EUROPEAN
COMMISSION

Brussels, 23.11.2017
SWD(2017) 396 final

COMMISSION STAFF WORKING DOCUMENT

Energy Union Factsheet Croatia

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK

Third Report on the State of the Energy Union

{COM(2017) 688 final} - {SWD(2017) 384 final} - {SWD(2017) 385 final} - {SWD(2017) 386 final} - {SWD(2017) 387 final} - {SWD(2017) 388 final} - {SWD(2017) 389 final} - {SWD(2017) 390 final} - {SWD(2017) 391 final} - {SWD(2017) 392 final} - {SWD(2017) 393 final} - {SWD(2017) 394 final} - {SWD(2017) 395 final} - {SWD(2017) 397 final} - {SWD(2017) 398 final} - {SWD(2017) 399 final} - {SWD(2017) 401 final} - {SWD(2017) 402 final} - {SWD(2017) 404 final} - {SWD(2017) 405 final} - {SWD(2017) 406 final} - {SWD(2017) 407 final} - {SWD(2017) 408 final} - {SWD(2017) 409 final} - {SWD(2017) 411 final} - {SWD(2017) 412 final} - {SWD(2017) 413 final} - {SWD(2017) 414 final}

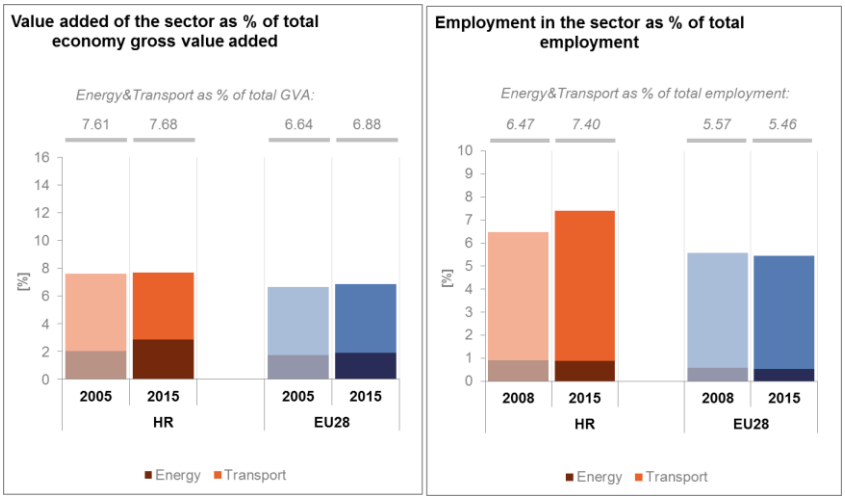
Croatia

Energy Union factsheet[1]

1. Macro-economic implications of energy activities

Energy and transport are key sectors for the overall functioning of the economy as they provide an important input and service to the other sectors of the economy. Together, the activity in these two sectors[2] accounted for 7.7 % of the total value added of Croatia in 2015. Similarly, their share in total employment[3] was 7.4 % 2015, of which 6.5 % in the transport sector and 0.9 % in the energy sector.

The decarbonisation of the energy and transport sectors will require significant investments and economic activity beyond the remit of these sectors themselves. The energy transition implies a structural shift in economic activity. Energy-related investment and jobs will in part migrate from traditional fossil fuel based activities towards construction, equipment manufacturing and other services related to the deployment of low carbon and clean energy technologies. At the moment, the efforts related to the energy transition in other sectors cannot be reliably quantified and are therefore not included.



(Source: Eurostat)

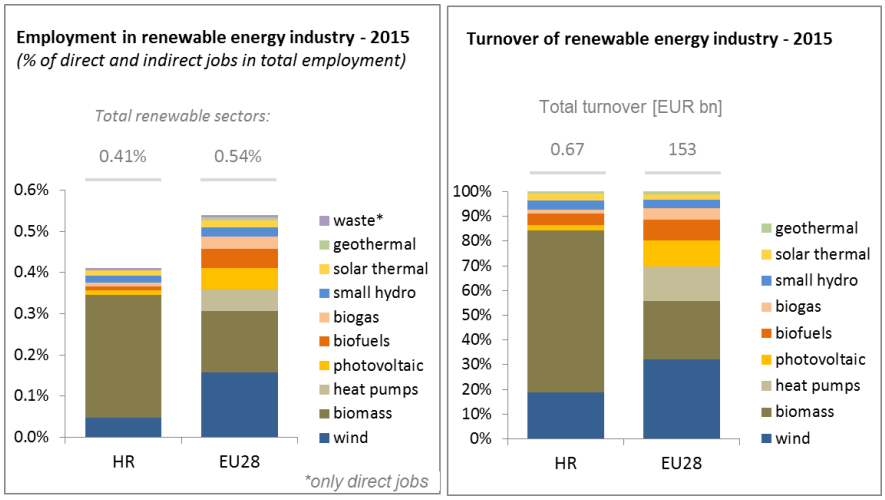
In the case of renewable energy sector, both the direct as well as the indirect effects on employment are being estimated. According to EurObserv'ER, in 2015, the share of renewable energy related employment in total employment of the economy in Croatia was at about 0.41 %, below the EU

