	**8.0**	**9.6**	10.7
Transport (national statistics)	5.9	5.8	6.1	5.5	5.7	5.2	5.2	5.3	5.5	5.5	7.5	6.8	6.9	7.3
Biodiesel (incl. HVO and plant oil)	4.0	3.8	4.1	3.5	3.7	3.2	3.2	3.3	3.4	3.4	5.1	4.3	4.2	4.3
Biogenic gasoline	1.5	1.5	1.5	1.4	1.5	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.5	1.5
Biomethane	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Renewables – electricity	0.3	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.1	1.3
Heating and cooling*	**12.1**	**12.6**	**13.4**	**13.4**	**13.4**	**13.4**	**13.0**	**13.4**	**14.2**	**14.5**	**14.5**	**15.5**	**17.5**	**18.4**
Heating and cooling (national statistics)	12.4	12.8	13.7	13.8	13.8	13.7	13.6	14.0	14.7	14.9	15.0	15.7	17.5	18.8
Biomass and renewable wastes	11.5	11.6	12.5	12.5	12.3	12.2	12.0	12.3	12.8	12.9	12.8	13.5	14.8	15.6
Other renewable energies	0.9	1.1	1.2	1.2	1.5	1.5	1.6	1.7	1.9	2.0	2.2	2.2	2.7	3.2

*Directive 2009/28/EC until 2020, from 2021 Directive 2018/2001

1) differs from Directive 2009/28/EC without normalisation for water and wind energy and with all electricity generation from biomass. Other renewable energies include geothermal energy, environmental heat, solar thermal energy, renewable district heating

Source: Federal Environment Agency (2024)

Clear differences continue to be visible between sectors and application areas. The electricity sector is the main driver for the growing share of renewables in gross final energy consumption. By 2023, the share of renewables in electricity rose to 51.4%, an increase of over 33 percentage points compared with 2010. The share of renewable energy in the electricity sector has thus grown significantly faster than the share in the transport sector (10.7% in 2023), and in heating and cooling (18.4% in import year 2023). Both of these sectors have experienced moderate increases in renewable energy since 2010.

4.2.2.ii. Indicative projections of development with existing policies and measures for 2030 (with an outlook to the year 2040)

The continued use of existing instruments assumed in the baseline has had effects of varying strength on the use of renewable energy in individual sectors. Hydrogen from renewable energy, also called green hydrogen, can exert a relevant level of influence on the share of renewable energy present in all three sectors. The 2024 projection data model used in this report records total hydrogen imports. The extent to which these imports derive from renewable energy or other sources was not determined at the start of

modelling, nor did it emerge as a result of the modelling. Further policy-setting regarding the hydrogen strategy is underway in Germany. To nevertheless be able to point to shares of renewables in sectors and by technology in this report, two variants of calculations were made to cover the entire theoretical field of results. The actual future share will lie within this field.

Table B12a describes the development if imported hydrogen and hydrogen derivatives are fully derived from renewable energy across the entire time frame (100% green hydrogen).

Under this assumption, the share of renewable energy in gross final energy consumption would rise from 16% in 2023 to 38.1% by 2030 (EU statistics). This increase would continue in the years to follow. Current assumptions indicate a higher level of electricity consumption in 2030 compared to the analysis of the previous NECP draft, which also entails a higher gross final energy consumption. The set goal of 41% renewable energy share will be clearly exceeded as soon as in 2031. In 2040, this share will reach 73%. The Federal Government will watch further developments in the share of renewable energy in gross final energy consumption and assess opportunities to ensure that the 2030 goal of a 41% share of renewable energy can be met even earlier.

National acceleration measures have led to rapid progress in the construction of renewable technologies in the electricity sector, especially in wind energy and photovoltaics. This is also evident in the clear increase in approvals issued for these technologies in 2023 and 2024. The share of renewable energy in gross electricity consumption will increase to 74.2% by 2030. This figure is derived from EU and national statistics. Minor statistical discrepancies are levelled out by particularities which arose in the modelling. According to this, the target value of 80% will be exceeded by 2032 at the latest. By 2040, the share of renewables in the electricity sector will rise to 96%.

Table B12a: Renewable energy - Shares in total sector consumption from 2024 to 2050, in % – assuming only green hydrogen imports

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Gross final energy consumption (RED II)	**23.5**	**25.4**	**27.5**	**29.6**	**31.8**	**34.8**	**38.1**	**41.6**	**45.4**	**49.4**	**53.5**	**57.5**	**73.0**	**81.9**	**88.3**
Gross final energy consumption (national statistics)	23.6	25.5	27.5	29.7	31.8	34.8	38.0	41.4	45.2	49.2	53.1	57.0	71.9	80.1	86.1

Electricity (RED II and national statistics)	**54.5**	**57.8**	**61.9**	**64.7**	**66.8**	**69.9**	**74.2**	**78.4**	**81.9**	**85.1**	**87.8**	**89.6**	**96.0**	**95.7**	**94.5**
Onshore wind	21.4	22.1	23.2	24.0	24.6	25.3	26.2	27.1	28.3	29.6	30.7	31.8	33.9	32.5	32.3
Offshore wind	5.6	6.3	7.2	7.7	8.1	9.3	12.1	14.2	15.3	16.2	16.7	16.8	16.7	19.2	19.4
Photovoltaics	15.3	18.0	20.7	23.0	25.0	26.9	28.6	30.3	31.9	33.3	34.5	35.5	40.4	38.8	37.4
Hydropower	3.7	3.6	3.5	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.5	2.4	2.1	2.0	1.9
Biomass (incl. share of organic waste)	8.4	7.8	7.2	6.6	5.8	5.1	4.4	3.9	3.7	3.5	3.3	3.2	2.9	3.1	3.4
Geothermal energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Imported green hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport (RED II)	**10.2**	**12.8**	**15.8**	**20.3**	**26.0**	**31.8**	**38.0**	**44.6**	**51.6**	**58.6**	**65.4**	**71.8**	**92.7**	**101.4**	**108.5**
Transport (national statistics)	**6.6**	**7.6**	**8.6**	**10.3**	**12.2**	**14.2**	**16.8**	**19.8**	**23.0**	**26.8**	**31.1**	**35.8**	**57.1**	**68.6**	**82.9**
Biodiesel (incl. HVO and plant oil)	3.5	3.6	3.6	3.7	3.9	3.4	3.5	3.2	3.0	2.8	2.5	2.3	1.1	1.0	0.8
Biogenic gasoline	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.7	1.6	1.6	1.4	0.8	1.1	1.3
Biogas	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewable energy – electricity	1.7	2.3	3.0	4.0	5.2	6.9	9.2	11.7	14.5	17.5	20.6	23.7	39.0	49.1	54.3
Green hydrogen/ e-fuels	0.0	0.1	0.2	0.6	1.0	1.3	1.4	1.4	1.4	2.5	4.0	5.8	12.7	12.8	18.4
Heating and cooling (Eurostat and national statistics)	**20.2**	**21.7**	**23.2**	**24.6**	**26.1**	**28.4**	**30.2**	**32.0**	**35.1**	**38.4**	**41.7**	**45.4**	**57.0**	**67.6**	**70.8**
Biomass and renewable wastes	14.9	15.7	16.4	17.2	17.7	19.0	19.4	19.9	20.6	21.4	22.2	23.6	27.2	31.1	32.7
Other renewable energies	5.2	6.0	6.7	7.3	8.0	8.9	9.9	10.9	12.1	13.4	14.7	15.9	21.4	25.3	26.6
Hydrogen	0.0	0.0	0.0	0.2	0.3	0.5	0.9	1.3	2.4	3.6	4.8	5.9	8.4	11.2	11.4

Other renewable energies include geothermal energy, environmental heat, solar thermal energy, renewable district heating

Note: Totals may differ due to rounding. Multiple attributions in the transport sector in accordance with the Renewable Energy Directive can lead to arithmetical renewable energy shares over 100 percent.

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

The share of renewable energy in the transport sector will increase sharply to 38% by 2030 due to the multiple counting of individual technologies anchored in the EU statistics. National statistics also record a clear rise to just under 17%. The growing share of renewable electricity used in electric mobility is primarily responsible for this development. The share of biogenic fuels is exhibiting slow development and will undergo a notable decrease from the mid-2030s. Green hydrogen/e-fuels will slowly grow in

importance towards the end of the decade, especially in aviation, maritime and inland waterway transport, but will lag behind electric mobility overall.

The differences between EU and national statistics on heating and cooling due to discrepancies resulting from the modelling are balanced out, and an identity of statistical values is assumed here to simplify matters. By 2030, the share of renewable energy will rise by nearly 12 percentage points to over 30%. The share is thus significantly above the applicable mandatory target of 23.5% for 2030. The share of biomass and renewable waste will keep growing over time. However, the significance of other renewable energies, such as geothermal energy, ambient heat, solar thermal energy and renewable district heating, will already begin to increase over the course of the 2020s.

Table B12b describes the development with the opposing assumption that imports of hydrogen and hydrogen derivatives come solely from other non-renewable energy sources (0% green hydrogen). In consequence, the renewable share here is lower than when hydrogen imports are assumed to come from entirely renewable energy sources.

Table B12b: Renewable energy - Shares in total sector consumption from 2024 to 2050, in % – assuming hydrogen imports from only non-renewable sources

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Gross final energy consumption	**23.5**	**25.4**	**27.5**	**29.5**	**31.6**	**34.5**	**37.8**	**41.3**	**44.8**	**48.2**	**51.4**	**54.5**	**67.1**	**75.5**	**79.7**
Total gross final energy consumption (national statistics)	23.6	25.5	27.5	29.5	31.6	34.5	37.7	41.2	44.6	48.0	51.0	54.1	66.3	74.0	77.9
Electricity (Eurostat and national statistics)	**54.5**	**57.8**	**61.9**	**64.7**	**66.8**	**69.9**	**74.2**	**78.4**	**81.9**	**85.1**	**87.8**	**89.6**	**96.0**	**95.7**	**94.5**
Onshore wind	21.4	22.1	23.2	24.0	24.6	25.3	26.2	27.1	28.3	29.6	30.7	31.8	33.9	32.5	32.3
Offshore wind	5.6	6.3	7.2	7.7	8.1	9.3	12.1	14.2	15.3	16.2	16.7	16.8	16.7	19.2	19.4
Photovoltaics	15.3	18.0	20.7	23.0	25.0	26.9	28.6	30.3	31.9	33.3	34.5	35.5	40.4	38.8	37.4
Hydropower	3.7	3.6	3.5	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.5	2.4	2.1	2.0	1.9
Biomass (incl. share of organic waste)	8.4	7.8	7.2	6.6	5.8	5.1	4.4	3.9	3.7	3.5	3.3	3.2	2.9	3.1	3.4
Geothermal energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Imported green hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport (RED II)	**10.2**	**12.8**	**15.8**	**19.9**	**25.2**	**30.7**	**36.9**	**43.6**	**50.6**	**57.1**	**63.1**	**68.7**	**87.4**	**96.4**	**101.0**
Transport (national statistics)	**6.6**	**7.6**	**8.6**	**9.9**	**11.4**	**13.2**	**15.7**	**18.7**	**21.9**	**25.0**	**28.2**	**31.5**	**47.6**	**58.1**	**66.3**
Biodiesel (incl. HVO and plant oil)	3.5	3.6	3.6	3.7	3.9	3.4	3.5	3.2	3.0	2.8	2.5	2.3	1.1	1.0	0.8
Biogenic gasoline	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.7	1.6	1.6	1.4	0.8	1.1	1.3
Biogas	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewable energy – electricity	1.7	2.3	3.0	4.0	5.2	6.9	9.2	11.7	14.5	17.5	20.6	23.7	39.0	49.1	54.3
Green hydrogen/e-fuels	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.6	1.1	1.6	3.2	2.3	1.7
Heating and cooling (Eurostat and national statistics)	**20.2**	**21.7**	**23.2**	**24.6**	**26.1**	**28.6**	**30.5**	**32.4**	**34.9**	**37.4**	**39.7**	**42.5**	**53.0**	**63.7**	**69.1**
Biomass and renewable wastes	14.9	15.7	16.4	17.2	17.7	19.0	19.4	19.9	20.6	21.4	22.2	23.6	27.2	31.1	32.7
Other renewable energies	5.2	6.0	6.7	7.3	8.0	8.9	9.9	10.9	12.1	13.4	14.7	15.9	21.4	25.3	26.6
Green hydrogen	0.0	0.0	0.0	0.2	0.4	0.7	1.2	1.7	2.2	2.6	2.8	3.0	4.4	7.3	9.8

*) Other renewable energies include geothermal energy, ambient heat, solar thermal energy, renewable district heating

Note: Totals may differ due to rounding. Multiple attributions in the transport sector as per the Renewable Energy Directive can lead to arithmetical renewable energy shares over 100 percent.

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

A comparison of Tables B12a and B12b reveals that differences in the share of renewables only start occurring from 2027, when use of imported hydrogen at significant levels is set to commence. Accordingly, differences at technology level are seen only in hydrogen applications. At sector level, heating and cooling and the transport sector are affected. These differences from the assumption of fully green hydrogen imports initially remain at a low level – well below a percentage point – and rise to just under 5 percentage points in transport by 2040, and to just above 4 percentage points for heating and cooling.

An overall consideration of both tables reveals that the share of renewable energy in gross final energy consumption in 2030 as per EU statistics lies within the range of 37.8 to 38.1 percent. (National statistics show a range of 37.7 to 38.0 percent.)

The share of renewable energy in the electricity sector remains at 74.2% in 2030 in both cases. The share of renewable energy in the transport sector lies within the range of 36.9 to 38% in 2030 as per EU statistics (national statistics show a range of 15.7 to 16.8). In 2030, the share of renewable energy in heating and cooling lies within a narrow range of 30.2 to 30.5%.

4.3. Dimension Energy efficiency

4.3.i. Current primary and final energy consumption in the economy and per sector (including industry, residential, services and transport)

Between 2008 and 2023, primary energy consumption was reduced by 25.3 percent. The reduction seen between 2010 and 2023 was 24 percent. Final energy consumption between 2008 and 2023 sank by 12.4 percent, and between 2010 and 2023, final energy consumption sank by 12.5% (Table B13).

The individual final consumption sectors exhibit decreases of differing amounts since 2010. In industry (other mining and manufacturing), consumption declined 14.6% between 2010 and 2023, and 26% in commerce, trade, and services. Private household consumption levels declined by 13.7%. In comparison, consumption in the transport sector sank by only 0.8%.

Table B13: Primary energy consumption (PEC) and final energy consumption (FEC) in total and by sector, 2008 and 2010 to 2023, in PJ

	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023*
PEC	14,370	14,126	13,515	13,615	13,897	13,232	13,368	13,494	13,516	13,178	12,808	11,887	12,443	11,675	10,735
FEC	9,327	9,334	8,968	9,049	9,242	8,749	9,014	9,088	9,171	9,058	9,050	8,471	8,789	8,517	8,168
Industry[1]	2,573	2,595	2,666	2,613	2,589	2,562	2,573	2,673	2,657	2,629	2,537	2,432	2,607	2,392	2,217
Transport	2,622	2,516	2,523	2,529	2,578	2,554	2,647	2,704	2,757	2,776	2,757	2,325	2,348	2,519	2,496
Households	2,617	2,681	2,343	2,508	2,616	2,249	2,348	2,410	2,407	2,401	2,492	2,484	2,584	2,424	2,314
Commerce, trade, and services[2]	1,515	1,542	1,436	1,399	1,458	1,386	1,446	1,337	1,349	1,252	1,264	1,231	1,251	1,182	1,141

1) Other mining and manufacturing
2) This encompasses all activities falling under commerce, trade and services
*) The data for 2023 are preliminary

Source: Federal Ministry for Economic Affairs and Climate Action (2024)

4.3.ii. Current potential for the application of high-efficiency combined heat and power and efficient district heating and district cooling.

Heating and cooling networks play a key role in the transition to climate-neutral heating and cooling supply. Their importance and scope will continue to grow in the future. Primarily fossil-based combined heat and power will conversely decline in importance for the provision of district heating and cooling in the future. Table B14 depicts the development of CHP heat generation in the baseline scenario.

Table B14: Heat generation in CHP installations until 2050, in TWh

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Lignite	10.5	9.2	8.9	8.3	7.9	6.3	1.1	0.0	0.0	0.0	0.0
Hard coal	17.6	13.2	11.8	10.8	9.1	7.4	2.2	0.0	0.0	0.0	0.0
Natural gas	102.3	107.4	107.3	106.5	104.5	100.8	102.2	70.6	33.8	17.1	16.2
Petroleum	6.2	6.4	6.2	6.3	6.3	6.3	6.5	5.0	2.8	1.5	1.1

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Biomass[a]	52.6	53.7	53.5	51.0	48.0	44.7	40.0	35.6	33.4	33.5	43.6
Other	15.9	15.6	15.3	14.8	14.2	13.6	13.0	11.5	10.1	9.4	9.2
Hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**205.2**	**205.4**	**203.1**	**197.6**	**190.0**	**179.3**	**165.0**	**122.7**	**80.2**	**61.5**	**70.1**

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

In reaction to the Russian war of aggression against Ukraine and the supply chain bottlenecks for fossil fuel imports which resulted from this, the share of renewable energy and residual heat in Germany's heating and cooling networks is to be increased significantly. The basis for this is, among other things, EU guidance stemming from the Energy Efficiency Directive and the Renewable Energy Directive.

The share of renewable energy and residual heat in district heating in Germany was around 23% in 2020, and 25% in 2022. It is set to rise to 50% by 2030. By 2045, heating and cooling networks must be fully decarbonised. The legal basis for this is the Heat Planning and Decarbonisation of Heating Networks Act, which came into effect on 1 January 2024. Both energy from renewable sources and from unavoidable residual heat can be used for decarbonisation. The law sets out an indicative figure of 50% for the share of renewable energy or unavoidable residual heat across German energy resources in 2030. The law also sets out a mandatory decarbonisation pathway, according to which a minimum share of 30% renewable energy or unavoidable residual heat must be reached by 2030, and an 80% share by 2040. New heating networks must contain a minimum share of 65% renewable energy or unavoidable residual heat at time of entry into service.

4.3.iii. Projections with consideration of current energy efficiency policies, measures and programmes for primary and final energy consumption as described under 1.2.ii for each sector until at least 2040 (including projections to 2030)

The development of primary energy consumption and final energy consumption in the baseline is depicted in Table B15. These figures show a reduction in primary energy consumption of 29.4% by 2030 and of 37.9% by 2040 when compared to 2008. In the same time

period, final energy consumption declines by 15.5 and 27.5% respectively (Table 15).

Table B15: Primary energy consumption (PEC), Final energy consumption (FEC) - in total and by sector from 2024 until 2050, in PJ

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
PEC	**11,005**	**10,916**	**10,729**	**10,581**	**10,486**	**10,325**	**10,148**	**9,410**	**8,925**	**8,799**	**8,843**
FEC	**8,316**	**8,294**	**8,256**	**8,214**	**8,147**	**8,020**	**7,883**	**7,247**	**6,767**	**6,463**	**6,366**
Industry[1]	2,285	2,329	2,365	2,402	2,424	2,402	2,385	2,325	2,312	2,303	2,373
Transport	2,572	2,582	2,582	2,568	2,546	2,496	2,437	2,142	1,926	1,834	1,795
Households	2,312	2,272	2,231	2,192	2,149	2,118	2,082	1,896	1,740	1,613	1,532
Commerce, trades and services[2]	1,147	1,111	1,078	1,053	1,028	1,004	979	884	789	713	666

1 Other mining industry and manufacturing
2 This encompasses all activities falling under commerce, trade, services
Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

The largest decline in final energy consumption is found in the sectors of commerce, trade, and services and private households, with over 35% and just under 21% respectively by 2030 (compared with 2008). Industry and transport also experience an overall decline in final energy consumption, with each falling by 7% by 2030.

The figures represented in Table B15 are based on calculation methods from the German Working Group on Energy Balances. These do however somewhat deviate from Eurostat methods, which are used for the calculation of target achievement in the energy efficiency area (see Chapter 2.2)[3]. The calculation basis of the Eurostat methods and the WEM scenario indicate a reduction in primary energy consumption of around 32.5% – to 9,000 PJ or 2,500 TWh – by 2030 when compared to 2008. The calculation basis of the Eurostat methods and the WEM scenario indicate a reduction in final energy consumption of around 16.5% – to 7,517 PJ or 2,088 TWh – by 2030 when compared to 2008.

[3] Differences also affect the inclusion of maritime transport (international marine bunkers) and of non-energy-related consumption in PEC and of ambient heat in FEC.

4.3.iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Examinations of requirements levels for cost-optimal minimum energy performance in buildings have been updated. It is clear that requirements for new construction and existing structures in Germany are generally cost-optimal and no urgent need for action is present, but further adjustments can take place going forward.

4.4. Dimension energy security

4.4.i Current energy mix, domestic energy resources, import dependency, including relevant risks

To a significant degree, Germany's current energy supply is still characterised by the use of fossil fuels. In 2023, petroleum, gases and coal accounted for just under 80% of Germany's primary energy consumption (cf. Table B16). The share of renewables has risen to almost 20%.