[1] The indicators used in this country factsheet largely build on indicators developed for the Commission Staff Working Document "Monitoring progress towards the Energy Union objectives – key indicators" (SWD(2017) 32 final) https://ec.europa.eu/commission/sites/beta-political/files/swd-energy-union-key-indicators_en.pdf

[2] Gross value added and employment in NACE sectors D-Electricity, gas, steam and air conditioning supply and H-Transportation and storage

[3] National accounts, Eurostat

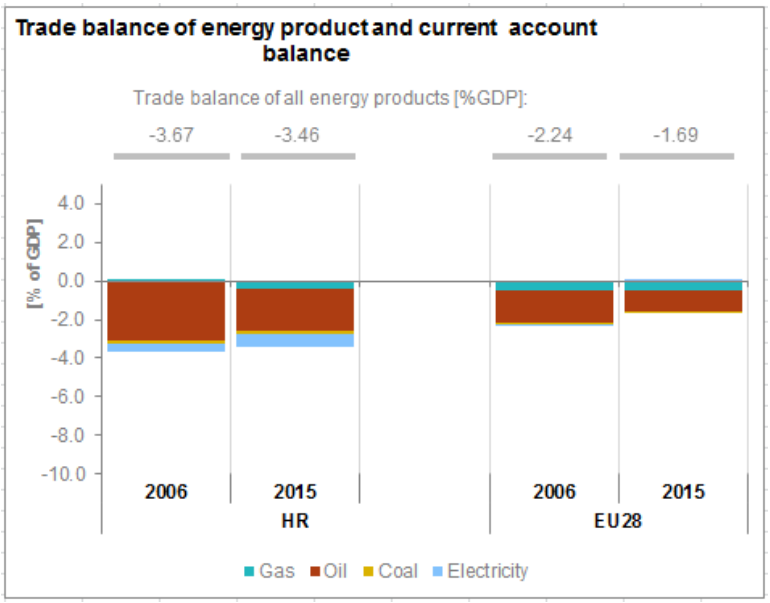
average of 0.54 %. The turnover of the renewable energy industry in the same year was estimated at around EUR 670 million, the largest part being attributed to the biomass (EUR 440 million) followed by wind (EUR 125 million) and biofuels (EUR 30million) industries.



(Source: EC based on Eurobserv'Er and Eurostat)

The overall investment is usually taken as an indication of the level of efforts and challenges in the energy sector. However, data is not available for Croatia for this indicator.

Croatia is a net importer of fossil fuels and electricity and the value of its imports in terms of share of GDP is higher than the EU average. The trade deficit in energy products slightly fell from about 3.7 % of GDP in 2006 to 3.5 % in 2015, mainly driven by a lower trade deficit for the oil import. In 2015, Croatia became net importer also of gas. The trade deficit for electricity grew significantly from 2006 and 2015 (by around 80 %).

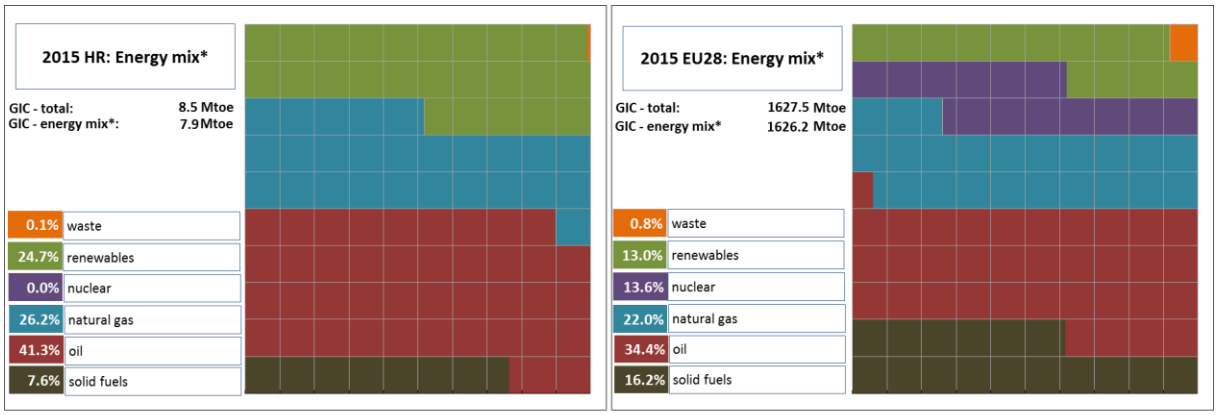


(Source: Eurostat)

2. Energy security, solidarity and trust

2.1. Energy Mix

The energy mix of primary products in Croatia is slightly different from the EU28 average, with a lower share of solid fuels (7.6 % vs. 16.2 %), no share of nuclear and a higher share of oil (41.3 % vs. 34.4 %), natural gas (26.2 % vs. 22.0 %) and notably renewable energy (24.7 % vs. 13 %).



*energy mix as share share in GIC-excluding electricity and derived heat exchanges , GIC=gross inland consumption

(Source: Eurostat)

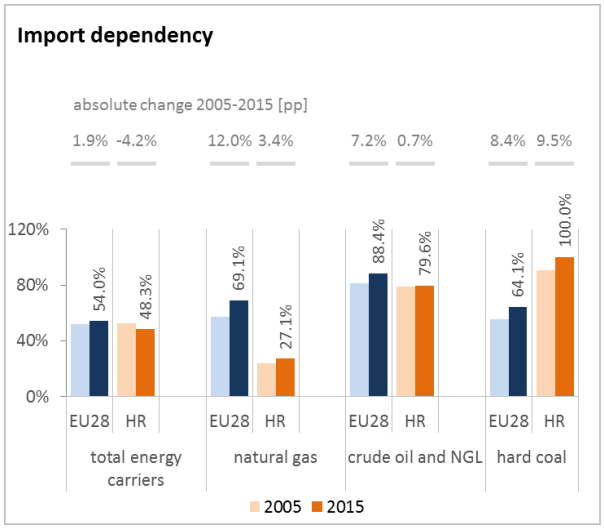
Hydropower plants as a renewable energy source are the largest producer of renewable electricity in Croatia. The production is highly dependent on hydrology with an average production of 7.3 TWh in the period 2010-2015.[4] Most of the hydropower plants (2188.5 MW of installed capacity) are owned by the HEP group which invests in their operation and maintenance. There are also investments by the HEP group in the revitalisation of old equipment by which it managed to increase capacities of existing hydropower plants. The HEP group has also plans to build new hydropower plants at several locations (HPP Kosinj/Senj , HPP Dubrovnik 2, HPP on Sava River - Podsused, Prečko, Zagreb and Drenje). Together with small hydropower plants that are planned by NREAP, the total investments in new facilities could reach 1 billion EUR in the following decade. Beside the planned storage and run-of river hydropower plants, there are several plans to build reversible or pumped hydro storage plants (PHS/RHPP) by the HEP group, private and public investors. Currently, only 4 PHS/RHPP are operated by the HEP group to better manage their assets and they are mostly used for electricity production, arbitrage on the market and water management. However, several new PHS are envisaged as multifunctional objects which may become of crucial importance in the adaptation to the climate change and management of droughts, irrigation, water management and firefighting in several regions.

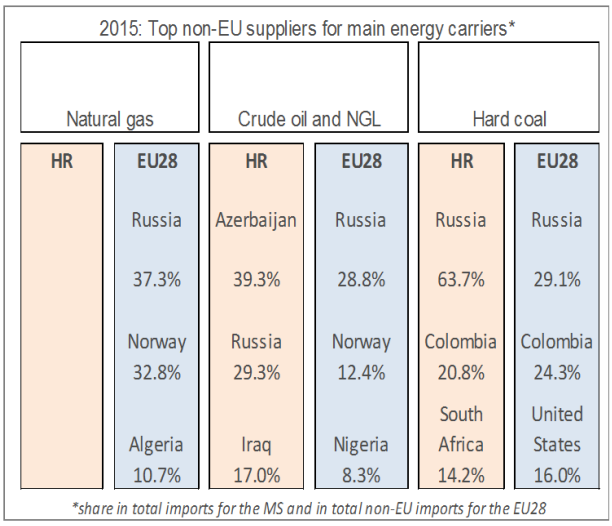
There are many restrictions on potential construction sites for new hydropower plants due to the fact that large areas of Croatia (30-40%) are under Natura 2000 and other environmental protection zones which on the one hand may result in higher investment costs to adopt to requirements of environmental protection, while they might increase innovation potential if applied solutions comply with the highest requirements of environmental protection.