Table B16: Primary energy consumption by energy source for 2010 to 2023, in PJ

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023*
Hard coal	1,714	1,715	1,725	1,840	1,759	1,729	1,693	1,502	1,428	1,084	896	1,112	1,142	931
Lignite	1,512	1,564	1,645	1,629	1,574	1,565	1,511	1,507	1,481	1,163	958	1,127	1,168	895
Petroleum	4,689	4,539	4,552	4,638	4,509	4,585	4,581	4,684	4,478	4,520	4,080	4,042	4,102	3,822
Gases	3,183	2,923	2,934	3,074	2,672	2,781	3,068	3,167	3,098	3,220	3,145	3,310	2,721	2,655
Nuclear energy	1,533	1,178	1,085	1,061	1,060	1,001	923	833	829	819	702	754	379	79
Renewable energy	1,310	1,365	1,524	1,571	1,568	1,672	1,677	1,790	1,825	1,903	1,970	1,949	2,044	2,107
Other energy sources	239	244	225	201	213	210	223	222	214	216	204	215	218	204
Foreign trade balance for electricity	-54	-14	-74	-116	-122	-174	-182	-189	-175	-118	-68	-67	-98	42
Total	**14,126 14,126**	**13,515**	**13,615**	**13,897**	**13,232**	**13,368**	**13,494**	**13,516**	**13,178**	**12,808**	**11,887**	**12,443**	**11,675**	**10,735**

*) The data for 2023 are preliminary.
Fossil gases only. Biogases are listed in the table as renewable energy.
Net electricity exports are indicated as negative numbers.
Source: Federal Ministry for Economic Affairs and Climate Action (2024)

Table B17 shows the net imports (in %) as imports minus exports and stock changes in relation to Germany's *de facto* primary energy consumption. Calculated figures above 100% for 2022 are the consequence of increased stockpiling, particularly in response to the outbreak of Russia's war of aggression on Ukraine and to the energy crisis associated with this.

Taken by itself, the indicator of 'dependency on imports' has little meaning and is not suitable as a sole target or performance indicator. Germany is an open economy and as such strongly integrated into international energy markets, allowing the country to benefit from cheaper energy imports and other advantages. In this context, it is important to minimise supply risks by taking measures for diversification.

The high level of dependency on imports in Germany's energy mix largely results from the country's high level of consumption of fossil fuels, which are mostly imported. The exception here is lignite, all of which is sourced domestically, with a small portion even going to export. At the end of 2018, the subsidies for the sale of domestic hard coal expired. This has meant that, since 2019, 100% of hard coal has been imported. In view of the liquidity of the global market for hard coal and the international supply structure, security of supply with imported hard coal is considered high. Between 2010 and 2021, former members of the Soviet Union became increasingly important suppliers of hard coal to Germany, reaching a share of 50% of these imports in 2021. Together with three additional countries, the USA (17%), Australia (13%) and Colombia (6%), these countries accounted for more than 80% of hard coal imports to Germany.

Following the entry into force of the EU coal embargo on Russian exports on 11 August 2022, Germany had to replace the relevant German hard coal imports at short notice. This led to a drop in the Russian share of hard coal imports to 2% in 2023, and to the replacement of these imports, mainly with supplies from the USA (29%), Australia (26%), Colombia (15%) and South Africa (11%).

Table B17: Dependency on imports for 2010 to 2023, net imports (in %)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	77.0	81.6	80.3	86.8	87,3	88,4	94.8	91.9	88.3	105.5	92.9	97.7	103.2	95.9
Lignite	-1.6	-1.8	-1.9	-1.9	-2.7	-2.6	-1.9	-2.1	-2.2	-2.4	-2.3	-2.3	-2.2	-2.3
Petroleum	97.8	96.3	98.3	97.6	97.8	98.7	98.0	97.0	97.2	99.1	98.5	96.7	98.9	97.1
Gases	81.3	86.7	85.6	86.8	89.1	88.6	90.2	91.3	95.6	98.6	88.7	88.8	106.3	93.3
Nuclear energy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewable energy	-0.6	0.0	0.5	-0.8	-1.7	-1.4	-1.4	-1.3	0.3	-0.8	1.2	-0.2	0.0	-0.1
Total	**59.0**	**60.6**	**61.3**	**62.4**	**61.6**	**61.7**	**63.8**	**63.3**	**63.6**	**67.4**	**63.7**	**63.0**	**68.6**	**66.2**

Net imports (in %) are calculated as imports minus exports and stocks in relation to Germany's primary energy consumption. Values calculated at higher than 100% result from increases in stocks. In line with the Eurostat definition, nuclear energy is considered a domestic primary energy source.

Source: Federal Ministry for Economic Affairs and Climate Action (2024)

Whilst gas consumption has fallen considerably since 2010 (cf. Table B16), domestic production has also fallen. As a result, the share of imported gas has seen a significant increase. In 2023, Germany covered roughly 93% of its demand for natural gas by imports. In 2023, the main exporters of gas to Germany were Norway, the Netherlands and Belgium, including LNG imports taken on shore in these countries. The Bundesnetzagentur records these figures and also the quantities in transit for its monitoring report.

Almost all of the petroleum used in Germany is imported. The largest share of Germany's petroleum imports in 2023 came from the U.S. and Norway (18% each), followed by Libya and Kazakhstan (slightly above 11% each), and the UK (10%). The share of imports from OPEC countries stood at roughly 28%.

4.4.ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

In the reference projection, primary energy consumption in Germany will fall by almost 860 PJ between 2024 and 2030 (Table B18). The reduction of primary energy consumption from fossil fuels is mainly driven by the increasing use of renewables in the buildings and electricity sectors, lower energy losses through conversion of wind power, electricity from PV and in electric

mobility, and by a downward trend in the use of coal and petroleum. The share of hard coal and lignite in electricity generation is going down considerably, not least as a result CO_2 prices rising under the ETS in the long term. Electricity generation from natural gas will also start a continuous decline as from around the middle of the decade. There is no more domestic nuclear power after the nuclear phase-out in 2023. The use of renewables is on a continuous rise, increasing by 53% by 2030 compared to 2023, with lower growth rates to follow in the decades after that.

Table B18: Primary energy consumption by energy source for 2024 to 2050, in PJ

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Hard coal	703	622	544	431	371	320	244	86	40	18	16
Lignite	885	811	486	257	115	80	45	25	20	18	15
Petroleum	4,095	4,069	4,060	4,012	3,954	3,800	3,632	2,747	2,051	1,738	1,447
Gases	2,813	2,780	2,833	2,852	2,779	2,627	2,513	1,716	1,143	858	868
Nuclear energy[8]	0	0	0	0	0	0	0	0	0	0	0
Renewable energy	2,244	2,385	2,537	2,684	2,839	3,046	3,275	4,359	5,115	5,529	5,750
Other energy sources	246	256	265	286	311	332	349	612	775	820	910
Foreign trade balance for electricity	19	-9	3	59	118	121	92	-133	-219	-181	-163
Total	**11,005**	**10,916**	**10,729**	**10,581**	**10,486**	**10,325**	**10,148**	**9,410**	**8,925**	**8,799**	**8,843**

* including small shares of district heating

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

According to the results in the model, the use of hard coal will drop to 86 PJ by 2035. This represents a decline of 95% compared to 2010. After 2035, the use of hard coal will continue to fall. Most of the remaining quantities of hard coal that will be used after 2040 are expected to be utilised for the production of metal and basic chemicals. Very small quantities of all of the above energy sources are also present in a multitude of subsectors. The results of the

modelling stem from the simulation method, which leaves certain niches to account for the heterogeneous nature of industrial applications and sites (such as a missing connection to the gas network/non-sufficient grid performance, etc.). This means that this type of model will always cause small quantities to remain, unless it includes instruments that restrict the availability of certain raw materials to zero.

The phase-out of lignite in North Rhine-Westphalia will be complete by 2030. Overall, the use of lignite will fall to 25 PJ by 2035. This corresponds to a 98% reduction compared to 2010. After 2035, the model projects that the use of lignite will continue to fall, down to 15 PJ. This is a quantity so small that the phase-out of coal can be assumed to have happened from this date at the latest.

The remaining use of lignite projected in the model is almost exclusively restricted to cement production. This quantity will also go down considerably over time. In the model, the transformation in this field is expected to slow down as of 2035, but continue at a very low level.

The reference projection shows that Germany's dependency on imports will fall from 67.4% in 2024 to 65.5% in 2030, as imported conventional energy sources are replaced with renewables. In the years after that, the degree of dependency will go down considerably to reach a point below the 40% mark after 2040 (cf. Table B19). It is true that the share of domestic energy sources tends to fall as a result of the decline in the use of domestic lignite and nuclear power, but the overall development is dominated by an increasing share of domestic renewables. The figures for imported renewables mostly refer to imports of biomass.

Table B19: Dependency on imports – net imports for 2024 to 2050 (in %)

Energy source	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Hard coal	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Lignite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gases	89.9	90.4	91.3	92.0	92.5	92.5	92.7	94.6	99.4	100.0	100.0
Nuclear energy	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Renewable energy	8.7	10.1	10.8	11.3	11.4	11.9	11.0	8.1	7.0	8.7	11.1

Energy source	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Total	67.4	67.0	68.5	69.3	69.3	67.7	65.5	52.8	43.1	39.2	38.7

Net imports (in %) are calculated as imports minus exports and stocks in relation to Germany's primary energy consumption. Calculations are also based on the assumption that Germany will no longer export lignite as of 2023 (lignite exports have also been very low historically). In line with the Eurostat definition, nuclear energy is considered a domestic primary energy source. This means that, following this interpretation, the use of nuclear power for electricity generation does not increase a country's dependency on imports. The energy mix making up Germany's electricity imports reflect the energy mix of the (EU member) states surrounding Germany and from which it receives electricity. Depending on the situation on the market, these electricity imports will contain varying shares of electricity from renewables (wind, solar, hydropower, bioenergy) and from conventional energy sources (especially hard coal/lignite, natural gas and nuclear energy). Depending on the reduction paths followed by the neighbouring states, these shares can change. The potential need for imports of biomass fuels is calculated as the projected use of biomass fuels minus the projected total of biomass fuel generated by agriculture and forestry and the estimated amount of biomass fuel created from biogenic residual and waste raw materials (cf. Projections Report 2023, Chapter 3.4.2)

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

4.5. Dimension internal energy market

4.5.1. Electricity interconnectivity

4.5.1.i. Current interconnection level and main interconnectors

The long-term development of electricity trading capacities in the European network is guided by the Ten-Year Network Development Plan (TYNDP 2022). The underlying assumptions can be found in Table B20.

Table B20: Medium trading capacity available for Germany and its electricity neighbours, 2020 to 2050, in MW

Exports (from GER to ...)	AT	BE	CH	CZ	DK	FR	NL	NO	PL	SE	UK	Total
2020	5000	0	800	2150	1600	2850	1468	0	400	615	0	14883
2025	5000	500	800	2150	1600	2850	1468	1400	400	615	0	16783
2030	6000	500	3273	2150	3100	2880	2500	1400	1000	2015	1400	26218
2035	6400	550	3273	2150	3100	2880	2750	1400	1375	2015	1400	27293
2040	6800	600	3273	2150	3100	2880	3000	1400	1750	2015	1400	28368
2045	6800	600	3273	2150	3100	2880	3000	1400	1750	2015	1400	28368
2050	6800	600	3273	2150	3100	2880	3000	1400	1750	2015	1400	28368

Imports (from ... to GER)	AT	BE	CH	CZ	DK	FR	NL	NO	PL	SE	UK	Total
2020	5000	0	4000	3750	585	1500	553	0	1050	615	0	17053
2025	5000	500	4000	3750	2385	1500	553	1400	1050	615	0	20753
2030	6000	500	4165	3750	2543	2880	2500	1400	1500	2015	1400	28653
2035	6400	550	4165	3750	2797	2880	2750	1400	1875	2015	1400	29982
2040	6800	600	4165	3750	3051	2880	3000	1400	2250	2015	1400	31311
2045	6800	600	4165	3750	3051	2880	3000	1400	2250	2015	1400	31311
2050	6800	600	4165	3750	3051	2880	3000	1400	2250	2015	1400	31311

Source: ENTSO-E TYNDP 2022 Global Ambitions Scenario and additional assumptions based on research for the projections of projects undertaken by the TSOs

4.5.1.ii. Projections of interconnector expansion requirements (including for the year 2030)

In a two-year rhythm, the Network Development Plan reviews the requirements for the expansion of transmission systems resulting from the development of the structure of domestic energy generation and consumption, and from the European internal energy market. The outcomes of the Network Development Plan are published at www.netzentwicklungsplan.de and the most up-to-date version is used as a basis for the quantitative analyses underlying the National Energy and Climate Plan.

4.5.2. Energy transmission infrastructure

4.5.2.i. Key characteristics of the existing transmission infrastructure for electricity and gas and the future long-distance infrastructure for hydrogen.

Electricity

According to the transmission system operators, the German transmission system for electricity currently comprises some 38,500 km of ultra-high voltage power line (220/380 KV). For more details on the electricity infrastructure, cf. Chapter 3.4.1.

Natural gas

Germany has a modern and solidly developed gas transmission infrastructure with a large pipe network that is 613,605 km long (as of 2022, German Association of Energy and Water Industries (BDEW) May 2023); including 130,393 km of low-pressure pipes, 182,624 km of medium-pressure pipes, 126,766 km of high-pressure pipes and 173,822 km of service pipes. The network of the transmission system operators comprises more than 110 compressor stations and is connected to neighbouring countries' natural gas networks via more than 25 IPs. The German gas transmission network is subdivided into a high-calorific gas (H-gas) area and a low-calorific gas (L-gas) area.

Measures to optimise, strengthen and expand the grid in line with requirements and to ensure security of supply are listed in the Network Development Plan for Gas. This plan must be drawn up by the transmission system operators (cf. Chapter 3.4.2.i and further below).

Hydrogen

Germany is planning a quick and cost-effective expansion of its hydrogen network infrastructure, which is to take place in two stages. The legal framework for the first stage, the hydrogen core network, is already in place in the form of the Act amending energy industry law in line with the provisions of Union law and amending other provisions under energy law, which took effect on 29 December 2023. In July 2024, the transmission system operators filed a joint proposal for the hydrogen core network with the Bundesnetzagentur. Under this proposal, a core network with a length of roughly 9,700 km is to be created by 2032, serving ports, the industrial sector, storage facilities and power plants. In a second

stage, the hydrogen core network is then to be further developed in line with requirements and as part of the regular integrated network development planning for gas and hydrogen.

4.5.2.ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

Electricity

For information on the expansion of the power grid, please cf. Chapters 2.4.2 and 3.4.1.

Natural gas

More details on the current Network Development Plan for Gas will be provided by the Federal Government in the upcoming finalised NECP update.

4.5.3. Electricity and gas markets, energy prices

4.5.3.i. Current situation of electricity and gas markets, including energy prices

In September 2021, day-ahead wholesale electricity prices began to rise. This trend continued into 2022, gaining traction in response to Russia's attack on Ukraine, which caused prices for natural gas and coal to also rise considerably. However, gas prices and wholesale electricity prices have fallen since 2023.

The development of electricity prices is highly volatile and strongly correlated with the development of gas prices, as gas-fired power stations set the electricity market price in many hours. The gas price development has been highly dependent on the development of the crisis in Ukraine and the steps of escalation taken by the Russian side regarding its supply of Germany and Europe with natural gas (BNetzA 2023). In mid-2022, especially, wholesale electricity prices peaked. Since then and into 2024, wholesale electricity prices have trended downwards. However, they are still above the levels recorded prior to 2021.

Analyses by the German Association of Energy and Water Industries (BDEW) show a considerable increase in consumer prices for electricity in 2021, which continued into 2023. Despite a decline in the price components imposed by government, especially the scrapping of the EEG surcharge, higher procurement prices have recently been the dominant factor in consumer prices. The

latest fall in wholesale electricity prices has slightly changed the trend on procurement costs. The average electricity price for small to medium industrial companies (excluding electricity duty) for new contracts has fallen considerably as of late. In the current annual average, the electricity price for small to medium-sized industrial companies has fallen to less than half of the peak prices recorded in the second semester of 2022. For some companies that used to be charged the EEG surcharge, electricity prices have fallen to the level seen in 2017.

Consumer prices for natural gas reflect the development of procurement costs that has already been described. Following the drastic price increases in the second half of 2022, prices have fallen on average in 2023 and 2024, albeit not enough to offset the surges seen since 2021 (cf. BDEW 2024).

4.5.3.ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Table B21 describes the outcomes of price projections made for the reference scenario used. The prices payable by final consumers are subject to levies, surcharges and fees. These price components are used to finance the grid and network infrastructure and the expansion of renewables. For reasons of climate action, energy policy and not least distribution policy, other refinancing mechanisms are also possible. This means that the long-term development of end-consumer prices for fuels and electricity are dependent on factors other than just (global) prices and cost developments and therefore uncertain. This has to be always borne in mind when interpreting projection outcomes.

Table B21: Gas and electricity prices by consumer group and hydrogen prices for 2021-2040, in cent (2022)/kWh

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Natural gas														
Border crossing price for natural gas	2.98	8.38	5.77	5.63	4.80	3.71	3.15	2.86	2.57	2.28	2.19	2.09	1.99	1.90
Household D1 (< 20 GJ)	10.15	13.04	14.66	15.84	15.59	14.78	14.48	14.44	14.40	14.34	15.24	15.93	16.42	16.76
Household D2 (20-200 GJ)	7.85	9.88	12.14	12.74	12.14	10.97	10.49	10.36	10.21	10.06	10.95	11.61	12.08	12.40
Household D3 (> 200 GJ)	6.93	8.91	11.45	12.01	11.35	10.13	9.63	9.48	9.33	9.16	10.04	10.70	11.17	11.48
Industry I1 (< 1,000 GJ)	7.09	8.76	11.40	12.04	11.36	10.11	9.59	9.44	9.27	9.10	9.99	10.65	11.12	11.43
Industry I2 (1,000-10,000 GJ)	5.98	7.81	10.28	11.08	10.42	9.23	8.74	8.60	8.45	8.30	9.19	9.86	10.34	10.66
Industry I3 (10,000-100,000 GJ)	5.04	7.50	8.59	9.41	8.92	8.00	7.65	7.59	7.52	7.44	8.37	9.07	9.58	9.92
Industry I4 (100,000 -1,000,000 GJ)	5.06	8.59	8.24	8.93	8.36	7.34	6.95	6.86	6.77	6.66	7.57	8.25	8.74	9.08

Industry I5 (1,000,000 - 4,000,000 GJ)	5.70	11.01	7.21	8.17	7.69	6.83	6.51	6.46	6.40	6.33	7.24	7.93	8.43	8.77
Industry I6 (> 4,000,000 GJ)	6.43	13.54	6.52	8.83	8.12	6.92	6.43	6.29	6.15	5.99	6.88	7.54	8.02	8.33
Electricity														
Household band DA (< 1,000 kWh)	49.56	49.80	51.93	52.92	50.50	49.30	48.69	48.68	48.98	49.47	50.24	48.71	48.16	47.49
Household band DB (1,000-2,500 kWh)	37.66	36.90	40.59	40.91	38.10	36.20	35.01	34.55	34.48	34.63	34.45	32.79	32.72	32.46
Household band DC (2,500-5,000 kWh)	34.03	33.19	36.75	36.94	34.16	32.18	30.92	30.39	30.25	30.33	29.98	28.35	28.39	28.24
Household band DD (5,000-15,000 kWh)	31.05	30.19	34.19	34.24	31.45	29.40	28.06	27.45	27.23	27.24	26.68	25.04	25.13	25.01
Household band DE (>15,000 kWh)	26.78	28.21	30.88	30.85	28.28	26.35	25.07	24.47	24.23	24.20	23.56	22.00	22.07	21.96
Industry band IA (<20 MWh)	31.72	31.78	32.46	32.71	30.23	28.51	27.42	27.00	26.92	27.05	26.93	25.59	25.72	25.66
Industry Band IB (20-500 MWh)	25.93	27.12	24.43	24.62	22.71	21.37	20.53	20.19	20.13	20.22	20.12	19.10	19.22	19.20
Industry band IC (500-2,000 MWh)	23.14	24.92	21.56	21.64	19.79	18.44	17.57	17.19	17.08	17.12	16.91	15.92	16.11	16.14
Industry Band ID (2,000-20,000 MWh)	19.80	23.07	20.19	20.12	18.05	16.43	15.36	14.85	14.64	14.60	14.15	13.08	13.40	13.54
Industry band IE (20,000-70,000 MWh)	16.48	22.06	18.96	18.81	16.69	14.99	13.84	13.28	13.02	12.95	12.38	11.28	11.65	11.83
Industry band IF (70,000-150,000 MWh)	15.72	20.94	16.72	16.49	14.46	12.78	11.63	11.04	10.75	10.63	9.94	8.87	9.24	9.43
Industry band IG (> 150,000 MWh)	13.81	22.63	14.76	14.56	12.72	11.19	10.16	9.63	9.38	9.28	8.71	7.77	8.15	8.36
H2 border crossing price	22.15	21.20	20.25	19.30	18.35	17.40	16.45	15.50	14.55	13.60	11.60	9.60	9.10	8.60

Source: Model based on projection data from 2024, With Existing Measures (WEM) scenario

4.6. Dimension research, innovation and competitiveness

4.6.i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)

Low-carbon technologies are an integral part of the green technologies sector. There are political, social, technological and economic developments that are driving the sector forward in an unprecedented way: apart from the European Union's Green Deal, these also include the growing demand for sustainable economic strategies and the efforts to rebuild economies after the COVID-19 pandemic and to make them climate-friendly.

So far, the forecasts on global and national market growth have been clearly confirmed and continue to present a positive outlook (Federal Environment Ministry, 2021). In 2020, the volume of the

market for German environmental and resource efficiency technologies tallied €392 billion. By 2030, the total volume of the domestic lead markets is set to more than double, reaching €856 billion. This corresponds to an average annual growth rate of 8.1%. Energy efficiency remains the largest lead market (€117 billion), followed by the lead market for sustainable mobility (€91 billion).

The energy transition is driving the lead market for the environmentally-friendly generation, storage and distribution of energy. Apart from photovoltaics and wind as renewable energy sources, stationary storage technologies taking the form of batteries and hydrogen will play an increasing role in driving the market. They are expected to grow at an annual rate of 8.5% until 2030, which is above the sector's average.

Beyond this, substantial investments are required to allow for the increasing interconnection between the generation, distribution and consumption of electricity and heat. Within the field of sustainable mobility within the meaning of the UN 2030 Agenda, demand is shifting from efficiency technologies to eMobility. Alternative propulsion technologies are by far expanding at the fastest speed. This market segment will develop at an average annual growth rate of 13.3% between 2020 and 2030, bringing up the global market volume to an expected €623 billion by 2030 (2016: €34 billion).

German suppliers are successfully defending their position on the global market. Products, processes and services belonging to the field of environmental and resource efficiency technology 'Made in Germany' are renowned across the world and are at the core of Germany's strong export performance in this sector. Whereas Germany contributes approx. 3% to global GDP, German companies in the environmental technology and resource efficiency industry hold around 14% of the global market in this industry. Europe remains the most important sales market for German suppliers; countries such as Brazil, Mexico, Canada, Japan and South Korea are gaining importance as export markets.

4.6.ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

Public spending on energy research has more than doubled in the past ten years. In 2022, the Federal Government invested €1.49 billion under its Energy Research Programme. This funding is

used for direct project funding on the one hand and institutional funding for the Helmholtz Association on the other. Additional expenditure on energy research by the *Länder* totalled approx. €387 million in 2020 (Federal Ministry for Economic Affairs and Climate Action 2023).

Spending on research and development in companies is an important driver of innovation – both in the field of low-carbon technologies and for a competitive economy in general. According to the statistics by the Donors' Association for the Promotion of Science and Humanities in Germany, companies have recently stepped up their research and development activities again, following the end of the COVID-19 pandemic (Stifterverband Wissenschaftsstatistik 2024 [2024 science statistics of the Donors' Association]) This is despite the fact that there are no estimates of current expenditure on innovative low-carbon technologies available at present. Surveys among businesses, however, show that climate action and climate neutrality is increasingly being regarded as important and serves as a driver for research and development activities: more than 41% of those companies surveyed that are doing R&D work claim that, in 2021, they conducted or commissioned R&D work making a specific contribution to climate neutrality (Stifterverband Wissenschaftsstatistik 2023).

Analyses of the patent applications for Germany as published by the German Patent and Trade Mark Office and by the European Patent Office show that German companies hold a leading position as far as climate-friendly technologies on their domestic market are concerned. Innovation activities in the field of electric mobility and alternative energy sources have seen a strong increase in recent years, whereas the development on alternative energy generation has been stagnating for years (German Patent and Trade Mark Office, 2021, 2022). Detailed quantitative analyses are currently not available. The latest figures for 2023 show that innovation activities in the field of renewables have picked up considerably. The number of patent applications for solar technology, wind power and other regenerative energy technologies increased by 18.6% year-over-year. The development of high-performance storage technologies, such as batteries, is of key importance to allow for the widest possible use of renewables. For this reason, innovations in battery technology are highly dynamic, with the number of published patent applications almost a third higher than in the preceding year and almost three times larger than ten years ago (German Patent and Trade Mark Office 2024).

4.6.iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

There are great variations in the electricity prices paid by industrial companies. The latest surveys conducted by the Bundesnetzagentur and the Bundeskartellamt have focused on electricity prices paid by industrial companies (with an annual purchasing volume of 24 GWh) which are not covered by an exemption clause; prices as on 1 April 2023 (Table B22). For the most part, these electricity prices fell within the range of 13.39 to 36.14 ct/kWh (excluding VAT). The mean price was 23.26 ct/kWh. Table B22 provides a breakdown per price component. At a mean value of 16.70 cg/kWh, the cost of energy procurement and sales make up more than two thirds of the total price.

Table 22: Electricity price components for industrial customers

Electricity price level for industrial customers (without privileges) as on 1 April 2023	ct/kWh (arithmetic mean values)
Grid fee	3.30
Metering, operation of metering points	0.05
Concession fee	0.14
Surcharges*	1.01
Electricity duty	2.05
Price component subject to the supplier (residual amount)	16.70
Total price (excluding VAT)	**23.26**

Industrial customers with an assumed annual offtake of 24 GWh without concessions as indicated by electricity suppliers

* Surcharge under CHP Act (0.378 ct/kWh), surcharge under section 19 StromNEV (0.066 ct/kWh), offshore grid surcharge (0.591 ct/kWh).

Source: BNetzA / BKartA (2023)

If electricity customers meet the requirements for certain regulations set out in the relevant ordinances and the relevant legislation, this leads to concessions for various surcharges and duties (Table 23). In the event that a customer meets all requirements for possible reductions, the price component that cannot be influenced by the supplier could fall from just under 10 ct/kWh to less than 1 ct/kWh.

Table B23: Potential concessions for industrial customers

Price survey (as of 1 April 2023)	Assumed value	Potential reduction	Remaining value
Electricity duty	2.05	-2.05	0.00
Net grid fee	2.94	-2.64	0.30
Other surcharges	1.01	-0.89	0.12
Concession fee	0.14	-0.14	0.00
Total	**6.14**	**-5.72**	**0.43**

Industrial customers with an assumed annual offtake of 24 GWh

Source: Bundesnetzagentur / Bundeskartellamt (2023)

The actual electricity prices paid by individual companies are strongly divergent. This is due factors such as individual take-off volumes and profiles that have an influence on pricing. There are also regional differences, for instance where grid fees are concerned. Different relief measures – for instance concessions on the EEG surcharge and on electricity duty – result in a situation whereby companies whose production is particularly electro-intensive and which face harsh international competition benefit from reduced electricity costs if certain requirements are met. These relief measures make a contribution to maintaining Germany's industrial base. The Federal Government is firmly convinced that the international competitiveness of the German industrial sector must be ensured. The objective continues to be to prevent offshoring of companies to countries with lower environmental standards and/or lower energy tax (carbon leakage).

4.6.iv. Description of energy subsidies, including for fossil fuels

At present, Germany notably has the following energy subsidies in place (Table B24) that also include direct or indirect subsidies for fossil fuels.

Table B24: Overview of subsidies linked to energy sources as indicated in the Federal Government's Subsidy Report

No.	Description of the subsidy	Amount of financial aid or aids or tax shortfalls in 2023 in € (Data based on the Federal Government's 29th Subsidy Report)	Objective of the measure and impact on the climate	Duration/ time limit
1	Grants for the sale of German hard coal for electricity generation, for sales to the steel industry and grants compensating for burdens caused by capacity adjustments		Ensuring a socially and regionally compatible phase-out of hard coal mining in Germany by the end of 2018.	Expired on 31 December 2018
2	Approval of re-adaptation benefits (APG) to employees working in hard coal mining	45,500,000	Ensuring a socially and regionally compatible phase-out of hard coal mining in Germany by the end of 2018.	Limited until 2027
3	Electricity price compensation	2,993,000,000	Grants to energy-intensive companies to offset increases in the electricity price due to emissions trading.	Limited until 31 December 2030
4	Tax concessions for companies in agriculture and forestry (agricultural diesel)	440,000,000	Agricultural companies receive a concession for diesel fuel, to the extent that it has been used for soil management or soil-bound livestock farming. The subsidy serves to uphold independent supply and secure the competitiveness of the German agricultural and forestry industries.	Gradual phase-out until 1 January 2026
5	Tax concession for energy products used to power gas turbines and combustion engines in installations eligible for these concessions as per section 3 Energy Duty Act (electricity generation, CHP, gas transport and gas storage)	In practice, the tax revenue is not reduced by these concessions.	The measure is based on a technical distinction between heating and motor fuels laid down in EU law and does not actually constitute aid. It means that the tax rate for motor fuels used for certain purposes (mainly energy generation in CHP installations) is initially reduced to the rate that applies for heating fuel. As a result, this tax concession for input materials for electricity generation prevents double taxation (electricity duty levied on the output side).	Unlimited
6	Tax concessions for energy products used in connection with the generation of energy (producer privilege)	270,000,000	The tax concession for self-generated energy products is stipulated by EU Directive 2003/96/EC. The Directive also provides for an optional tax concession for energy products from third parties, which, in Germany, is achieved by lowering the tax rate to the minimum rate applicable under EU law.	Unlimited

7	Energy tax concession for certain processes and procedures	450,000,000	The subsidy exempts highly energy-intensive processes and procedures from energy duty.	Unlimited
8	Energy tax concession for electricity generation	1,750,000,000	Measures to avoid double taxation of electricity generation.	Unlimited
9	Complete tax relief for CHP	200,000,000	The measures supports the generation of electricity and heat in CHP installations	Expired on 31 Decemb er 2023
10	Partial energy tax concession for CHP	85,000,000	The measures supports the generation of electricity and heat in CHP installations	Unlimited
11	Energy tax concession for companies in the goods-producing sector and for companies in agriculture and forestry	170,000,000	The support serves to safeguard the international competitiveness of the companies in the goods-producing sector and in agriculture and forestry	Unlimited
12	Energy tax concession for companies in the goods-producing sector in special cases (peak energy price offsetting)	(175,000,000)	This provision gave companies in the goods-producing sector relief to ensure that they would not be burdened beyond a sustainable contribution in a way threatening their international competitiveness. The provision was to prevent carbon leakage. The offsetting mechanism for peak energy prices expired at the end of 2023.	Expired on 31 Decemb er 2023
13	Electricity tax concession for companies in the goods-producing sector and for companies in agriculture and forestry	950,000,000 2024 3,650,000,000 2025 4,500,000,000	The support serves to safeguard the international competitiveness of the companies in the goods-producing sector and in agriculture and forestry. The concession has been increased for 2024 and 2025 as part of the Federal Government's electricity price package.	Unlimited
14	Electricity tax concession for certain processes and procedures	750,000,000	The subsidy exempts highly energy-intensive processes and procedures from electricity duty. The support serves to safeguard the competitiveness of the German industrial sector and to prevent carbon leakage.	Unlimited
15	Electricity tax concession for companies in the goods-producing sector in special cases (peak electricity price offsetting)	(1,375,000,000)	This provision gave companies in the goods-producing sector relief to ensure that they would not be burdened beyond a sustainable contribution in a way threatening their international competitiveness. The provision was to prevent carbon leakage. The offsetting mechanism for peak electricity prices expired at the end of 2023.	Expired on 31 Decemb er 2023
16	Tax concession for natural gas used as a fuel	36,000,000	Gas-based fuels can be used to replace liquid fossil fuels and diversity the energy supply. The support served to conserve resources, limit global warming and establish natural gas on the fuel market.	Limited until 31 Decemb er 2026
17	Energy tax concessions for working machinery and vehicles which exclusively serve the handling of freight in maritime ports	25,000,000	This subsidy fosters the shift of traffic from the roads to maritime and rail transport, which can have a positive impact on the environment.	Unlimited
18	Tax concessions for energy products	504,000,000	This subsidy serves to secure Germany's position as an economic powerhouse.	Unlimited

5. Impact Assessment of Planned Policies and Measures

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to projections with existing policies and measures (as described in section 4)

5.1.i. Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures.

Provided suitable policies and measures are implemented, emissions of greenhouse gases are set to fall by at least 65% by 2030. In addition – as its contributions to the achievement of the EU's energy targets –, Germany's consumption of primary energy is to go down by 39.3% in comparison to 2008 by 2030 and its final energy consumption by at least 26.5%. The share of gross final energy consumption supplied by renewable energies in Germany is to be 41% in 2030 (section 2).

As an impact assessment of the strategies and measures that are planned, the following analysis is based on a scenario that depicts a possible future development path for the energy system in Germany. The scenario set out below derives from the reference scenario (section 4). Further-reaching measures that were planned in autumn 2023 (see section 3) are taken into consideration as well. The scenario therefore corresponds to the with-additional-measures scenario set out in the reporting required by Article 18 of Regulation (EU) 2018/1999 (Governance Regulation). It was not possible for the projections to take account of more extensive measures that have been planned additionally since autumn 2023 or decisions taken after this point in time under which measures are not being implemented as originally planned. Furthermore, it has been assumed for the projections that the exogenous factors

discussed above will influence the development of the energy system and GHG emissions in unchanged ways (see section 4.1.).

Greenhouse gas emissions

The results of the projections for the development of with-additional-measures greenhouse gas emissions are set out in Table B25. Total emissions without international transport and LULUCF go down to approximately 454 Mt CO_2-eq. by 2030. This represents a nearly 64% reduction in comparison to 1990.

Table B25: Greenhouse gas emissions by sector, 2024–2050, in Mt CO_2-eq.

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Energy-related emissions	569	549	502	457	422	395	362	221	135	95	85
Energy industry	208	198	164	133	115	108	95	54	35	35	39
Industry	101	99	96	93	89	84	80	55	41	32	30
Transport	148	144	141	135	128	121	111	67	32	15	6
Other*	109	103	98	93	87	80	73	43	25	12	9
Diffuse emissions	3	3	3	3	3	3	3	2	1	1	1
Non-energy-related emissions	108	108	105	101	99	94	90	70	64	65	67
Industrial processes	50	50	48	46	44	40	38	24	17	17	17
Agriculture	52	52	52	51	51	50	50	48	47	47	47
LULUCF	0	2	0	-1	0	-1	-2	-5	-3	-2	0
Waste	5	5	5	5	4	4	4	4	3	3	3
Total without LULUCF	677	655	607	559	521	491	454	296	202	163	152
Total with LULUCF	677	657	607	558	521	490	452	291	199	161	153
For information only: International aviation and maritime transport	35	37	38	40	42	42	42	40	40	40	36

* Commerce, trade and services; households; agricultural energy; military energy uses

Source: Modelling of 2024 projection data, with-additional-measures (WAM) scenario

The LULUCF sector currently constitutes a source of greenhouse gases and will also miss its carbon sink targets by 23.7 Mt CO_2-eq. in 2030 (target: -25 Mt CO_2-eq.). The projection shows that this sector's important function for climate action as a natural carbon sink urgently needs to be strengthened.

The projections of annual greenhouse gas emissions can in turn be divided into emissions in the ETS sectors and those sectors subject to the EU Effort Sharing Regulation (Table B26). The conventions applied for the corresponding tables in section 4 are followed here.

Table B26: Greenhouse gas emissions – under ETS and the EU Effort Sharing Regulation (ESR), 2024–2050, in Mt CO_2-eq.

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
ETS emissions (stationary)	306	294	255	219	196	183	165	97	63	55	56
ESR emissions	370	360	351	338	324	307	287	199	139	107	96

Source: Modelling of 2024 projection data, with-additional-measures (WAM) scenario

If the with-additional-measures projections are taken as the basis, then 111 Mt CO_2-eq. more greenhouse gases are emitted cumulatively during the overall ESR-relevant period from 2021 to 2030 than allocated to Germany under the EU Effort Sharing Regulation (ESR). The German Federal Government is currently examining the feasibility of implementing further measures (see point 5.1.ii.).

Renewable energies

The development of renewable energies in the results of the with-additional-measures projections is described below. As discussed in section 4.2.1., hydrogen from renewable energies, green hydrogen as it is known, may have a relevant influence on the shares of renewable energies used in all three sectors. The modelling of the 2024 projection data that is drawn on in this report includes total hydrogen imports without specifying the extent to which they originate from renewable energies or from other sources.

Nevertheless, in order to be able to state the shares of renewable energies for different sectors and technologies at this point, two variant sets of calculations have been carried out that span the whole spectrum of theoretical results. Renewables' actual future market share will lie somewhere along this spectrum.

Table B27a shows the development that will take place if imports of hydrogen and hydrogen derivatives are sourced completely from renewable energies (100-per-cent green hydrogen) throughout the period.

Subject to these assumptions, the share of gross final energy consumption coming from renewable energies rises by 18 percentage points from 2023 to 38.2% in 2030 (EU statistics; according to the national statistics, it will reach 38.1% in 2030) and continues to go up steadily in the subsequent years. Under this projection, the 2030 target of a 41%-share will be achieved in 2031. The German Federal Government will observe the further development of renewable energies' contributions to gross final energy consumption and examine options for action to ensure the target of 41% being supplied by renewable energies set for 2030 can be attained even earlier. The share coming from renewables will reach 73% by 2040.

Table B27a: Renewable energies – shares of total consumption by sector, 2024–2050, in % – assuming exclusively green hydrogen imports

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Gross final energy consumption (RED II)	**23.6**	**25.4**	**27.4**	**29.6**	**31.9**	**34.9**	**38.2**	**41.7**	**45.2**	**49.4**	**53.5**	**57.4**	**73.1**	**82.1**	**88.8**
Gross final energy consumption (national statistics)	23.6	25.5	27.5	29.6	31.9	34.9	38.1	41.5	45.0	49.1	53.1	56.9	72.0	80.2	86.4
Electricity (RED II & national statistics)	**54.3**	**57.3**	**61.1**	**63.7**	**65.5**	**68.3**	**72.3**	**76.4**	**78.9**	**82.5**	**85.2**	**87.1**	**94.8**	**95.0**	**94.2**
Onshore wind	21.3	21.9	22.9	23.6	24.1	24.8	25.4	26.2	27.0	28.4	29.6	30.6	33.3	32.2	32.1
Offshore wind	5.6	6.3	7.1	7.6	7.9	9.1	11.7	13.9	14.7	15.7	16.3	16.6	16.7	19.3	19.4
Photovoltaics	15.2	17.8	20.4	22.7	24.5	26.3	27.8	29.2	30.4	31.9	33.2	34.1	39.6	38.2	37.1
Hydropower	3.7	3.6	3.5	3.3	3.2	3.0	2.8	2.7	2.5	2.5	2.4	2.3	2.1	1.9	1.9
Biomass (incl. organic share of waste)	8.3	7.7	7.1	6.5	5.7	5.0	4.2	3.8	3.5	3.4	3.2	3.0	2.8	3.0	3.4
Geothermal energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Imported green hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.7	0.6	0.5	0.5	0.2	0.2	0.2

Transport (RED II)	**10.3**	**12.8**	**15.9**	**20.3**	**25.9**	**31.6**	**37.7**	**44.2**	**51.1**	**58.2**	**64.5**	**71.2**	**92.5**	**101.3**	**108.5**
Transport (national statistics)	6.6	7.6	8.6	10.2	12.1	14.0	16.6	19.5	22.6	26.3	30.6	35.3	56.7	68.2	82.7
Biodiesel (incl. HVO and plant oil)	3.5	3.6	3.6	3.7	3.8	3.4	3.5	3.2	3.0	2.7	2.4	2.2	1.0	0.9	0.8
Petrol/bioethanol blends	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.7	1.7	1.6	1.4	0.8	1.1	1.3
Biogases	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables – electricity	1.7	2.3	3.0	3.9	5.1	6.8	9.0	11.5	14.1	17.1	20.2	23.3	38.8	48.8	54.1
Green hydrogen/e-fuels	0.0	0.1	0.2	0.6	1.0	1.3	1.4	1.4	1.4	2.4	3.9	5.7	12.6	12.7	18.4
Heating and cooling (Eurostat & national statistics)	**20.2**	**21.7**	**23.2**	**24.7**	**26.4**	**28.9**	**30.5**	**32.4**	**35.3**	**38.8**	**42.4**	**46.2**	**58.0**	**68.3**	**71.3**
Biomass and renewable wastes	15.0	15.7	16.4	17.1	17.9	19.2	19.7	20.2	21.0	21.7	22.5	23.9	27.6	31.4	32.8
Other renewable energies	5.2	6.0	6.8	7.4	8.2	9.1	10.1	11.1	12.3	13.7	15.1	16.4	21.7	25.3	26.5
Hydrogen	0.0	0.0	0.0	0.1	0.3	0.5	0.8	1.1	2.1	3.4	4.8	5.9	8.7	11.6	11.9

Other renewable energies include geothermal energy, ambient heat, solar thermal power, renewable district heating

Note: There may be anomalies in the sums due to rounding. Multiple counting under the Renewable Energy Directive may result in notional shares for renewables greater than 100% in the transport sector.