[4] http://www.eihp.hr/wp-content/uploads/2016/12/Energija2015.pdf

2.2. Import dependency and security

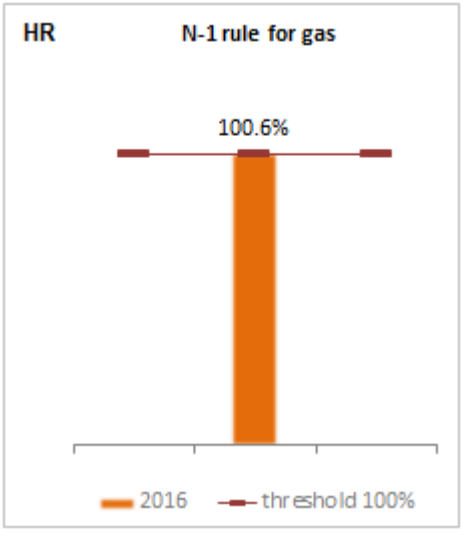
48.3 % of Croatia's energy consumption comes from imports, slightly less than the EU average (54 %). There has also been a small decrease in overall import dependency over the last ten years. The import dependency is much lower for natural gas (27.1 %), although it increased slightly compared with the previous ten years, but higher for crude oil/LNG (79.6 %) and hard coal (more than 100 %). Lack of data does not allow for identifying the main import sources for natural gas; for crude oil/LNG the country relies mostly on Azerbaijan (39.3 %) and Russia (29.3 %) and for hard coal on Russia (63.7%).





(source: Eurostat)

The security of gas supply regulation requires that, if the single largest gas infrastructure fails in one Member State, the capacity of the remaining infrastructure is able to satisfy total gas demand during a day of exceptionally high gas demand. Croatia complies with this rule.



(Source: gas coordination group)

3. Internal market

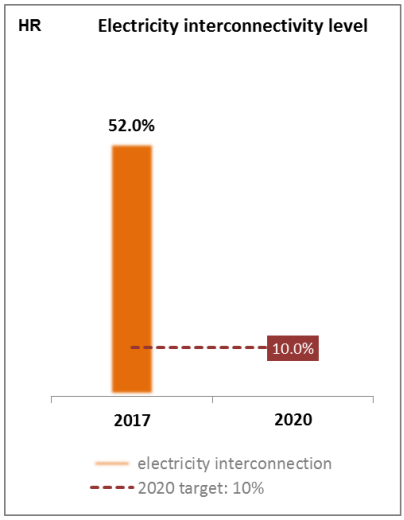
In general, the functioning of the internal market is still being challenged mainly by: incomplete certification of the gas TSO; issues with the functioning of the electricity TSO (having to obtain consent from the Market Operator before adopting rules on balancing); and the independence and jurisdiction of the NRA which is still insufficient.

3.1. Interconnections and wholesale market functioning

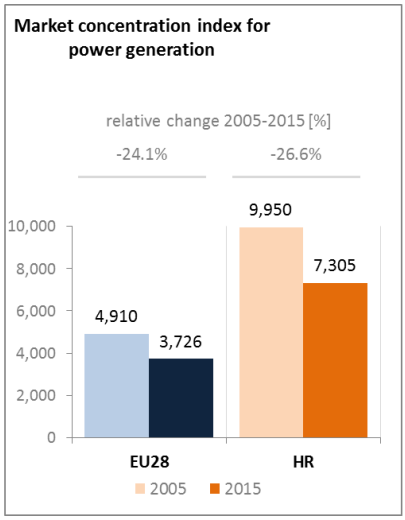
3.1.1. Electricity

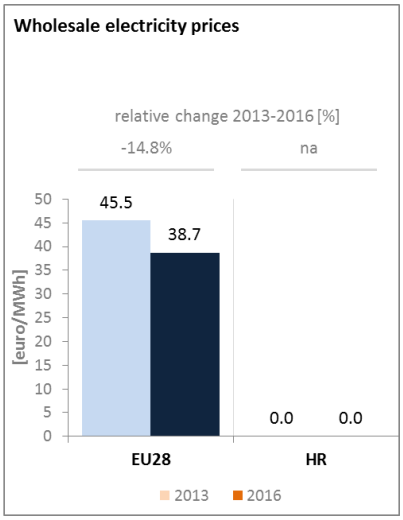
The interconnection level[5] for electricity was 52 % in 2017, which is above the 2020 target at EU level (though below the 2014 level). There are several Projects of Common Interest (PCIs) under the guidelines for trans-European energy infrastructure planned in Croatia, including two electricity clusters, a high-voltage transmission line between Croatia and Bosnia and Herzegovina and a high-voltage transmission line between Croatia, Hungary and Slovenia. Considerable investment is expected.