Source: Modelling in 2024 projection report, with-additional-measures (WAM) scenario

Renewable energies' share of gross power consumption in the electricity sector is 72.3% in 2030. This is slightly less than under the reference scenario (section 4.2.2.) because, although approximately the same amounts of power are generated from renewables, gross power consumption is somewhat higher. As under the reference scenario, the 80%-target is reached in 2032 at the latest.

In the transport sector, the share held by renewable energies rises to 37.7% by 2030 according to the EU statistics on account of the multiple counting of individual technologies embedded in the figures (national statistics: 16.8%). This share is approximately equivalent to that found under the reference scenario (38.0%).

By contrast it is assumed, in the interests of simplicity, that the two sets of statistics are identical for applications in the heating and cooling sector. By 2030 renewable energies' share of this market rises to 30.5%, which is equivalent to the share found under the reference scenario (30.2%) and above the 23.5%-target for 2030.

Table B27b shows developments subject to the contrary assumption that imports of hydrogen and hydrogen derivatives originate entirely from sources other than renewable energies (0% green hydrogen). Above all, the shares of renewables in gross final energy consumption and gross power consumption for 2030 are somewhat less here than when hydrogen imports from exclusively renewable sources are assumed.

Table B27b: Renewable energies – shares of total consumption by sector, 2023–2050, in % – assuming hydrogen imports from exclusively non-renewable sources

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
Gross final energy consumption (RED II)	**23.6**	**25.4**	**27.4**	**29.4**	**31.6**	**34.6**	**37.9**	**41.5**	**45.1**	**48.6**	**52.0**	**55.1**	**67.9**	**76.3**	**80.5**
Gross final energy consumption (national statistics)	23.6	25.5	27.5	29.5	31.6	34.6	37.8	41.4	44.9	48.4	51.6	54.6	67.0	74.7	78.6
Electricity (RED II & national statistics)	**54.3**	**57.3**	**61.1**	**63.7**	**65.5**	**68.3**	**72.0**	**75.9**	**78.3**	**81.9**	**84.7**	**86.6**	**94.6**	**94.8**	**94.0**
Onshore wind	21.3	21.9	22.9	23.6	24.1	24.8	25.4	26.2	27.0	28.4	29.6	30.6	33.3	32.2	32.1
Offshore wind	5.6	6.3	7.1	7.6	7.9	9.1	11.7	13.9	14.7	15.7	16.3	16.6	16.7	19.3	19.4
Photovoltaics	15.2	17.8	20.4	22.7	24.5	26.3	27.8	29.2	30.4	31.9	33.2	34.1	39.6	38.2	37.1
Hydropower	3.7	3.6	3.5	3.3	3.2	3.0	2.8	2.7	2.5	2.5	2.4	2.3	2.1	1.9	1.9
Biomass (incl. organic share of waste)	8.3	7.7	7.1	6.5	5.7	5.0	4.2	3.8	3.5	3.4	3.2	3.0	2.8	3.0	3.4
Geothermal energy	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Imported green hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport (RED II)	**10.3**	**12.8**	**15.9**	**19.8**	**25.0**	**30.5**	**36.6**	**43.2**	**50.1**	**56.5**	**62.3**	**68.2**	**87.4**	**96.3**	**101.0**
Transport (national statistics)	**6.6**	**7.6**	**8.6**	**9.8**	**11.4**	**13.0**	**15.5**	**18.4**	**21.4**	**24.6**	**28.0**	**31.5**	**47.9**	**58.0**	**66.1**
Biodiesel (incl. HVO and plant oil)	3.5	3.6	3.6	3.7	3.8	3.4	3.5	3.2	3.0	2.7	2.4	2.2	1.0	0.9	0.8
Petrol/bioethanol blends	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.7	1.7	1.6	1.4	0.8	1.1	1.3
Biogases	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables – electricity	1.7	2.3	3.0	3.9	5.1	6.8	9.0	11.4	14.0	17.0	20.0	23.1	38.7	48.7	54.0
Green hydrogen/e-fuels	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.8	1.4	2.1	3.9	2.6	1.9
Heating and cooling (Eurostat & national statistics)	**20.2**	**21.7**	**23.2**	**24.7**	**26.5**	**29.1**	**31.1**	**33.5**	**36.6**	**39.3**	**41.9**	**44.7**	**55.0**	**65.8**	**71.0**
Biomass and renewable wastes	15.0	15.7	16.4	17.1	17.9	19.2	19.7	20.2	21.0	21.7	22.5	23.9	27.6	31.4	32.8

Other renewable energies	5.2	6.0	6.8	7.4	8.2	9.1	10.1	11.2	12.4	13.7	15.1	16.3	21.6	25.2	26.5
Green hydrogen	0.0	0.0	0.0	0.2	0.4	0.7	1.4	2.1	3.2	3.8	4.3	4.5	5.8	9.2	11.6

Other renewable energies include geothermal energy, ambient heat, solar thermal power, renewable district heating
Note: There may be anomalies in the sums due to rounding. Multiple counting under the Renewable Energy Directive may result in notional shares for renewables greater than 100% in the transport sector.
Source: Modelling of 2024 projection data, with-additional-measures (WAM) scenario

When the two tables are looked at together, the share of gross final energy consumption from renewable energies according to the EU statistics lies in a range from 37.9 to 38.2% in 2030 (national statistics: 37.7–38.0%). The share of renewable energies in the electricity sector lies in a narrow range from 72.0 to 72.3%. According to the EU statistics, the share of renewable energies in the transport sector lies in a range from 36.6 to 37.7% in 2030 (national statistics: 16.8%). Renewable energies' market share in the heating and cooling sector lies in a range from 30.5 to 31.1%.

Primary and final energy consumption

The development of primary and final energy consumption is shown in Table B28. Primary energy consumption goes down to 10,152 PJ by 2030. This is slightly higher than under the reference scenario (10,148 PJ; Table B15). Compared to 2008, primary energy consumption also falls 29.4% by 2030 in this scenario. The decline in consumption by 2040 is 38.6%.

Final energy consumption in 2030 is 7,815 PJ and therefore somewhat lower than under the reference scenario (7,883 PJ). It goes down by 16.2% during the period from 2008 to 2030, which is somewhat more than under the reference scenario (15.5%). The fall by 2040 is 29%. The decline in final energy consumption is distributed unevenly between different sectors. Consumption goes down markedly (-38%) by 2030 in commerce, trade and services compared to 2008. Falls in consumption are also found for private households (-21%), and industry and transport (both -7%).

Table B28: Primary energy consumption (PEC), final energy consumption (FEC) – overall and by sector, 2024–2050, in PJ

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
PEC	11,001	10,915	10,727	10,561	10,482	10,341	10,152	9,309	8,826	8,717	8,768
FEC	8,312	8,288	8,248	8,191	8,108	7,969	7,815	7,107	6,627	6,336	6,238
Industry[1]	2,285	2,329	2,364	2,400	2,422	2,401	2,384	2,326	2,313	2,307	2,375
Transport	2,569	2,575	2,574	2,560	2,538	2,487	2,427	2,129	1,913	1,823	1,785
Households	2,312	2,272	2,230	2,189	2,143	2,111	2,071	1,867	1,695	1,567	1,477
CTS[2]	1,147	1,112	1,079	1,042	1,005	970	933	785	706	639	601

1 Other mining and manufacturing
2 Commerce, trade, services

Source: Modelling in 2024 projection report, with-additional-measures (WAM) scenario

The figures set out in Table B28 are based on the calculation methods used by the German Working Group on Energy Balances. However, these methods differ in some respects from the ones applied by Eurostat, which are authoritative when calculating whether energy efficiency targets have been met (see section 2.2.). On the basis of calculations carried out using the Eurostat methods and the WAM scenario, primary energy consumption goes down to 9,004 PJ by 2030, while final energy consumption goes down to 7,448 PJ.

Table B29 shows the development of primary energy consumption broken down by energy carrier. It differs only slightly from the reference scenario (Table B18) over time. For example, the consumption of hard coal and lignite gradually declines by comparable amounts in both scenarios.

Table B29: Primary energy consumption – by energy carrier, up to 2050, in PJ

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Hard coal	705	625	547	430	365	313	219	85	41	18	15
Lignite	887	820	499	265	113	76	36	24	20	17	15
Petroleum	4,092	4,063	4,055	4,002	3,943	3,786	3,618	2,713	2,029	1,727	1,443
Gases	2,807	2,769	2,810	2,810	2,800	2,707	2,593	1,577	1,058	816	844

	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Nuclear energy	0	0	0	0	0	0	0	0	0	0	0
Renewable energies	2,241	2,381	2,530	2,676	2,830	3,033	3,255	4,328	5,076	5,475	5,689
Other energy carriers	246	256	264	286	311	331	348	611	772	814	906
External trade balance in electrical energy*	22	1	23	93	120	95	84	-28	-171	-151	-143
Total	**11,001**	**10,915**	**10,727**	**10,561**	**10,482**	**10,341**	**10,152**	**9,309**	**8,826**	**8,717**	**8,768**

* Includes small shares of district heating

Source: Modelling in 2024 projection report, with-additional-measures (WAM) scenario

Air pollutants

Pursuant to Directive (EU) 2016/2284 (NEC Directive), a projection of the emissions of certain air pollutants is to be presented at least every two years; in addition, a national air pollution control programme (NAPCP) is to be presented every four years that includes measures intended to achieve the emission reduction commitments laid down in the NEC Directive. Germany's second NAPCP was adopted by the Federal Cabinet on 15 May 2024 and communicated to the European Commission.

The greatest possible consistency between the reporting in the NECP and the NAPCP is to be striven for; this is also intended to prevent undesirable outcomes that occur because climate action measures do not always lead to reductions of air pollutant emissions (e.g. fine particulates from the burning of wood or NO_x emitted when burning hydrogen). The different deadlines that have been set make consistent reporting highly challenging.

5.1.ii Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

The further improvement of energy efficiency in Germany's building stock is a key cornerstone of the Federal Government's climate policy. Corresponding policies and measures also feature in the latest Climate Action Programme (2023).

The CO_2 price for heating and transport is to be raised again as originally planned from 2024 on (following the suspension of the increase in the price path scheduled for 2023) as a targeted way of improving the cost-effectiveness of climate-friendly technologies compared to more climate-damaging alternatives. There are plans for this national CO_2 pricing scheme to be merged into the EU's new ETS 2 as of 2027.

Except in so far as they are required to finance the German Emissions Trading Authority, the revenues from the European and national CO_2 pricing schemes flow into the Climate and Transformation Fund (see point 3.1.1.iii.) in accordance with Section 4 of the CTF Act. Not least in order to prevent social hardships, support programmes continue to be a permanent feature of the policy mix. The requirements attached to this support are adjusted at regular intervals to take account of the transformation paths necessary in order to reach Germany's targets, as happened for example in 2023 when the Federal Funding for Efficient Buildings (BEG) scheme was revised. Carbon leakage risks are addressed by the Guideline on Electricity Price Compensation and the BEHG Carbon Leakage Ordinance (BECV), which entered into force in 2021.

As envisioned under the UN's Agenda 2030, national CO_2 pricing for emissions outside the EU ETS will make sustainable biomass more attractive as an energy carrier from a business point of view, specifically in various, sometimes competing, energy uses such as electricity generation, biofuels or thermal utilisation in industry and buildings. There are limited amounts of potential raw materials sustainably available for use as biomass in Germany, and the same is true of imported biomass. It is therefore necessary to use this

scarce biomass efficiently, sustainably and effectively for the purposes of climate action. Parameters that are intended to foster sustainable, climate-effective, resource-efficient biomass production and use in Germany are currently being defined as part of the National Biomass Strategy (NABIS).

Germany's energy efficiency policy identifies potential efficiencies across all sectors, thus making it possible to set up and further develop support programmes in a targeted manner. On account of the multiplicity of interactions between individual strategies and measures, the integrated effect of the action taken can only be looked at in this way and not as the sum of the effects achieved with single measures. Specific aspects are illuminated in greater detail below:

Rebound effects can occur when energy-saving measures are taken, in the buildings sector or industry for example. The immediate energy saving achieved by a measure may be counteracted by additional energy consumption. For example, tenants in renovated properties sometimes heat their homes at higher temperatures than before the renovation work, consequently cancelling out part of the expected energy saving again. This is why funding programmes in the buildings sector are to be focussed on greenhouse gas emissions per square metre. The interactions between energy efficiency measures are taken into account notionally when saving effects are calculated by incorporating individual interaction factors. An overview of these factors is given in the Excel worksheet appended to this report, which contains a detailed list and descriptions of measures for the implementation of Article 8 of the EED. Explanations of how the additionality of the various measures has been ensured will be found in the sections on methodological aspects included in the information provided.

In the energy industry, the gradual phasing-out of coal-fired electricity generation and the accelerated expansion of renewable energies are two major, pioneering strategic measures that are having closely correlated impacts. The gradual decline of fossil electricity generation from lignite and hard coal is to be compensated for with additional renewable electricity. Security of supply will be maintained throughout as these changes take place. The modifications to the regulation of the energy markets and infrastructure planning this will require are integral to the energy transition.

A series of wider-ranging policy approaches and systemic relationships are relevant where strategies and measures straddle different areas of policy:

For example, increased electrification in the transport and heating/cooling sectors is making significant contributions to the substitution of fossil energy carriers and, therefore, effective decarbonisation in these sectors. Meanwhile more and more photovoltaic systems are being installed on buildings, the overwhelming majority of which feed electricity into the grid or are used for mobility or heating applications. This sector-coupling strategy is important if greenhouse gas reductions are to be achieved in all sectors and the headline climate targets met. Measures such as promoting electric mobility or the uptake of heat pumps create increased demand for electricity. If extra overall demand arises and is met by fossil-fuel generation capacities, this throws up additional challenges reaching the targets set for energy conversion, whether it is the targets for the expansion of renewable energies that are at stake or the decarbonisation of electricity generation. This means it will be decisive to simultaneously reduce energy demand by enhancing energy efficiency.

Further policies and measures across the five dimensions of the Energy Union

Germany is working continually on policies and measures intended to reach the targets specified in section 2.

Germany has already narrowed by 90% the climate action gap between the progress being made in 2021, when the current Federal Government took office, and the reductions of greenhouse gases that were required. Compared to the draft NECP report, Germany has further narrowed the gap in terms of GHG emissions with its 2023 Immediate Climate Action Programme. This includes measures such as the Decarbonisation of Industry funding programme with the climate action contracts supported under it and the Building Energy Act which, among other things, has required new heating systems to be powered by at least 65-per-cent renewable energies (since 1 January 2024). This requirement initially applies in newly developed areas. It will only apply to legacy buildings and new buildings constructed on empty parcels in already built-up areas once the deadlines for the drafting of municipal heat plans have expired. The heating transition is being supported by the Federal Funding for Efficient Buildings scheme and its extensive funding resources.

Furthermore, the German Federal Government has adopted a series of measures to further expand renewable energies and, in particular, accelerate the planning and granting of approvals for renewables projects. These are already starting to have initial effects. The granting of approvals for, and expansion of, renewable energies have speeded up noticeably. 14 GW of photovoltaic installations were installed in 2024. The volume of new onshore wind capacities added has doubled to 3.6 GW and the capacity granted approvals has tripled to 8 GW. The reversal of the trend in approvals is now leading to a reversal of the trend in auctions as well: the auction held in August was the first in a long time to have been oversubscribed. The ambitious annual target of 10 GW appears achievable. More than 60% of Germany's electricity came from renewable sources for the first time in the first quarter of 2024. Germany has therefore raised its renewable energy target once again above that set in the draft updated NECP to a share of 41% of gross final energy consumption in 2030, matching its national contributions under the EU Governance Regulation. According to the latest projection data, Germany will attain this target in 2031. The Federal Government will take further measures to meet it by 2030. The projections make it clear how important it will be, in particular, to further speed up the approval procedures for renewable energies, power storage systems and networks, and establish a more permanent basis for elements of EU Regulation 2022/2577 that have especially proven their worth as accelerators. Apart from this, the German Federal Government wishes to place a stronger emphasis on cooperative projects. The North Sea Cooperation will play a decisive role in this respect. We believe a clear EU framework to support these cooperative projects would be important and profitable for the whole of Europe.

The German Federal Government is also engaged in continuing policy processes in other sectors, constantly examining and initiating new measures. The projections for the updated NECP on which work began in the autumn of 2023 could only reflect the measures adopted up to that point. They do not include other policies and measures that are in place and/or planned when the present report is published. This is true in particular of the rise in the CO_2 price from €35 to €45 and the Solar Package I.

Adopted measures not included in the projections for the updated NECP

Measure	**Dimension***
Increase in CO_2 price (€35 to €45 as of 1 January 2024)	1, 2
Solar Package I	1

*The five dimensions of the Energy Union in the NECP:

1: Emissions and greenhouse gas removals (incl. renewable energies)

2: Energy efficiency

3: Energy supply security

4: Internal energy market

5: Research, innovation and competitiveness

In order to ensure the targets discussed in section 2 are met, narrow the climate action gap yet further and continue to accelerate the expansion of renewable energies, the German Federal Government is further developing its energy and climate policies on an ongoing basis. Table 2 sets out measures that are currently under examination.

Further measures currently under examination

Measure	**Description**	**Dimension***
Amendment of public procurement law	Greater consideration of product sustainability and energy efficiency	1, 2
Carbon capture and storage (CCS), carbon removal, negative emissions	Further refinement of the Carbon Management Strategy, elaboration of the Long-term Strategy on Negative Emissions	1
Decarbonisation of/alternative drives for agricultural and forestry equipment	Research programme worth €1 million on climate-friendly drives in the agriculture sector, creation of a "roadmap" to boost alternative drive technologies (internal combustion engines for non-fossil fuels and electrification) in the agriculture and forestry sector	
E-mobility, bidirectional charging	Eliminate barriers as rapidly as possible, drive ahead the smart meter roll-out, flexible tariffs, strengthen incentives	1
Energy efficiency	Possible further measures for the management of energy efficiency	1, 2
Draft act implementing Directive (EU) 2023/2413 for onshore wind energy, solar energy and on-site energy storage systems, examination of a further acceleration of approval	Identification of further measures to speed up approval procedures, partly informed by the requirements of EU law and monitoring of EU law	1, 4

procedures for renewable energies and networks		
Flexibilisation	By means of variable electricity tariffs and dynamic grid tariffs, the reform of the rules under which grid charges are waived for major consumers, digitalisation, dismantling of barriers, incorporation of flex into the capacity mechanism (decisions taken under the growth initiative) and the Flexibility Roadmap, which brings together various points	1, 2, 3, 4
Draft act accelerating approval procedures for geothermal systems, heat pumps and thermal storage facilities, and modifying other legal parameters for the climate-neutral expansion of heating supply systems	Creation of legal parameters for the simplified, accelerated expansion of geothermal systems, heat pumps and thermal storage facilities.	1
Large heat pumps	Coordination of approval process for applicants and public authorities.	1
Measures relating to new materials and construction materials	Extension of building lifespans, improvement of resource efficiency, strengthening of the circular economy	1, 2
Non-residential buildings (MEPS)	Increased attention to be paid to non-residential buildings in future. The implementation of the Minimum Energy Performance Standards under Article 9(1) of the EPBD will have a major role in this respect.	1, 2
Offshore wind cooperation	Further drive ahead joint, cross-border cooperative projects in the offshore wind sector; make use of the North Sea Cooperation; support the EU framework/ flanking measures (e.g. EU top-up tenders as means of accelerating cooperation)	1.4
Boost the potential for digitalisation, automation and transparency	The potential for the reduction of emissions through digitalisation, automation and transparency will be addressed to a greater extent	1, 2, 3, 4
Implementation of the reform of EU emissions		1, 2

trading, including provisions for the transition from the Fuel Emission Allowance Trading Act (BEHG) to the future EU ETS 2	Including increase in BEHG price to €55–65 by 2026	
Hydrogen Acceleration Act	Acceleration and digitalisation of planning, approval and public-procurement procedures for infrastructure projects intended to produce, store or import hydrogen	1
Further measures in the district heating sector	Planned revision of the Ordinance on General Conditions for District Heating Provision (AVBFernwärmeV) and examination of amendments to the Heat Supply Ordinance in order, among other things, to dismantle barriers to the upgrading and construction of new heating grids	1

*The five dimensions of the Energy Union in the NECP:

1: Emissions and greenhouse gas removals (incl. renewable energies)

2: Energy efficiency

3: Energy supply security

4: Internal energy market

5: Research, innovation and competitiveness

5.1.iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Union climate and energy policy measures

In principle, the German Federal Government's policies and measures are always developed and decisions taken about them with existing and planned European Union measures in mind. This is also true when it comes to energy and climate matters. In these fields especially, it is necessary to achieve positive interactions between individual measures. The resulting synergies and spillover effects are important because they can support and accelerate the attainment of national and European energy and climate targets.

5.2. Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts, including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

Economic, education, skills and social impacts

Investment activity is of decisive significance for macroeconomic impacts. As a result of how policy parameters have changed, additional investments are being undertaken in almost all areas of energy production and use. Subject to the assumptions that these investments would not have been initiated without the alterations made to climate policy and that they do not crowd out other investments of equivalent value, they will have an expansive effect on gross domestic product (GDP).

According to estimates commissioned by the UBA (2024d, e) that also allow for sensitivities, in relation to the crowding-out of other investments for instance, a middle assumption scenario with additional measures finds a positive macroeconomic effect in comparison to the reference development path (section 4). Price-adjusted gross domestic product (GDP) is 0.4% higher in 2030 under this estimate than under the reference scenario. According to the estimate, this is equivalent to GDP being €15.5 billion higher (Table B30). This stimulus carries on growing stronger until the middle of the coming decade and then fades away. The fundamental reasons for this expansive effect are the additional investments made as further measures are implemented. The overall effect may be distributed unevenly across economic sectors and bring about structural shifts between different parts of the economy. These estimates suggest the additional measures will generate greater labour demand. It will be necessary to fill an extra 158,000 full-time-equivalent positions by 2030.[4]

[4] Other studies also investigate the economic effects of climate policy measures. Unlike these publications, the UBA (2024d) reflects the concrete set of existing measures that are assumed in sections 4 and 5.

Table B30: GDP and labour demand: differences between with-additional-measures scenario and reference scenario

		2025	2030	2035	2040	2045
Gross domestic product (GDP)	in billion €$_{2022}$	0.8	15.5	36.3	22.6	18.8
	in %	0.0	0.4	0.9	0.5	0.4
Labour demand	in thousand full-time-equivalent jobs	9.0	158.0	325.0	148.0	88.0

Source: UBA (2024d, e), impact assessment of 2024 projection data, with-existing-measures (WEM) and with-additional-measures (WAM) scenarios.

In retrospect, employment patterns have changed a great deal, in the energy industry for example. A gradual, but tangible, shift in employment has been seen over the last two decades from the classic, mainly conventional energy sectors to renewable energies. A development of this kind is the logical outcome of the intended decarbonisation of the energy system in Germany and will continue in future. But digitalisation and the transformation of the economy towards greenhouse gas neutrality are also bringing about massive changes in the kinds of skills that are required. Germany's transformation into a digital, ecological economy can only succeed if the necessary skilled workers are available. There are already shortages of both suitably qualified skilled workers and graduates today in many parts of the German economy. These bottlenecks will continue to worsen as a consequence of demographic changes. Vocational groups that are vital for the energy transition are affected as well, including workers in technical, IT and construction jobs.

Social impacts, including just transition aspects

It is important to the German Federal Government that no one should be left behind in the transformation process and the just transition to greenhouse gas neutrality proves a success. When designing energy and climate measures, the German Federal Government therefore always pays attention to the social dimensions of its actions, for transformation processes can only be successful if they enjoy the support of the whole population. In particular, it must always be guaranteed that, for example, energy services, food and housing are affordable for all strata of society. This is why the German Federal Government is supporting citizens with a range of ongoing assistance measures as the transformation progresses.

As far as the national emissions trading system for heating and transport (BEHG) is concerned, it has become apparent that, in

relative terms, it imposes greater burdens on households with low incomes than on households with high incomes (German Federal Government 2022). At the same time this is being countered with one significant relief measure: from an incomes point of view, lower-income groups will benefit more from the abolition of the renewable energy surcharge (EEG surcharge) than higher-income groups. Its early reduction to zero in 2022 and final abolition in 2023 have therefore relieved a great deal of the strain on domestic customers.

Attention will also have to be paid to distribution effects when the transition is made from the national emissions trading system to ETS 2 in 2027, especially with a focus on lower and middle-income groups. Apart from national measures, the European Social Climate Fund will have a particular role here. The German Federal Government will ensure that, as of 2026, the target groups defined in Regulation EU 955 (2023) are supported through the transformation using the resources from the Fund allocated to Germany. The updated NECP outlines the political framework for the German Social Climate Plan, in which the Federal Government will present an internally coherent package of national measures that is consistent with the NECP and designed to tackle the impacts of CO_2 pricing on disadvantaged groups, and will thus guarantee affordable heating/cooling and reasonably priced mobility, while contributing to the attainment of the climate targets set for Germany and the European Union. In this way, the German Federal Government will ensure the consistency of the two plans and the analytical assumptions and projections upon which they are founded.

An income-dependent component was introduced into the support for the renovation of buildings for the first time at the beginning of 2024 with the new Guideline on Federal Funding for Efficient Buildings – Individual Measures (BEG EM). Owner occupiers with taxable household incomes up to €40,000/year receive a 30-per-cent income bonus when they replace their heating systems. In addition, owner occupiers with taxable household incomes up to €90,000/year are able to take out supplementary loans at favourable interest rates for renovation measures.

The Carbon Dioxide Cost Sharing Act governs how CO_2 costs are shared between tenants and landlords. It is intended to offer incentives on both sides of the rental market: for tenants to behave energy-efficiently and for landlords to invest in low-climate-impact heating systems and/or the energy-efficient refurbishment of their properties. For this purpose, the CO_2 costs of residential buildings

are shared on the basis of the rented property's energy efficiency performance. Reliefs are granted to tenants in buildings with poor levels of energy efficiency. It is to be anticipated that these reliefs will be felt for the first time in 2024 when the management charges for the first accounting period that falls under the Carbon Dioxide Cost Sharing Act (2023) are calculated.

In addition, with the entry into force of the Housing Benefit Plus Act the German Federation has enacted the most comprehensive uprating of housing benefit entitlements to date. The Federal Government has consequently laid the statutory foundations for lower-income households in Germany to be compensated to an even greater extent than in the past for the rises in their housing and heating costs. The central elements of the reform are an increase in housing benefit rates, a widening of the group entitled to claim housing benefit and the introduction of a heating costs component, a climate component and an increase in the general housing benefit rates.

One measure that continues to benefit lower-income groups is the funding for the "Stromspar-Check" scheme, which helps households identify energy-saving steps they can take. Under this measure, low-income households are advised about how to economise on electricity and heating energy, and also receive financial support. As part of the procedure for implementing the requirements of the EU Electricity Directive (Directive (EU) 2019/944), it is intended to find a long-term solution for the handling of the issues that arise when energy supplies are cut off because individuals have failed to pay their electricity or gas bills. For a limited time until the end of April 2025 amendments to the Electricity Default Supply Ordinance and Gas Default Supply Ordinance allow consumers to request the suspension of up to three of their monthly instalment payments for the duration of a respite agreement, provided they inform their default supplier in text form before the beginning of the period in question.

The extent to which individuals are able to contribute to and benefit from measures relating to the energy transition and transformation also varies from region to region. For instance, residents of rural regions and urban residents are being affected in different ways by the necessary restructuring in the energy, transport, buildings and agriculture sectors. Given the current state of public transport services, for example, households in rural areas are often forced to rely on cars, which is why the switchover to climate-friendly e-mobility may impose considerable financial burdens there, especially on low-income households. Measures are

being taken in the transport sector to address problems that affect people in rural regions to a particular extent.

The major expansion of renewable energies will also be more visible in the countryside than in towns and cities. This structural transformation poses challenges for structurally disadvantaged regions, but also holds out opportunities. Options are opening up in these often rural regions because, for example, there is land available that can potentially be used to produce renewable energies, which may in turn prove to be a competitive advantage. Against this background, it has also been possible for a number of successes be recorded attracting businesses to disadvantaged areas in the last few years.

When it comes to jobs, contradictory effects are to be observed in structurally disadvantaged regions. Firstly, workers are being freed up in particular fields as the transformation process unfolds; secondly, shortages of skilled employees are tending to grow larger as demographic changes take place and due to migration movements. In essence, disadvantaged regions, many of which are facing particular structural challenges as well, will increasingly be affected more than prosperous regions by societal ageing and shortages of skilled workers over the next few years and decades. It was partly against this background that the German Federation and the federal states intensified the focus on soft locational factors in December 2022 when they decided to reform the Joint Task "Improving the Regional Economic Infrastructure" (GWR). The hope is that – alongside the existing measures to create and secure jobs – expanded options to support regional public services will help regions become more attractive not just to businesses, but to employees as well. With this reform, the Federation and the federal states are aiming to make the GWR an even more effective instrument for the management of regional transformation processes. To this end, the GWR's systematic objectives have also been broadened, and in future it will no longer be aimed purely at creating jobs, but have three main goals, one of which will be to accelerate transformation processes towards a sustainable, climate-neutral economy. In this connection, the options for action to help accelerate such a transformation have been extended.

Other reform projects relating to regional structural support, in particular the continued development of the Germany-wide funding system for structurally disadvantaged regions during the present electoral term, are intended to further improve the future viability of disadvantaged regions.

Furthermore, the social monitoring of climate action will mean the distributive effects of relevant measures are analysed in future while they are still at the development stage and measures are designed to be as socially equitable as possible.

Rented residential buildings

Since the provisions introduced with the second revision of the Building Energy Act also apply to rented buildings, they have consequences for tenants and landlords. In order to address this appropriately, changes have also been made to the law that governs the residential rental market. The previously existing options for rents on modernised properties to be increased have been supplemented. It is accordingly possible for the rent on a property to rise following its modernisation if a heating system that meets the requirements of the Building Energy Act has been installed. Provided this modernisation measure fundamentally satisfies the qualifying criteria for grants from public budgets and the landlord claims such funding, the rent can be raised by 10% of the costs spent on the property less the third-party funds that have been claimed. Should the landlord not have received any funding, the rate by which the rent can be increased is 8%. This is intended to create incentives for climate-friendly modernisation using renewable energies and steps to enhance the energy efficiency with which heating systems are operated. At the same time a special cap on rent increases after modernisation work involving the installation of heating systems has been introduced in order to protect tenants. As a consequence, monthly rents are not allowed to go up by more than 50 cents per square metre within six years. In the case of a 100-m^2 flat, the maximum rent rise that can be demanded is therefore €50 a month.

Environmental and health impacts

Effects that alleviate pressures on the environment and human health and synergy effects for a sustainable energy industry are supposed to go hand in hand under the existing and planned policies and measures. At the same time it is necessary to largely ensure the further expansion of renewable energies and technological developments do not have disadvantageous environmental and health impacts.

Energy conversion processes are still responsible for a major proportion of the air pollution in Germany. Apart from greenhouse gases, airborne pollutants are released in particular in all the sectors where fossil and biogenic fuels are burned. The substance

inputs into the environment from the energy sector have impacts on human health as well. For example, nitrogen dioxide (NO_2), a byproduct of processes in combustion plants and internal combustion engines, is an irritant gas that harms the respiratory tract and exacerbates the irritant effects of other pollutants, so making it possible for respiratory or cardiovascular conditions to occur. Fine particulates also have negative impacts on human health. Decarbonisation measures will see these emissions, and therefore the burdens on humans and nature, become less severe in many fields.

Furthermore, the most efficient utilisation of raw materials and sustainable land use will make significant contributions to climate action and the preservation of biodiversity, because land is taken up by the extraction, processing and transportation of energy carriers, including their upstream chains, as well as energy installations. The task is to minimise this land use and prevent the permanent deterioration of soils and loss of land for other purposes and uses. The aim should be to manage the expansion of renewable energies in harmony with nature and keep installations away from high-conservation-value areas as much as possible. This requires intelligent planning and management approaches that designate suitable areas for development and rule it out in unsuitable areas.

The accelerated expansion of renewable energies, in particular the overwhelming public interest accorded to them and changes in species protection (see section 3.1.2. above: Renewable Energy Sources Act, implementation of Regulation 2022/2577 laying down a framework to accelerate the deployment of renewable energy), are placing strains on nature conservation and environmental protection, which will necessarily have to be compensated for. Above all, this will mean conducting species support programmes. The relevant provisions in the Renewable Energy Sources Act will apply until such time as electricity generation is nearly greenhouse gas-neutral in Germany; the provisions of Regulation 2022/2577 only apply for a transitional period.

5.3. Overview of investment needs

5.3.i. Existing investment flows and forward investment assumptions with regard to the planned policies and measures

Increased levels of investment will be required in the coming years in order to ensure the energy transition progresses successfully and, at the same time, provide modern, efficient infrastructure.

With a view to the achievement of its climate targets, Germany is also committed to the implementation of the third long-term objective laid down in Article 2.1.c of the Paris Agreement, that of making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. The operationalisation of this objective is necessary in order, on the one hand, to direct the necessary finance into the transformation of greenhouse gas-neutral development and, on the other hand, to put an end to climate-damaging financial activities.

The energy industry has already made large-scale investments in the restructuring of the energy system over the last two decades. But considerable investments have also been made by German households and businesses in various areas of final energy demand.

The energy industry engages in the supply of fuels, the operation and maintenance of installations for the production, storage and distribution of energy, and trading in final energy. It uses both fossil and, to an increasing extent, renewable energy carriers. More than €30 billion were invested in these parts of the energy industry in 2021 (GWS 2023). The lion's share of this money was spent on investments in the decarbonisation of electricity and heating systems. Smaller proportions were devoted to investments in infrastructure for the distribution of final energy (electricity, gas, heat), storage (gas, electricity, heat), and the supply of heating and transport fuels.

Investments that affect final energy demand are made above all in the heating and transport sectors. Spending on the energy-efficient renovation of buildings is an important factor in this respect. According to some estimates, €46.5 billion were invested in 2020 (BMWK 2023). The energy-efficient renovation of buildings is one of the central measures with which energy efficiency is being enhanced; it has only been possible for investments in other aspects of energy efficiency to be surveyed incompletely to date.

Reaching net greenhouse gas neutrality in Germany in 2045 will involve significant additional investments. A precise, comprehensive assessment of the volumes of investment required across all sectors poses a series of methodological challenges; such exercises are subject to a variety of uncertainties. The German Federal Government currently does not carry out any assessments of this kind; however, it does observe the analyses and studies conducted by third parties who have been commissioned to examine the issue, without endorsing all their results.

The foreseeable investment costs for the core hydrogen network that is to be built by the 2032 deadline will, according to the application submitted by the transmission system operators in July 2024, amount to approximately €19.7 billion.

Apart from detailed, sector-specific assessments like this from participating market actors, there are a number of analyses, some of them based on models, that either mainly study investment needs on the supply side of the energy market or look globally at the energy system as a whole.

The estimates discussed in section 5.2., which were drawn up for the UBA (2024c, d), factor in the additional investments in various sectors that will be driven by the measures taken to date (reference scenario; section 4) and the additional measures that have been described. They predict annually increasing additional investments that reach a level of up to €122 billion a year (with-additional-measures scenario). Cumulatively over the period from 2023 to 2030, additional investments of almost €630 billion will be made exclusively under the current measures (reference scenario) and approximately €690 billion if planned measures are included. These investments will be concentrated on the energy sector, where about half the additional money will be spent, followed by the buildings sector with a share of about one-third and industry with about one-seventh of the total. By contrast, comparatively minor additional investments will be made in the transport sector.

Some other recent studies identify higher (sectoral) investment needs because, for example, they also take account of the years before 2023 or after 2030 or – unlike the UBA (2024d, e) – presume more comprehensive measures will be taken that are sufficient to attain climate neutrality in 2045. In broad terms, however, these studies confirm the order of magnitude of the figures put forward by the UBA (2024d, e). A number of studies suggest annually rising additional investments will be made on the supply side of the energy market, above all until the middle of the next decade, only

for the volumes to then slowly go down again – once the foundations have been laid for climate neutrality in 2045. By contrast, the additional investments in energy-consuming sectors, principally the buildings sector, will stay at high levels for longer.

No comprehensive, detailed account of the investment effects of all existing and planned measures is available, although spending plans have been formulated for individual support measures. Nor is it possible at present to state the total investments required for all planned measures, so including investments that would not have been made without climate action.

The investments made in the course of existing and additional measures will primarily be initiated by private households and businesses. Only in a few fields, such as public electricity and heating supply systems, are public providers direct investors in the restructuring of the energy system. At the same time significant amounts of financial resources will be made available by the public sector for the funding of private investments. In particular, it is necessary to strengthen the general framework for investment and innovation.

Attempts to divide expected investment needs into private and public investments encounter methodological challenges. For instance, a direct assessment of the public share of climate action investments is only possible to a limited extent in some cases. Much the same is true for the scale of the funding that will be disbursed in future. No estimates of the volume of public climate action investments can be presented at this point. Relevant public climate action investments are made mainly by businesses (majority) owned by public authorities (municipalities, the federal states, the German Federation). In Germany, this is happening above all in energy production and distribution, as well as the transport sector. With the exception of support payments, investments in the industrial sector will be made by private actors and not public ones. In the buildings sector, the size of the publicly owned housing stock may offer a relevant benchmark for the scale of the public investments that will be undertaken. In addition, further energy and climate action-related investments will be made by public bodies, such as social insurance providers and defence organisations. Finally, the significance of public climate action investments may vary in different sectors depending on whether the emphasis is placed on climate action investments overall or on additional investments to achieve climate neutrality (Prognos 2022).

5.3.ii. Sector or market risk factors or barriers in the national or regional context

Investments in climate action and a future-proof energy system for Germany cannot be looked at discretely in a macroeconomic vacuum. Intended investments and the implementation of planned policies and measures may be obstructed or at least held up by possible economic or structural bottlenecks. The many billions of euros continuously invested over recent years can be interpreted as indicating that such bottleneck risks have not been of any great relevance up until now. For example, public funding programmes, in particular those administered by the KfW, have tackled possible financing bottlenecks faced by businesses and private households, ensuring microeconomic investments that are (also) macroeconomically worthwhile are not neglected.

Furthermore, sufficient raw materials continue to have to be available so that there are no constraints on the manufacture of important (investment) goods for climate action and the energy transition. The same holds true for the need to have sufficient numbers of skilled workers in order that planned investments can be implemented efficiently.

In addition, it must be borne in mind that wider-ranging impacts like rebound effects at the level of energy demand and lock-in effects (path dependencies) associated with particular infrastructure investments limit the efficient implementation of energy transition investments and their effectiveness.

The inability to plan with confidence can hinder investments in climate action and a future-proof energy system as well. The German Federal Government's climate action policy therefore also includes measures that, in particular, seek to create a secure planning environment. Specifically, these include CO_2 pricing, which is gaining increasingly in significance as a key instrument at the heart of an efficient policy mix. Finally, one crucial determinant of investment activity is the level of the price components regulated by the state. Against this background, the German Federal Government has abolished the EEG surcharge and, instead, is financing the Renewable Energy Sources Act from federal funds.

5.3.iii. Analysis of additional public finance support or resources to fill gaps identified under point ii

Where the Climate Action Programme's measures are financed using public financial resources, this is anchored essentially in the

2024 business plan for the Climate and Transformation Fund (CTF). The CTF therefore remains the central financing instrument for the energy transition and climate action in Germany.

The question of the refinancing of electricity generating capacities and electricity grids continues to be relevant. Although financing for the expansion of renewables under the Renewable Energy Sources Act is secured through the federal budget, answers simultaneously have to be found for the future design of the electricity market. In this respect, the main issues are the regulation of grid charges, the allocation of costs between different groups of consumers (including grants to households) and the levels of taxes and duties.

The mobilisation of private capital for the energy transition is a critical challenge. The Federal Ministry for Economic Affairs and Climate Action is working on specially tailored financing modules. In view of the enormous demand for finance, energy companies will, for example, require additional equity capital so they can take out the further loans required for their investments without becoming overindebted. In this connection, blended finance instruments (combined public-private financial arrangements) may support a risk/reward profile that appeals more to the market and so broaden the basis for the financing of climate action investments.

The federal states are ploughing considerable resources from the European Regional Development Fund (ERDF) into the promotion of climate action, in some cases even devoting more than the specified quota of 30% of the total budget to climate measures.

Furthermore, financing is being delivered via the EU's new Just Transition Fund (JTF) in coal-mining regions that have been affected particularly dramatically by structural transformations. The JTF is intended to help cushion the negative impacts of the energy transition by supporting the most severely affected areas and workers, promoting a balanced social and economic transition. Alongside resources from the long-established structural funds, the regions of the EU particularly affected by structural transformation as a result of the green transition are therefore receiving financial support from the JTF for innovation and competitiveness initiatives as well. The JTF is contributing to efforts to align economics and ecology with one another and make socially acceptable flanking measures possible that support structural transformation.

Where planned policies and measures are continued and consolidated on the basis of existing measures, existing financing

mechanisms will generally be kept in place as well, the funding of energy-efficient building renovations under national public support programmes for example. It is not currently possible to predict how much EU financing mechanisms can be drawn on to finance the investments required in Germany specifically.

5.4. Impacts of planned policies and measures described in section 3 on other Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

5.4.i. Impacts on the energy system in neighbouring and other Member States in the region to the extent possible

Electricity

The advancing upgrading of power lines within Germany and to the neighbouring states and the ongoing expansion of renewable energies in all the European states will – current assessments suggest – bring about increasing convergence between the electricity systems in Germany and its neighbours. The exchange of electricity between regions will help ensure volatile electricity output, above all from wind and photovoltaics, is better integrated into the overall system and will therefore improve security of supply for the whole region. Meanwhile the inter-regional provision of backup capacities (power stations, storage facilities, flexible loading) is also boosting the efficiency of the electricity systems in all these countries.

Natural gas

Decarbonisation efforts could lead to falls in the use of gas, natural gas in particular, for both primary and final energy by 2030. The reasons for this might be declining demand for final energy in buildings on account of their energy-efficient renovation and the growing market shares gained by renewables.

5.4.ii. Impacts on energy prices, utilities, and energy market integration

Energy prices

It is, in principle, to be assumed that the declining demand for fossil energy carriers brought about by climate action measures in

Germany and Europe will tend to push down energy prices. At the same time rising demand for hydrogen will put upward pressure on prices. The impacts of national measures on the international fuel markets are to be assessed as generally negligible.

A somewhat stronger influence – in particular on the neighbouring countries that are linked to the German electricity grid by interconnectors – is evident when it comes to electricity prices. One central climate action measure in the energy industry is the phasing-out of coal-fired power stations. At the same time electricity is increasingly being generated from renewable energies. If EU ETS prices are high, rising shares for renewable energies in gross power consumption will result over the long term in a tendency for wholesale prices to come down, both in Germany and in other Member States. Conversely, the major expansion of renewable energies planned in the neighbouring countries will also reduce the wholesale price in Germany. Since procurement costs play a central role in the levels of electricity prices for end customers, direct impacts will be felt by consumers. The future development of electricity prices will be shaped by, among other things, the demand for electricity as stronger sector coupling is implemented in the heating and transport sectors.

Utilities

The Federal Network Agency carries out regular monitoring of security of supply in Germany's grid-based electricity and natural gas systems. Its most recent report (February 2023) shows that, under the most recent plans put forward by the German Federal Government, supplies of electricity will continue to be guaranteed at a high level during the period from 2025 to 2031 (even if coal is phased out in 2030). The Federal Network Agency based its analysis on the Federal Government's current plans for the restructuring of the electricity system. These involve renewable energies being expanded in line with the targets of the revised Renewable Energy Sources Act and revised Offshore Wind Energy Act – the generating capacities provided by onshore wind, offshore wind and photovoltaics will be increased to 360 GW by 2030, while the transmission and distribution grids will be upgraded under the Grid Development Plan. Provided these objectives are implemented, the electricity system will actually be so robust, according to the report, that security of supply would still be guaranteed even if there were 10 gigawatts (GW) less generating capacity on the market. The gradual, ever greater integration of the European electricity markets is contributing additionally to security of supply.

Energy market integration

One central point with regard to energy market integration is the further expansion of trading capacities between the Member States. Thanks to the direct and indirect measures to expand the grid envisaged in the Climate Action Programme, the foundations are being laid for a further intensification of electricity trading with the neighbouring countries linked to the German grid by interconnectors. Increasing cross-border trading will help to integrate renewable energies more effectively into the electricity system, deploy controllable capacities and flexibility options more efficiently, and harmonise wholesale electricity prices. This will allow the costs of electricity systems to be cut in all countries. At the same time the energy mix of German electricity imports reflects the energy mixes of the surrounding states from which Germany purchases electricity. Depending on the market situation, it consists of varying proportions of electricity from renewable energies (wind, solar, hydropower, bioenergy) and conventional energy carriers (mainly coal, natural gas and nuclear energy). The proportions of the latter may change on account of the reduction paths being followed in some neighbouring states.

5.4.iii. Where relevant, impacts on regional cooperation

Electricity

It is anticipated that regional cooperation will be of growing significance in the electricity system. The greater the interdependencies between national electricity systems, the more important regular dialogue among the states involved at the regional level is as well. Firstly, this facilitates a more intensive exchange of information than would be possible at a Europe-wide level. Secondly, specific regional aspects can be addressed more effectively and suitable solutions found. And, thirdly, innovative, new approaches to the operation of the electricity system can be trialled in regional cooperation, something that is absolutely essential in a system going through a fundamental transformation. This means shared learning curves can initially be organised at the regional level before the measures tested potentially come to be adopted as standard throughout Europe.

Natural gas

Intensive efforts are being made to decarbonise the remaining demand for gas in Germany and many of the neighbouring states. The result may be that, where it is to be used for hydrogen in future,

the current transmission infrastructure will also have to be inspected and potentially overhauled on a cross-border basis so that various proportions of hydrogen can be blended into the supply. Other pipelines could be rededicated completely for the transportation of hydrogen. This will require extensive bilateral and regional consultation so that the measures taken can be upscaled appropriately and cost-effectively.

The application on the core hydrogen network submitted by the gas transmission system operators to the Federal Network Agency in July 2024 (see https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/Wasserstoff/Kernnetz/start.html) includes potential converted lines (pipelines that are currently still used to transport natural gas and will be converted to carry hydrogen), as well as newly laid lines. The aim is for converted pipelines to make up approximately 60% of the total length of the core hydrogen network, with about 40% being newly laid. The core network will consist of hydrogen pipelines that are to be put progressively into operation by the 2032 target date. What is important in this respect is that security of supply with natural gas remains guaranteed at every point during the conversion process and the conversion of pipelines to hydrogen does not cause any bottlenecks in the natural gas supply. What are known as strengthening measures for natural gas will be required on a small scale for this purpose, the scheduling of which is to be synchronised with the conversion of pipelines to carry hydrogen.

Petroleum

The move away from the consumption of oil for heating has, firstly, led to the development of environmentally benign fuel technologies; secondly, there is recognition of the need to develop potential new techniques such as “power to heat” or new fuels for the future (e.g. e-fuels). The significance of regional/international cooperation will grow at the same time. Cross-border cooperation will be of great relevance, in particular against the background of the new technological systems being developed for the use of heating oil and the development of new fuels for the future. It is sufficient to develop solution concepts for new heating or drive systems nationally as long as these conceptual models are being discussed at the laboratory level. Once developments have reached market maturity, international cooperation is indispensable if they are to be able to establish themselves on the market.

The electrification of the transport sector will bring about a decline in the demand for transport fuels in future and consequently put the European refinery industry under pressure. It will have to be ensured that security of supply remains maintained during this transformation process.

5.5. Contribution of planned policies and measures to the achievement of the Union's climate-neutrality objective set out in Article 2(1) of Regulation (EU) 2021/1119.

With the Federal Climate Change Act as amended on 18 August 2021, Germany committed to achieve net greenhouse gas neutrality by 2045 and a negative emissions balance after 2050. The Federal Climate Change Act sets out an emissions reduction path oriented towards these targets from 2021 up to and including 2040; proposed legislation specifying annual reduction targets for the years 2041–2045 is to be presented by the German Federal Government in 2032 at the latest.

Compliance with the reduction path set out in the Federal Climate Change Act is reviewed annually; if the target path is not adhered to in two successive years, the German Federal Government is obliged to adopt additional reduction measures.

The measures included in the 2023 Climate Action Programme will largely close the gap identified in the 2021 projection report between the situation at that time and the progress required to meet the 2030 climate target – as long as these measures are implemented consistently. A 65-per-cent contribution to the reduction of emissions by 2030 compared to 1990 has therefore moved within reach for the first time. The 2024 projection data demonstrate that Germany’s 2030 climate targets can essentially be met. They simultaneously show what risks and uncertainties threaten the achievement of the targets. These have been examined in detail by the Council of Experts on Climate Change in its report published on 3 June 2024.

Section 3a of the KSG complements the reduction paths that have been defined by setting a target for the expansion of natural sinks. The Action Plan on Nature-based Solutions for Climate and Biodiversity (ANK), which was adopted in March 2023, is the German Federal Government’s central instrument for the achievement of the targets laid down in Section 3a(1) of the KSG. The measures taken under the ANK are subject to regular progress

reviews and will be adjusted if new findings about the sector's development or measures' effectiveness make this necessary. The ANK lays down appropriate requirements for the evaluation scheduled for the first time in 2025 and, where applicable, the continuation of the programme. In particular, the trends in emissions balances in the LULUCF sector are to be taken into consideration when the ANK is evaluated. The programme is to be scrutinised and adjusted as necessary every two years on the basis of up-to-date projection data.

References – Analytical Part of the NECP

BDEW (2024): BDEW-Strompreisanalyse Februar 2024.
www.bdew.de/service/daten-und-grafiken/bdew-strompreisanalyse/
BDEW-Gaspreisanalyse Februar 2024.
www.bdew.de/service/daten-und-grafiken/bdew-gaspreisanalyse/

BMWK (2023): Energieeffizienz in Zahlen.
https://www.bmwk.de/Redaktion/DE/Publikationen/Energie/energieeffizienz-in-zahlen-2022.pdf?__blob=publicationFile&v=7

BMWK; BMF (2023): Gesamtwirtschaftliches Produktionspotenzial und Konjunkturkomponenten: Datengrundlagen und Ergebnisse der Schätzungen der Bundesregierung: Stand: Herbstprojektion der Bundesregierung vom 11. Oktober 2023.
www.bmwk.de/Redaktion/DE/Downloads/G/gesamtwirtschaftliches-produktionspotenzial-herbstprojektion-2023.pdf

BMU (2021): GreenTech made in Germany 2021: Umwelttechnik-Atlas für Deutschland.
www.rolandberger.com/publications/publication_pdf/roland_berger_greentech_atlas_2.pdf

BNetzA (2023): Der Strommarkt im 1. Quartal 2023: Großhandelsstrompreis gesunken.
www.smard.de/page/home/topic-article/209944/210326

BNetzA; BKartA (2023): Monitoringbericht 2023: Monitoringbericht gemäß § 63 Abs. 3 i. V. m. § 35 EnWG und § 48 Abs. 3 i. V. m. § 53 Abs. 3 GWB.
https://data.bundesnetzagentur.de/Bundesnetzagentur/SharedDocs/Mediathek/Monitoringberichte/MonitoringberichtEnergie2023.pdf

DPMA (2021, 2022): Jahresbericht 2021.
www.dpma.de/digitaler_jahresbericht/2021/jb21_de/patente.html#patente_2
Jahresbericht 2022.
www.dpma.de/digitaler_jahresbericht/2022/jb22_de/patente.html#patente_2

DPMA (2024): Frischer Wind bei Innovationen zu erneuerbaren Energien: Pressemitteilung vom 26. April 2024.
www.dpma.de/service/presse/pressemitteilungen/25042024/index.html

European Commission (2022): Recommended parameters for reporting on GHG projections in 2023: Version after consultation of WG2 under the Climate Change Committee on 10 March 2022, sharing of draft recommendation on 30 March 2022 and consultation of National Experts designated by members of WG2 on 26 April 2022.

GWS - Institute of Economic Structures Research (2023): Ökonomische Indikatoren des Energiesystems, Produktion, Investitionen und Beschäftigung: GWS Research Report 2023 / 04.
https://papers.gws-os.com/gws-researchreport23-4.pdf

Prognos (2022): Beitrag von Green Finance zum Erreichen von Klimaneutralität in Deutschland: Öffentlicher Anteil an Klimaschutzinvestitionen: Kurzstudie im Auftrag der Kreditanstalt für Wiederaufbau. Basel. https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Studien-und-Materialien/Prognos_Kurzstudie_Green_Finance_AnteilOeffentlich.pdf

Stifterverband Wissenschaftsstatistik (2023): facts: Zahlen und Fakten aus der Wissenschaftsstatistik Forschung und Entwicklung in der Wirtschaft 2021.
www.stifterverband.org/sites/default/files/2023-04/fue-facts_2021.pdf

Stifterverband Wissenschaftsstatistik (2024): facts: Zahlen und Fakten aus der Wissenschaftsstatistik Forschung und Entwicklung in der Wirtschaft 2022.
www.stifterverband.org/sites/default/files/2024-04/fue-facts_2022.pdf

UBA (publ.) (2024a): Treibhausgas-Projektionen 2024 – Ergebnisse kompakt.
https://www.umweltbundesamt.de/publikationen/treibhausgas-projektionen-2024-ergebnisse-kompakt

UBA (publ.) (2024b): Mendelevitch, R.; Repenning, J.; Matthes, F. C.; Deurer, J.: Treibhausgas-Projektionen 2024 für Deutschland – Rahmendaten. Oeko-Institut; IREES, Dessau-Roßlau.
https://www.umweltbundesamt.de/publikationen/treibhausgas-projektionen-2024-fuer-deutschland

UBA (publ.) (2024c): Harthan, R.; Förster H.; Borkowski, K.; Braungardt, S.; Brugger, H.; Fleiter, T.; Mandel, T.; Deurer, J.; Steinbach, J.; Osterburg, B.; Fuß, R.; Rock, R.: Technischer Anhang der Treibhausgas-Projektionen 2024 für Deutschland (Projektionsbericht 2024). Oeko-Institut; IREES. Dessau-Roßlau.
https://www.umweltbundesamt.de/publikationen/technischer-anhang-der-treibhausgas-projektionen

UBA (publ.) (2024d): Schumacher, K.; Appenfeller, D.; Cludius, J.; Bei der Wieden, M.; Kasten, P.; Kreye, K.; Görz, W. K.; Jansen, L. L.; Loreck, C.; Förster, H.; Harthan, R.; Sievers, L.; Grimm, A. et al.: Sozio-ökonomische Folgenabschätzung zum Projektionsbericht 2023 (Climate Change, 17/2024). Oeko-Institut; Fraunhofer ISI; IREES. Dessau-Roßlau.
https://www.umweltbundesamt.de/publikationen/sozio-oekonomische-folgenabschaetzung

UBA (publ.) (2024e): Schumacher, K.; Appenfeller, D.; Cludius, J.; Bei der Wieden, M.; Kasten, P.; Kreye, K.; Görz, W. K.; Jansen, L. L.; Loreck, C.; Förster, H.; Harthan, R.; Sievers, L.; Grimm, A. et al.: Sozio-ökonomische Folgenabschätzung zum Projektionsbericht 2024. Oeko-Institut; Fraunhofer ISI; IREES. Dessau-Roßlau. Forthcoming.

Measures for the implementation of Article 8 of Directive (EU) 2023/1791

The Federal Government of the Federal Republic of Germany hereby submits to the Commission, subject to further examination, a preliminary communication on the planned implementation of Article 8 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (as amended by Directive 2023/1791/EU) (hereinafter EED). The communication contains the following information in accordance with the requirements of Annex V, point 5 EED and Annex III of Regulation 2018/1999/EU:

- A provisional quantification of the savings target for the Federal Republic of Germany in accordance with Article 8(1)(b) EED (Section 1.);
- Description of the possible use of the options provided for in Article 8(2) EED (Section 2.);
- The provisional designation of strategic measures pursuant to Article 11 EED, including the cumulative final energy savings to be achieved by these in the period 2021-2030, as well as the detailed methodological explanation of this estimate (Section 3.);
- Information on the calculation methods used (Section 4.)
- as well as measures and systems for checking and monitoring the savings (Section 5.)

The corresponding specifications in Article 8 and Annex V EED and Annex III of Regulation 2018/1999/EU were taken into account when estimating the cumulative final energy savings resulting from the measures.

The planned implementation may be subject to changes due to future decisions by the Federal Government and the German Bundestag. The Federal Government will promptly communicate further instruments and measures relevant to the fulfilment of Article 8 Paragraph 1 Letter b EED, thereby ensuring that the Federal Republic of Germany will achieve the savings target pursuant to Article 8 EED. These may include, among other things, other existing strategic measures to increase energy efficiency. This may also include the reporting of additional measures. The Federal Government will also inform the EU Commission of any adjustments within the framework of its reporting obligations under the Governance Regulation.

1. Calculation of the amount of energy saving commitments to be achieved over the entire period from 1 January 2021 to 31 December 31 2030

a) annual final energy consumption, averaged over the last three-year period before 1 January 2019

The calculation basis for determining the savings target in accordance with Article 7, paragraph 1, letter b) EED is based on the values of the average final energy consumption of the Federal Republic of Germany from 2016 to 2018 based on the figures on the final energy consumption provided by EUROSTAT.

- Final energy consumption 2016: 216,87 Mtoe (9079 PJ)
- Final energy consumption 2017: 218,62 Mtoe (9153 PJ)
- Final energy consumption 2018: 215,17 Mtoe (9009 PJ)
- Average final energy consumption per year for 2016 - 2018: **9.081 PJ / 216,89 Mtoe**

b) The total cumulative energy savings to be achieved in final energy consumption pursuant to Article 8(1)(b) of Directive 2012/27/EU [in kt crude oil equivalent]

The savings target pursuant to Article 8(1)(b) EED is therefore set at 5757.15 PJ or 95.46 Mtoe. This derives from the following considerations:

	%	in PJ	In Mtoe
2021-2023	0.8	1961.427	46.84789
2024-2025	1.3	1534.635	36.65413
2026-2027	1.5	1225.892	29.27993
2028-2030	1.9	1035.198	24.72527
Total		5757.153	137.5072

c) Data and sources used to calculate final energy consumption:

The figures for final energy consumption are based on Eurostat[25] data. In the Eurostat database, the indicator tracking progress towards the targets is coded “FEC2020-2030” and is named “Final energy consumption (Europe 2020-2030)”.

2. Use of the options provided for in Article 8 paragraphs 6 and 8 of Directive 2023/1791/EU:

The Federal Government does not currently intend to use the options provided for in Article 8 paragraph 2 EED.

3. **Strategic measures to achieve the energy savings pursuant to Article 8 paragraph 1 of Directive 2023/1791/EU:**

In order to meet the savings target pursuant to Article 8 paragraph 1 EED of 5757.2 PJ or 137.5 Mtoe, the Federal Government is choosing to implement alternative strategic measures pursuant to Article 10 EED. A combination of existing measures and new measures to be adopted will be used. The Federal Government reserves the right to report further measures to achieve the targets pursuant to Article 8 to the Commission as soon as they are adopted.

a) Overview of the expected cumulative final energy savings for the period from 1 January 2021 to 31 December 2030

The following table provides an overview of the existing and planned alternative measures pursuant to Article 10 EED and the expected cumulative final energy savings for the period from 1 January 2021 to 31 December 2030:

Measures	Subject matter	Expected cumulative energy savings 2021-2030 in ktoe[5]
Energy Efficiency Act - Introduction of EMS	The Energy Efficiency Act requires companies with an energy consumption of more than 7.5 GWh to introduce an EMS. In part, this is an anticipation of the EED implementation, which provides for the mandatory introduction of EMS from an energy consumption of 85 TJ (~24 GWh).	336

[5] Net effects taking into account deadweight, pull-forward, spill-over, structural and rebound effects. At the level of individual measures, taking into consideration interactions between measures in accordance with the individual interaction factors listed in Section 4e.

Energy Efficiency Act, Section 11, climate-neutral data centres	The new Energy Efficiency Act obliges authorities, energy-intensive companies and data centres to save more energy. This is because climate action and the energy transition can only be successful if energy consumption is permanently reduced. The law came into force on 18 November 2023. Section 11 sets out the requirements for data centres. On the one hand, data centres that started operations before 1 July 2026 must be operated in such a way that they permanently achieve an energy consumption effectiveness of less than or equal to 1.5 from 1 July 2027 and an energy consumption effectiveness of less than or equal to 1.3 from 1 July 2030. Data centres that start operations on or after 1 July 2026 must achieve an energy consumption efficiency of less than or equal to 1.2 and also have a proportion of reused energy of at least 10%. The proportion of reused energy must meet additional requirements for data centres that become operational at a later point.	446
Module 2 of the Federal Funding for energy consulting for non-residential buildings, facilities and systems	Funding for energy consulting for existing and new non-residential buildings	493
Federal Funding for Efficient Buildings (BEG) - Existing Buildings	The Federal Funding for Efficient Buildings (BEG) aims to increase the energy efficiency of buildings and to support the switch to renewable heating. The programme offers financial support for renovation measures that improve the energy quality of residential and non-residential buildings as well as for the replacement of heating systems. It covers various funding areas, including individual measures on the building envelope, system technology, heating optimisation as well as specialist planning and construction supervision. The funding is available to both private and institutional investors. The effect of the Federal Funding for Efficient Buildings is estimated with the respective design for the year in consideration. From 2024, the effects for the BEG will be used as a basis with effect from 1 January 1 2024. The funding of new buildings in the BEG is considered in a separate template.	18100
Federal Funding for Efficient Buildings (BEG) - New Buildings	As part of the KfW funding with product number 297/298, the Federation grants funding in the form of low-interest loans to reduce environmental impacts and increase sustainability standards when creating new housing and when constructing new residential buildings. Programme 300 promotes income-dependent home ownership in the new building sector for families - WEF. Programme 299 addresses the construction of new non-residential buildings and programmes 498, 499 are aimed at municipalities.	899
Tax breaks for the retrofitting of buildings to improve energy efficiency (section 35c Income Tax Act)	Tax breaks are permissible for individual measures (such as replacing the heating system or insulating individual components of the shell of a building) in owner-occupied private apartments and residential buildings. Both individual measures and the possibility of a comprehensive renovation (total renovation) carried out step by step, if necessary, through several individual measures are eligible for tax breaks. Since 1 January 2020, the tax breaks have been used as an alternative to the Federal Funding for Efficient Buildings (BEG).	1228
Requirement to use 65% renewable energies for newly installed heating systems (section 71 Buildings Energy Act)	Requirement to use 65% renewable energies for newly installed heating systems (section 71 Buildings Energy Act. The estimates	8764

	refer to the amendment passed by the Bundestag on 9 September 2023.	
Revision of the Buildings Energy Act - other	Conditional renovation obligations of the currently valid Buildings Energy Act (renovation to reference building*1.4); reference: “cancelling” the conditional renovation obligations of the Buildings Energy Act; However, it is assumed that in around half of all renovation cases an energy modernisation will nevertheless take place (i.e. autonomously) to the currently valid minimum level under the Buildings Energy Act.	9458
Heating label	Since early 2016 the national efficiency label indicates to consumers the level of the efficiency status of their old heating installation. At the beginning of 2016, devices were labelled on a voluntary basis by chimney sweeps, heating technicians or energy consultants as part of existing contractual relationships. Since the beginning of 2017, district chimney sweeps have been obliged to add labels to devices that have not yet been labelled as part of the regular fireplace inspection. Heating system owners must tolerate this labelling. When the label is applied, they receive an individual determination of the heating device’s efficiency class, an information leaflet containing additional information about the Federal Government’s consulting and funding offers in the area of heating systems, and oral information about the energy efficiency of the heating device. This label and the information provided are intended to encourage heating system owners to seek a consultation on energy or replace the old system if necessary.	151
Information on energy consulting services for residential buildings	The Federal Funding for Energy Consulting for Residential Buildings (EBW) supports energy consulting services provided by experts.	5431
EnsikuMaV (Ordinance to ensure the supply of energy via measures effective in the short term):	Ordinance to ensure the supply of energy via measures effective in the short term , valid from September 2022 to 15 April 2023; rapid impact measures include lowering the minimum room temperature in workplaces by one degree Celsius and setting the maximum temperature in public workplaces at 19 degrees, as well as banning heating for private swimming pools.	181
EnsimiMaV (Ordinance to ensure the supply of energy via measures effective in the medium term):	Ordinance to ensure the supply of energy via measures effective in the medium term (EnsimiMaV) The ordinance sets requirements for the inspection and optimisation of heating systems and for the implementation of economic efficiency measures in companies.	3415
Funding focus “municipal networks” in the municipal guidelines	The overarching goal of the guidelines is to develop sustainable, economical and easily implementable energy and resource saving potential by promoting municipal cooperation in order to permanently reduce greenhouse gas emissions and resource consumption in the municipalities. By using external network, energy and/or resource experts, the participating municipalities are to be enabled to identify savings potential and to set up municipal networks and implement the measures discussed in these networks.	47
Energy savings check-up	The measure has been operational since December 2008 and remains operational initially until 31 March 2026 under various names (“Electricity Saving Check-Up”, December 2008 - December 2012, “Electricity Saving Check Plus”, 1 January 2013 - 31 March 2016, “Municipal Electricity Saving Check-Up” (“Stromspar-Check Kommunal”), 1 April 2016 to 31 March 2019, “Electricity Saving Check Active”, 1 April 2019 to 31 March 2022, “Electricity Saving Check-Up in Your Area”, 1 April 2022 to 31 March 2023 and “Electricity Saving Check-Up - simply save heat, water & electricity”, 1 April 2023-31 March 2026.) A continuation beyond 2026 is planned. The design was partly different in the various phases. An extension until 2030 is assumed whilst keeping the current profile	145

	and scope. The measure includes the continuation of the “Electricity Saving Check-Up” projects that have been funded by the National Climate Initiative since December 2008. The core element is the targeted consulting of low-income households by long-term unemployed people who are trained to become “electricity saving helpers”. The target group are households receiving transfer payments and, since 2016, other households with an income below the seizure exemption limit. The consulting initially only related to saving electricity and hot water. Since 2019, consulting on saving heating energy has also been offered. As part of the consulting service, households receive free energy-saving items (for example LED lamps, switchable power strips, water-saving showers, door brushes or sealing tapes) with which they can immediately reduce their energy consumption and thus contribute to climate action. Since 2013, households that fulfil certain conditions have also received a subsidy to replace a particularly inefficient old refrigerator with a new one in class A+++. Furthermore, the programme continuously guarantees networking with the aim of attracting other actors and multipliers for the consolidation and expansion, e.g. municipalities, other advisory centres and actors of the “Social City”. The project is accompanied by monitoring.	
Federal Funding for energy and resource efficiency in business (EEW)	With the “Federal Funding for Energy Efficiency in Business” programme, several previously valid funding measures were bundled in 2019 which restructured the funding of energy efficiency measures in the business sector. A funding competition is now offered in a separate funding guideline, in addition to a grant and loan version of the programme, which in turn is divided into several modules. Both funding guidelines were amended on 1 November 2021. In addition to improved funding conditions for external waste heat utilisation, electricity efficiency and SMEs, the new funding item resource efficiency was introduced in both funding guidelines and added to the programme title. In the grant and loan version of the programme, the new funding item transformation concepts (module 5) was also introduced, which is intended to support companies in planning their decarbonisation strategy. A further amendment to both guidelines took place in November 2022; it only provided for minor adjustments in the individual modules. The amendment to the funding guideline (grant version) on 1 May 2023 introduced further changes. In addition to other adjustments, this amendment also included the creation of a new Module 6, which offers small companies the opportunity to replace fossil-fueled devices and systems with electric ones, and added geothermal energy to Module 2 as a funding item. The last amendment in February 2024 made funding savings (reduction in funding quotas) and simplified the application process. In addition, the programme was already adapted to the new provisions of the GBER. The EEW currently includes the following elements: Module 1: Cross-cutting technologies Module 2: Process heat from renewable energy Module 3: Measurement and control technology, sensors and energy management software Module 4: Energy- and resource-related optimisation of systems and processes Module 5: Transformation plan Module 6: Electrification of small companies Competition for funding:	22017
Funding of energy efficient air conditioners and non-halogenated refrigerants in stationary devices	In addition to reducing climate-damaging F-gases, the measure also aims to increase the efficiency of the subsidised systems above the market average. The effect of the subsidised use of waste heat is particularly relevant for the final energy savings.	219
Guideline for the funding of climate action projects in the municipal environment “municipal guideline” (KRL) -	The measure includes funding for the renovation of outdoor and street lighting as well as indoor and hall lighting within the framework of the municipal guidelines. It is assumed that the measure will be continued in a comparable way until 2030.	220

programme component lighting		
The Federal Funding for energy consulting for non-residential buildings, facilities and systems	The Federal Funding for energy consulting for non-residential buildings, facilities and systems consists of a total of 3 modules. Module 1 supports energy audits for small and medium-sized companies that meet the essential requirements of an energy audit as defined in section 8a of the Energy Services and Other Energy Efficiency Measures Act (EDL-G) and in particular the requirements of DIN EN 16247. Module 2 supports energy consulting for existing and for new non-residential buildings, which makes it possible to consider energy efficiency and renewable energies in the planning and decision-making process and thus exploit the efficiency potential at the most favourable time for each customer. The contracting orientation consultation funded in Module 3 aims at a contracting model with a contractual savings guarantee.	421
SME Initiative for Energy Transition and Climate Change Mitigation	Support for small and medium-sized companies from the skilled crafts and industry sector in the area of energy efficiency and climate action. On 1 January 2019, another stage of the SME initiative was launched, which continues the projects that had been started before and designs new measures, such as the digitisation of the electronic energy book (e-tool), the development of a business development roadmap for SMEs, the issue of mobility and the targeted integration of energy efficiency into further training and education in skilled crafts. This measure was discontinued at the end of 2023.	68
Energy efficiency and climate action networks	The “Energy Efficiency Networks Initiative”, which has been supported by the Federal Government together with business associations and organisations since late 2014, has proven to be one of the most successful NAPE measures. Therefore, in mid-September 2020, the Federal Government together with 21 supporting business associations and organisations and with ten cooperation partners agreed to continue the initiative as the “Energy Efficiency and Climate Action Networks Initiative”. This second phase is to be continued until the end of 2025 (goals: 300-350 new networks, savings of 9-11 TWh of final energy and 5-6 million tonnes of GHG emissions). The relevant industrial sectors, the energy industry, skilled crafts and commerce are involved in the action alliance. The guiding principle is that the exchange of experience in the network will stimulate significantly more and faster efficiency measures in companies than would be the case without the exchange. The networks consist of an average of 10 companies, which set both individual goals and joint savings goals at the launch of the network. Moderators and expert energy consultants structure and support the functioning of the network.	3301
KfW Energy Efficiency Programme for production facilities and processes	The KfW Energy Efficiency Programme funds the implementation of energy efficiency measures in companies (production facilities/processes including horizontal technologies) via the provision of low-interest loans. Current conditions: Investment in modernisation which results in a specific energy saving of at least 10% from the average consumption of the last three years. In the case of new investment, the degree of energy conservation compared with the average for the sector is the criterion.	722
Package of measures: Promoting climate-friendly manufacturing processes	This package of measures comprises programmes to promote the market introduction of climate-friendly manufacturing processes: - Funding programme for the decarbonisation of industry (from 2024 Federal funding for industry and climate action) The aim is to fund investments to cut process-related emissions in the field of emission-intensive industries. The projects should involve application-oriented R&D, commercial-scale trials and broad-based market launch of mature or new technologies. Implementation in the Funding guideline for the decarbonisation of industry (from 2024 Funding guideline for the Federal funding for industry and carbon management) (Funding guideline for Federal funding for industry and climate action).	2656

	- Carbon contracts for difference: The process of decarbonisation is to be supported by the carbon contracts for difference (CCfDs). The CCfDs are to hedge against the higher operational costs tied to innovative climate technologies via the difference to the carbon price. CCfDs are addressed to key technologies that will be of long-term significance, but which are not yet economic at today's carbon prices. - EU Innovation Fund: The Innovation Fund of the EU ETS promotes innovative demonstration projects for climate-friendly technologies. Since 2020, the funding has also gone towards projects demonstrating innovative climate-friendly production processes in industry, incl. CCU and CCS. This means that, overall, funding goes towards: - innovative low-carbon technologies and processes in energy-intensive industries including products which replace carbon-intensive industries, - carbon capture and use (CCU), - construction and operation of carbon capture and storage (CCS), - innovative renewable energy generation and - energy storage. - IPCEI Hydrogen Creation of a new Important Project of Common European Interest (IPCEI) in the field of hydrogen technologies and systems. Promotion of market roll-out of green hydrogen.	
Lightweighting Technology Transfer Programme (TTP LB)	The programme promotes the substitution of GHG-intensive resources and raw materials, and the circular use of materials. This takes place in 5 programme lines: - Technology development to boost lightweighting in the German economy - Reducing CO_2 and binding CO_2 via the use of new design technologies and materials - Saving CO_2 via resource efficiency und substitution - Demonstration projects - Standardisation	2079
Carbon leakage state aid in the context of the Carbon Leakage Ordinance (BECV)	The introduction of national fuel emissions trading creates the risk of carbon leakage. This means that, due to the higher costs, companies relocate their production to other countries, with no GHG emissions being reduced at an overarching level. In order to avoid this risk, there has been the possibility since 2023 to apply for state aid to offset some of the increased costs. However, this state aid is tied to the delivery of ecological services in return. Within the necessary process of transformation of industrial production, the Ordinance on measures for the avoidance of carbon leakage through national fuel emissions trading is to create a link between the intended relief from operating costs delivered by the state aid, and incentives for the implementation of climate-friendly measures in the companies' investment plans.	417
Federal programme for energy efficiency and CO_2-emission reduction in the agricultural and horticultural sector	The federal programme for energy efficiency and CO_2-emission reduction in the agricultural and horticultural sector offers financial support to help companies in these sectors to invest in more sparing, climate-friendly technologies. The funding programme is based on funding guidelines offering assistance in the fields of energy advice, investment measures to improve energy efficiency, reduction of carbon emissions and the roll-out of renewable energy, district heating and district cooling. Knowledge transfer and information measures and research and development are no longer eligible for funding following the redesign of the Climate and Transformation Fund.	763
Guidelines to promote the sale of electric vehicles (environmental bonus)	From mid-2016 until 17 December 2023, electric vehicles were funded via a purchase premium, known as the "environmental bonus". Initially, half of the bonus was granted by the car-maker (manufacturer's share) and half by a federal grant (federal share). The guidelines to promote the sale of electric vehicles were revised several times during the programme. For example, from February 2020, the 4th guidelines coupled the funding rates to the value of	9526

	the vehicle, vehicles costing less than €40,000 were subsidised at a higher rate, and a funding ceiling was introduced for a vehicle value of €65,000, above which no funding was provided. In June 2020, the 6th funding guideline introduced a significant rise in the rates of federal funding (the manufacturers' share was not changed) via the innovation bonus, doubling the federal share compared with the manufacturers' share. The 9th and final funding guideline ended the innovation premium, and no more plug-in hybrids were funded. The federal grant for battery electric vehicles (BEVs) and fuel cell vehicles (FCEVs) in the final year of the programme stood at €4,500 for vehicles costing less than €40,000 (€3,000 for vehicles costing more than €40,000), and the manufacturers' share was €2,250 and €1,500 respectively. On 17 December 2023, the programme, which was originally intended to run until the end of 2024, was terminated ahead of schedule due to financing problems in the federal budget.	
Reduction of company car taxation for electric cars by 2030	The reduced company car taxation for the private use of BEVs (75% reduction, a quartering of the assessment basis up to a gross listed price of up to €70,000) and plug-in hybrids or BEVs with a gross listed price of over €70,000 (halving of the assessment basis) is extended until 2030. In case of company BEVs and FCEVs, basis is 1/4; 1/2 for PHEVs (not more than 50g CO_2/km or minimum electric range of 60 km (1.1.22 to 31.12.24) or 80 km (1.1.25 to 31.12.30) by plug-in) of gross listed price per month.	450
Funding programme for the purchase of electric buses for local public transport	Based on the above-mentioned guidelines, funding goes towards the purchase of buses with alternative drivelines for local public transport. The focus of the funding is on electric driveline variants.	333
Making railway travel cheaper	Reduction of VAT for long-distance passenger rail journeys from 19% to 7% (local passenger rail transport was already taxed at 7%, and freight stays at 19%).	216
Introduction of the Deutschlandticket	On 3 September 2022, the coalition committee decided to introduce a nation-wide local transport ticket. Following this, the conference of transport ministers agreed in October 2022 on fundamental technical and substantive preconditions for the introduction of nation-wide local public transport ticket (at an introductory price of €49/month). The Deutschlandticket was introduced on 1 May 2023. In return, the Federation is providing the Länder with regionalisation funds of €1.5 billion in the years from 2023 to 2025.	330
Guidelines for the funding of commercial and special-purpose vehicles using climate-friendly propulsion systems and of the associated refuelling and charging infrastructure	From July 2018, grants were available for the purchase of trucks with alternative drivelines via the Energy-efficient Commercial Vehicles funding programme. The programme expired on 31.12.2020. The funding guidelines for commercial vehicles with alternative, climate-friendly drivelines and related fuelling and charging infrastructure, which entered into force on 02.08.2021, increased the funding to 80% of the additional technology-induced investment costs. The measure terminates at the end of 2024.	72
CO_2 differentiation and widening of the truck toll	Zero-emission vehicles are fully exempt from the truck toll until the end of 2025. After this time, zero-emission vehicles will pay only 25% of the part of the toll for infrastructure costs plus the part of the toll for the costs of noise and air pollution. Zero-emission vehicles with a technically admissible total mass of up to 4.25 tonnes are permanently exempted from the toll. Since 01.12.2023, an additional part of the toll has been levied on traffic-induced carbon emissions via the truck toll. It is based on a price of €200 per tonne of CO_2. The truck toll was extended on 01.07.2024 to cover trucks with a technically permissible total mass of more than 3.5 tonnes.	1557
Increase in funding for efficient trailers	In the context of the measure entitled "Expansion of the funding for efficient trailers", the funding programme entitled "fleet renewal programme for heavy commercial vehicles" is redesigned for pure component funding. Here, grants are given towards the purchase costs of intelligent trailer technologies (ITTs) and of carbon-reducing additional equipment for a new commercial vehicle (e.g. for aerodynamic add-ons, aerodynamic trailers, optimisation of tyre rolling resistance (tyres and axes), optimisation of loading	169

	capacity/no. of journeys, lightweighting, making the trailer cranable, increasing refrigeration efficiency). In addition to new purchases, grants also go towards the retrofitting of existing trailers.	
Increased weighting of the carbon emission charge contained in the motor vehicle tax	In order to steer demand more clearly towards cars with reduced emissions potential, the CO_2 tax rate has been given even greater weight via the introduction of a progressive CO_2 rate in motor vehicle tax for vehicles with internal combustion engines. Cars with a CO_2 type approval test of up to 95 g/km which were first registered from 12 June 2020 until 31 December 2024 are given favourable treatment worth €30 per year in motor vehicle taxation until 31.12.2025.	179
Energy and electricity duty	The Energy Duty Act and the Electricity Duty Act regulate the taxation of various energy carriers (e.g. heating oil, gasoline, diesel, natural gas, LPG, CNG) and of electricity. Thanks to their price-stimulus-providing effect, these duties influence the behaviour of end-users, encouraging greater use of energy-efficient technologies and a sparing use of energy. The energy duty and the electricity duty are based on EU-wide harmonised law (Directive 2003/96/EC). The Energy Duty Act entered into force in 2006 (replacing the Oil Duty Act), and the Electricity Duty Act came into effect in 1999. The acts are revised on an ongoing basis (most recently in 2024).	13821
Carbon pricing for the transport and heat sectors	From 2021, the Fuel Emission Allowance Trading Act introduced carbon pricing for the transport and heat sectors (non ETS sectors). The national Emissions Trading System (nETS) covers the emissions from the combustion of fossil heating and motor fuels (in particular heating oil, liquefied gas, natural gas, coal, gasoline, diesel). A fixed price system will be introduced before the end of 2025, in which allowances are sold at the upstream trading level to party marketing or delivering the fuels. This provides for a reliable price pathway that enables households and businesses to prepare for the development. At the same time, the Federal Government is planning for the establishment of a trading platform which permits auctioning of the allowances and trading.	6070
Aviation tax	Increase in the aviation tax from 01.04.2020 for destinations within Europe by €5.53 to €13.03, for medium-range distances up to 6,000 km by €9.58 to €33.01, and for long-range flights by €17.25 to €59.43.	1815
Total		116515

b) Description of the measures in accordance with the requirements in Annex III para. 3 no. 3.2 and 3.3. and Annex III para. 4 letter c) - d) of Regulation 2018/1999/EU

A detailed description of these measures and the annual savings achieved by them in accordance with the requirements in Annex III para. 3 no. 3.2 and 3.3. and Annex III para. 4 letter c) - d) of Regulation 2018/1999/EU can be found in the attached Excel sheet. Further technical details can be provided on request.

c) Measures and share of savings which need to be achieved in households at risk of energy poverty in accordance with Article 8(3)

The electricity savings check measure M23 and the energy advice measure M21 (consumer advice section) can also address aspects of energy poverty. The electricity savings check is addressed exclusively to the target group of low-income households, and thus makes a significant contribution towards tackling energy poverty. Targeted advice is given to low-income households on saving electricity and energy, and the households are given energy-saving articles free of charge.

Within the context of the measures on energy advice for households by the consumer advice centres, which form part of energy advice measure M21, all the energy advice services for low-income households are free of charge. The Federation of German Consumer Organisations (vzbv) offers an independent advisory service for private consumers; in addition to advice in the consumer centres, online and phone-based advice, and on-site advisory services are also available for consumers. Energy checks can offer advice on a number of fields (e.g. electricity and heat consumption, heating technology, use of renewable energy such as PV, solar thermal energy). The service provided by the consumer advice centres addresses all the questions relating to issues like energy efficiency, energy conservation and renewable energies.

Further to this, the Federal Government is drawing up further measures and updating existing measures to meet the requirements.

The share of savings which need to be achieved in households at risk of energy poverty in accordance with Article 8(3) is still being calculated.

4. Calculation methodology for measures notified under Article 10 of Directive 2012/27/EU (in the version of Directive 2021/1791) (except for taxation measures)

a) Measurement methods used referred to in point 1 of Annex V to Directive 2012/27/EU (in the version of Directive 2023/1791)

Depending on the measure, different measurement methods are used in line with the data available. For most of the funding measures, the described savings are based on extrapolations of savings measured by evaluations in line with Annex V no. 1 letter a of the EED.

b) Method to express the energy savings (primary or final energy savings)

The savings achieved by the measures cited above are presented for final energy.

c) Lifetimes of measures, rate at which the savings decline over time and approach used to take into account the lifetime of savings

The information about the lifetimes of the various measures can be found in the brief descriptions under 3. Where it was possible to categorise the measures as one of the measures in Annex VIII of the Annex to the Commission Recommendation on transposing the energy savings obligations under the Energy Efficiency Directive[35], the lifetimes cited there were used. No source is referenced in this case. If no appropriate lifetime was found, it has been stipulated and justified in the brief description.
The issue of degradation, i.e. the reduction in savings over time e.g. due to wear and tear of the new products / components, does not seem to play a major role according to current knowledge. In the case of investment measures, no wear and tear has been empirically proven, at least at the outset of the lifetime. On 15.3.2019, an expert workshop was hosted in Brussels by the European Commission on the subject of lifetimes and performance degradation. The documents on the workshop and the minutes state that there is at present no robust scientific basis on which to develop a method that can take explicit account of the degradation of savings. In view of this, no calculation of a diminishing rate is made at the present time, as it would not be statistically robust.

d) Brief description of the calculation methodology, including how additionality and materiality of savings are ensured and which methodologies and benchmarks are used for deemed and scaled savings

The calculation of the energy savings is mainly based on the recommendations by the European Commission of 2 July 2010 (Recommendations on Measurement and Verification Methods in the framework of the Directive 2006/32/EC on Energy End-Use Efficiency and Energy Services) The bottom-up calculation methods proposed there primarily refer to measures in the fields of action of buildings and facilities, equipment and lighting. They were drawn up by the Commission as non-binding proposals or recommendations in order to give the Member States scope to adapt the calculation methods appropriately in view of the very different national information and data situations. The Commission’s recommendations on the calculation of energy savings by bottom-up calculation methods do not cover all the fields of action in which measures have been taken to boost energy efficiency. The Commission’s recommendations therefore expressly provide that the Member States should develop or use additional national bottom-up calculation methods to calculate energy savings of those instruments not covered by the Commission’s recommendations. This particularly refers to instruments and measures in the fields of action “Transport and Mobility” and “Horizontal Measures” The Federal Government has made corresponding use of this envisaged possibility. Further to this, use was made of existing evaluations of funding measures / programmes where they were appropriate. Such programme evaluations also use bottom-up-based calculation methods. However, they are generally tied to additional empirical components like standardised surveys or interviews of experts, and can thus generally deliver more precise estimates of the attained energy savings via increased effort and, related to this, higher evaluation costs.

The methods were used in the second National Energy Efficiency Action Plan of the Federal Republic of Germany (NEEAP 2011) to calculate measure-induced energy savings, and were described in detail there in an accompanying methodological document. Subsequently, these methods were used for the reporting of the other NEEAPs and the communication implementing Art. 7 EED for the 2014-2020 period, and were further developed giving consideration to the requirements of the annex to the Commission’s

recommendation on transposing the energy savings obligations under the Energy Efficiency Directive, Brussels, 13 September 2023, C(2023) 1791 final.

The calculation method used for a specific measure (calculation formula based on the recommendations of the Commission, national calculation formula or use of existing external evaluation) is cited in the brief descriptions of the measures. The net effects take into account possible deadweight, pull-forward, spill-over, structural and rebound effects. Further to this, consideration is given to interactions between measures in accordance with the individual interaction factors listed in Section 4e. A description of how additionality of the respective measures can be ensured can be found above in the brief descriptions of the measures presented under 3, in the Methodological Aspects.

In the case of the energy efficiency funding programmes, the requirements of budgetary law, and especially of section 23 Federal Budget Code, mean that measures cannot normally be funded if they could be implemented on an economically viable basis without funding or if the implementation of the measure is required by law. This means that the funding must be material for the implementation of an (energy efficiency) measure and that potential deadweight effects must be minimised.

e) Information on how the possible overlaps between the measures and individual actions are addressed to avoid double counting of energy savings

The Federal Government uses interaction factors (or instrument factors) when calculating the energy saving effects. These interaction factors are a correction variable to avoid double counting of energy savings. They ensure that any double counting (especially when a single energy saving measure is addressed by a larger bundle of instruments and programmes) is corrected, and that the identified energy saving is only counted once in the total saving. Here, the energy saving in a certain field is allocated pro rata to the measures addressing this field.

Interaction factors (or, at the time, instrument factors) were used as a methodological approach in the second National Energy Efficiency Action Plan of the Federal Republic of Germany (NEEAP 2011) to calculate measure-induced energy savings, and were described in detail there in an accompanying methodological document. Subsequently, these methods were used and further developed for the reporting of the other NEEAPs and the communication implementing Art. 7 EED for the 2014-2020 period.

The common overlap between each pair of measures is estimated for the notified measures. However, this cannot take place until all the measures to be reported are known, and will therefore be provided subsequently.

f) Where relevant, climatic variations and approach used

Since Germany’s climate is relatively homogeneous, no consideration is envisaged for or given to differing climatic conditions in the reported measures.

Interactions with other measures have already been taken into account in the methods used to quantify the savings effect.

5. Monitoring and verification

a) Brief description of the monitoring and verification system and the process of the verification

In order to ensure that the intended goals are actually achieved, measures to attain energy savings which involve budget funding are regularly evaluated and monitored by independent external experts, institutes and bodies. They are subject to success monitoring in line with the requirements of the Federal Budget Code (section 7(2) Federal Budget Code). The attainment of the target, the effectiveness and the economic viability of the measures are studied. A systematic and transparent assessment takes place, oriented to the quality standards of the German Society for Evaluation (DeGEval). Depending on the measure or the design of the evaluation of the individual measures, energy savings are either calculated by the experts themselves, or the results of the evaluation feed as a basis into the energy saving calculations of the relevant ministries (e.g. taking account of the number of the actual cases provided with funding and the measures actually implemented which save energy). In order to fulfil its statutory tasks, the Federal Office for Energy Efficiency set up a monitoring and verification system. A structured monitoring template collects, for example, information about the savings achieved by the alternative measures under Article 10 EED by the stakeholders responsible for the measures (in the case of measures involving budget funding, these are the findings of evaluations carried out by independent bodies). In a subsequent plausibilisation process, the

completeness and consistency (within a reference year, in comparison to standard variables for comparable measures and over time) of the data are verified.

b) Implementing public authority and its main responsibilities in charge of monitoring and verification system in relation to the energy efficiency obligation scheme or alternative measures

The Federal Office for Energy Efficiency, which is based in the Federal Office for Economic Affairs and Export Control, works on the statutory basis of the Energy Services Act[37] to monitor the savings effects of energy efficiency mechanisms and other strategy measures of the public sector intended to effect energy savings by end-users, and processes these savings for the purpose of reporting in the context of the national and European energy efficiency and savings targets. This includes the monitoring and verification of the savings effects of the alternative measures under Article 10 EED.

c) Independence of monitoring and verification from the obligated, participating or entrusted parties

Measures to attain energy savings which involve budget funding are regularly evaluated and monitored by independent external experts, institutes and bodies.

d) Statistically significant proportion of energy efficiency improvement measures and proportion and criteria used to define and select a representative sample

The definition of a statistically significant sample largely depends on the number of cases under consideration and other parameters of the measure. It is therefore impossible to provide a generally valid definition, e.g. by citing percentages and case numbers, but must be considered in view of the parameters of the measure.

The Federal Ministry for Economic Affairs and Climate Action has had methodology guidelines[38] drawn up which must be observed by external experts evaluating efficiency measures and which provide a uniform methodology for the ex-post and accompanying evaluation of the energy efficiency policy measures. This also helps to ensure the quality of the evaluation results. The guidelines describe, independently of the number of cases in question, how the observed savings of a statistically significant proportion of the measures to improve energy efficiency are to be evaluated on the basis of a representative sample.

e) Reporting obligations for obligated parties (savings achieved by each obligated party, or each sub-category of obligated party, and in total under the scheme)
As there are no energy efficiency obligation systems in place in Germany, no parties are “obligated” within the meaning of Article 9 EED. However, the ministries responsible for the measures report on the effects in the context of the regular monitoring of the savings achieved by efficiency measures.

[37] Amendment to the Act on Energy Services and Other Energy Efficiency Measures.

[38] Methodology guidelines for evaluations of efficiency measures of the Federal Ministry for Economic Affairs and Climate Action (project no. 63/15 - Topping up)

f) Publication of energy savings achieved (each year) under the energy efficiency obligation scheme and alternative measures

Ongoing support for and comprehensive monitoring of the implementation of all the planned measures and of the reduction effects attained by them will take place in the update of the regular reports already being published by the Federal Government entitled “Monitoring the energy transition” and the “Climate Action Report”.

g) Information on Member State law on penalties to be applied in the case of non-compliance

In line with the varying nature of the alternative methods under Art. 10 EED selected by the Federal Republic, the related potential sanctions in the case of non-compliance with the respective requirements also differ. A rough distinction can be made between measures in the field of regulatory law and funding measures. In the case of funding measures, the disbursement of the funding is made only following completion of the verification of all the documents to be presented in the proof of use procedure. In line with the General Ancillary Provisions under Administrative Provision no. 5.1 regarding section 44 of the Federal Budget Code, the applicant is obliged to retain all subsidy-related documents for at least five years, and to present them in the event of a review. Failure to comply with this obligation means that the preconditions for approval are not met retroactively, and the funding can be recovered along with interest payments. In the

case of measures in which tax privileges or reduced charges are granted, these are withdrawn in the case of non-compliance. Violations of regulatory law are sanctioned by fines (e.g. if the requirements of section 48 Buildings Energy Act (M11) are not met, a fine of up to €50,000 can be imposed).

h) Information on policy measures provided for in the event that progress is not satisfactory

An annual review of the effectiveness of the measures cited above is envisaged on the basis of the monitoring carried out by the Federal Office for Energy Efficiency. In this way, the Federal Government creates the objectivity on the attainment of its efficiency and climate targets. To this end, the Federal Government will place the Climate Action Cabinet Committee (the “Climate Cabinet”) on a permanent footing and give it the task to annually review the measures’ effectiveness, efficiency and ability to meet the target. If the progress is unsatisfactory, the relevant minister will present the Climate Cabinet with an immediate action programme to fine-tune the sector which is not attaining the statutory targets set for it, within three months of the emission data being confirmed by the expert commission. On this basis, the Climate Cabinet is preparing decisions on how the Climate Action Programme 2030 adopted by the Federal Government can be jointly adapted in such a way that its underlying objectives are attained.

ANNEX 1 Policies and measures along the five dimensions of the Energy Union

Dimension 1: Mitigation of greenhouse gas emissions
Dimension 2: Energy efficiency
Dimension 3: Security of the energy supply
Dimension 4: Internal energy market
Dimension 5: Research, innovation and competitiveness

No.	**Measure**	**Dimension**	**Latest reporting**
1	European emissions trading system	1	NECP-R
2	Reduction of the surcharge under the Renewable Energy Sources Act (*EEG*)	1	NECP-R
3	Energy and electricity tax	1, 2	NECP-R
4	Carbon pricing for the transport and heat sectors under the Fuel Emission Allowance Trading Act	1	NECP-R
5	Climate and Transformation Fund Act (*KTFG*):	1	

6	National Climate Initiative (*NKI*)	1	NECP-R
7	Minimum efficiency standards EU Ecodesign Directive	1, 2	NECP-R
8	Energy labelling – EU Regulation setting a framework for energy labelling	1, 2	NECP-R
9	NEC Directive on the reduction of national emissions of certain atmospheric pollutants	1	
10	Municipal heat planning	1	
11	Climate-neutral federal administration by 2030	1, 2	NECP-R
12	National Hydrogen Strategy	1	NECP-R
13	Voluntary product labelling for energy-related products	1, 2	
14	Funding of energy advice for non-residential buildings, installations and systems (*EBN*)	1, 2	NECP-R
15	Strengthening research for more energy efficiency	1, 2, 5	

16	Improving the framework for energy-efficiency services	1, 2	
17	Energy-efficient urban re-development	1, 2	
18	Energy Efficiency Act	1, 2	
	Electricity sector/energy industry		
19	Coal phase-out 2038 including an accelerated phase-out of lignite in the Rhenish mining area	1	NECP-R
20	Expansion of renewable energy in line with actual expansion figures and the auctions under the Renewable Energy Sources Act (*EEG*)	1	NECP-R
21	Combined Heat and Power Act (*KWKG*)	1	NECP-R
22	Increasingly convert heat networks to the use of renewable energy sources and unavoidable waste heat – funding volume in accordance with the Federal funding for efficient heat networks (*BEW*) and, if applicable, the Heat Planning Act	1	NECP-R

23	Expansion of electrolyser capacity in accordance with the National Hydrogen Strategy	1	NECP-R
24	Regulatory sandboxes	1, 5	
25	Accompanying measures for the energy transition	1, 2	NECP-R
	Transport		
26	Reduction of company car taxation for electric cars by 2030	1	NECP-R
27	Increased weighting of the carbon emission charge in the motor vehicle tax from 2021	1, 2	NECP-R
28	Reduction in electricity costs – abolition of the surcharge under the Renewable Energy Sources Act (*EEG*)	1	NECP-R
29	Amendment of the commuting allowance for long-distance commuters	1	NECP-R
30	Increase the attractiveness of public transport	1	NECP-R

31	Introduction of the *Deutschlandticket* (Germany-wide regional and local public transport ticket)	1	NECP-R
32	Expansion of cycling infrastructure	1	NECP-R
33	Grant for heavy-duty vehicles with climate-friendly drive systems	1	NECP-R
34	CO_2 differentiation for the lorry toll / expansion of the lorry toll	1	NECP-R
35	Increase in funding for efficient trailers	1, 2	NECP-R
36	Federal financial assistance for shore-side power in sea and inland ports	1	NECP-R
37	CO_2 emission standards for passenger cars and light-duty vehicles	1	NECP-R
38	CO_2 emission standards for passenger cars and heavy-duty vehicles	1	NECP-R
39	GHG quota / RED revision (incl. funding programme for advanced biofuels and electricity-based fuels)	1	NECP-R

40	Additive quota for PtL in aviation and ReFUelEU Aviation	1	NECP-R
41	Expand refuelling and charging infrastructure for passenger cars and light-duty vehicles	1	NECP-R
42	Expand refuelling and charging infrastructure for passenger cars and heavy-duty vehicles	1	NECP-R
43	Hybrid-electric flying/climate-neutral flying	1	NECP-R
44	Ensure automated and connected transport and smooth flow of traffic and innovative forms of mobility	1, 2	NECP-R
45	German Digital Strategy	1, 2	NECP-R
46	Promotion of inland shipping navigation (various programmes)	1	NECP-R
47	Climate-neutral vessel / maritime research programme	1, 5	NECP-R
48	Accelerated planning and implementation of new infrastructure	1	NECP-R

49	Promotion of corporate mobility management	1	
50	Modernisation of road traffic law	1	
	Buildings		
51	Federal Funding for Efficient Buildings (*BEG*) (revision of the new funding scheme for heating systems in line with the 65% rule)	1, 2	NECP-R
52	Funding programme for climate-friendly new construction	1, 2	
53	Home ownership for families	1	
54	Tax incentives for the energy retrofitting of buildings	1, 2	NECP-R
55	Buildings Energy Act (*GEG*)	1, 2	NECP-R
56	Federal funding for serial retrofitting	1, 2	NECP-R
57	Federal buildings to serve as a role model	1, 2	NECP-R
58	National energy efficiency label for old heating installations	1, 2	NECP-R

59	Energy performance certificate	1, 2	NECP-R
60	Timber construction initiative	1	
61	Digital Building Resource Passport	1	
62	Federal funding programme for energy advice on residential buildings	1, 2	NECP-R
63	Further development of the Future of Buildings innovation programme	1 2	NECP-R
64	Modernisation surcharge	1 2	
65	"Sustainable buildings" quality seal	1, 2	
66	Limitation of the surcharge under the Fuel Emission Allowance Trading Act (*BEHG*)	1, 2	NECP-R
67	Heat pump development programme and quality campaign	1	
68	Heating optimisation (Ordinance on Securing the Energy Supply through Medium-term Impact Measures (*EnSimiMaV*))	1, 2	NECP-R

69	Federal programme for retrofitting municipal facilities for sports, youth, and culture	1 2	NECP-R
	Electrical appliances and other applications		
70	Minimum efficiency standards – EU Ecodesign Directive	1 2	NECP-R
71	Energy labelling – EU Regulation setting a framework for energy labelling	1 2	NECP-R
72	Advisory service for low-income households (electricity savings check)	1 2	NECP-R
73	Introduction of smart measuring devices (smart meters) for measuring electricity consumption	1 2	NECP-R
	Industry and commerce, trade, services		
74	EU Emissions Trading Scheme (ETS)	1, 2	NECP-R
75	Federal funding for energy and resource efficiency in business (grants and loans / funding competition)	1, 2	NECP-R

76	Refrigeration and Air Conditioning Directive	1	NECP-R
77	National Climate Initiative (*NKI*): Municipal guidelines for investment measures	1	NECP-R
78	Minimum efficiency standards – EU Ecodesign Directive	1 2	NECP-R
79	for energy advice on non-residential buildings, installations and systems	1 2	NECP-R
80	SME Initiative Energy Transition and Climate Action	1	NECP-R
81	Initiative on energy efficiency and climate action networks	1 2	NECP-R
82	Energy savings meter pilot programme	1 2	NECP-R
83	Energy audit obligation for non-SMEs	1, 2	NECP-R
84	*KfW* Energy Efficiency Programme for production facilities and processes	1 2	NECP-R
85	Decarbonisation in industry funding programme	1, 5	NECP-R

86	EU ETS Innovation Fund	1	NECP-R
87	Carbon contracts for difference	1	NECP-R
88	IPCEI Hydrogen in industrial production	1	NECP-R
89	Lightweighting technology transfer programme	1	NECP-R
90	Funding programme for the industrial bioeconomy	1, 5	
91	Obligation to introduce energy management systems	1, 2	NECP-R
92	Industrial processes and product use (fluorinated greenhouse gases)	1	NECP-R
93	EU F-Gas Regulation 517/2014	1	NECP-R
94	HFC emissions in the EU ETS	1	NECP-R
95	EU MAC Directive 2006/40/EC	1	NECP-R
96	Chemicals Climate Protection Ordinance	1	NECP-R
97	Refrigeration and Air Conditioning Directive	1	NECP-R

98	Voluntary self commitment SF_6	1	NECP-R
	Agriculture		
99	Fermentation of manure of animal origin	1	
100	Expanding organic farming	1	NECP-R
101	Improving energy efficiency in agriculture	1, 2	NECP-R
102	Reducing nitrogen surplus and improving nitrogen efficiency	1, 2	NECP-R
103	Reducing greenhouse gas emissions in livestock farming	1	
104	Research initiative to achieve the 2030 climate targets	1, 5	
	LULUCF		
105	Limit the use of new land for settlement and transport purposes to less than 30 hectares per day by 2030	1	NECP-R
106	Maintaining and building up humus in arable land	1	

107	Conservation of permanent grassland	1	
108	Protection of peatlands including reduction of the use of peat in growing media	1	NECP-R
109	Conservation and sustainable management of forests	1	
110	Rewarding the ecosystem services of forests	1	
111	Research initiative on climate action in agriculture and forestry	1, 5	
112	Forest Climate Fund	1	
	Waste management		
113	Landfill Ordinance	1	NECP-R
114	Circular Economy Act	1, 2	NECP-R
115	Promotion of landfill aeration	1	NECP-R
116	Promotion of technologies for the optimised capture of landfill gases in municipal waste	1	NECP-R

117	Promotion of climate-friendly wastewater treatment	1	NECP-R
118	Reduction of food waste	2	NECP-R
119	Ordinance on Securing the Energy Supply through Rapid Impact Measures	1, 2, 4	NECP-R
120	State Aid for Carbon Leakage	2	
121	Aviation tax	2	NECP-R
122	Tax incentives for electric mobility	2	NECP-R
123	Security of gas supply	3	NECP-R
124	Grid reserve	3	NECP-R
125	Capacity reserve	3	NECP-R
126	Monitoring the security of electricity supply	3	NECP-R
127	System Stability Roadmap	3	NECP-R
128	Monitoring the security of gas supply	3	NECP-R
129	Collaborations	3	NECP-R

130	Projects for interconnector expansion in the Power Grid Expansion Act and the Federal Requirements Plan Act	4	NECP-R
131	Monitoring and controlling of grid expansion projects for electricity	4	NECP-R
132	Faster expansion of the electricity grid	4	NECP-R
133	Optimisation and modernisation of existing grid	4	NECP-R
134	Network Development Plan (*NDP*) – Gas	4	
135	Measures in the action plan to reduce grid congestion	4	NECP-R
136	Ensuring flexibility of the energy system	4	
137	Energy Research Programme and funding	5	
138	Strategic Energy Technology Plan (EU SET Plan)	5	
139	EU Framework Programme for Research and Innovation 'Horizon 2020'	5	

140	Strengthening Germany as a centre for research on energy storage technology	5	
141	EU ETS Innovation Fund: further development of the NER 300 programme	5	