Competition in Croatia's electricity wholesale market is still very limited. Market concentration is well above EU average, though there has been a noticeable decrease since 2005. No data for wholesale electricity prices or trading are available. The wholesale electricity price in Croatia is still not deregulated and market liquidity is still low. The Commission has received notice of the certification of the TSO by HERA (the National Energy Regulatory Authority) under the Independent Transmission Operator (ITO) model and has already expressed its considerations on how such certification can be considered adequate for the unbundling provisions.



(source: EC based on ENTSO-E scenario outlook and adequacy forecast 2014)





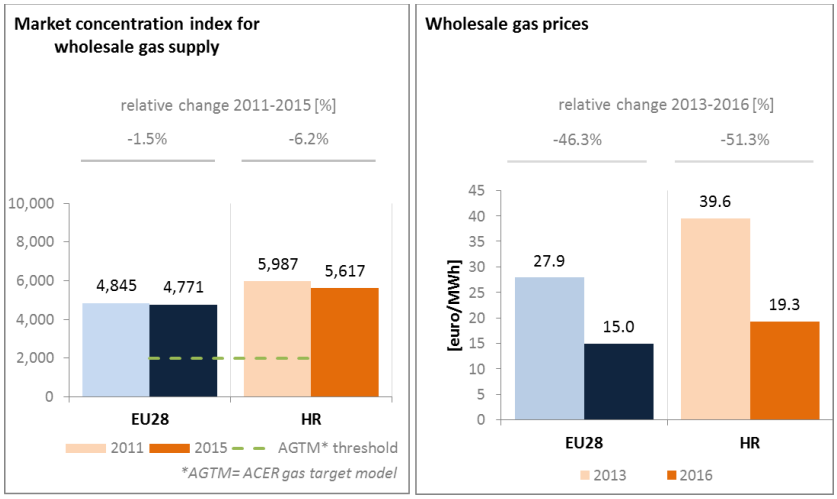
(sources: EC services based on Eurostat for the left graph and based on Platts and European power exchanges for the right graph)

[5] The interconnectivity level is calculated as a ratio between import interconnection and net generation capacities of the country (i.e. the 2017 value is the ratio between simultaneous import interconnection capacity [GW] and net generating capacity [GW] in the country at 11 January 2017, 19:00 pm as resulted from ENTSO-E Winter Outlook 2016/2017)

3.2. Gas

In gas, there are three main projects in Croatia. The phased development of Krk LNG terminal; the Zlobin — Bosiljevo — Sisak — Kozarac — Slobodnica pipeline as the evacuation route for Krk LNG towards Hungary; and the items of the Croatia — Slovenia — Austria route at Rogatec. All of these projects are PCIs. The Krk LNG terminal is the most advanced: it is designed as a phased development with a Floating Storage and Regasification Unit (so-called FSRU) in the first phase, which has been awarded a EUR 104.4 million CEF grant for works at the end of 2016. The initial maximum send-out capacity of the terminal is planned at 2 billion cubic metre per year (bcm/y). A final Investment Decision (FID) is expected by the beginning 2018 which would allow starting operations by the end of 2019 at the earliest. The Croatian government's proactive support and cooperation with the Commission (in particular with regard to the needed tariff and regulatory reform) and neighbouring countries (such as Hungary concerning the reverse flow on the interconnection between the two countries) is vital for the successful implementation of the project. The other two projects are in the preparatory stage.

Market concentration for wholesale gas supply and wholesale gas prices remain above EU average, in spite of a substantial price decrease between 2013 and 2016. There is currently no gas hub; hence wholesale gas trading is based on bilateral contracts and price regulation on the gas wholesale market prevents market entry and competition. Wholesale gas market prices in Croatia are still not deregulated, and the unbundling process (certification of the gas TSO) is still not completed. Barriers to the export and import of gas, especially in relation to the interconnection with Hungary, still exist and restrictions are imposed on the functioning of the storage facilities and gas suppliers.



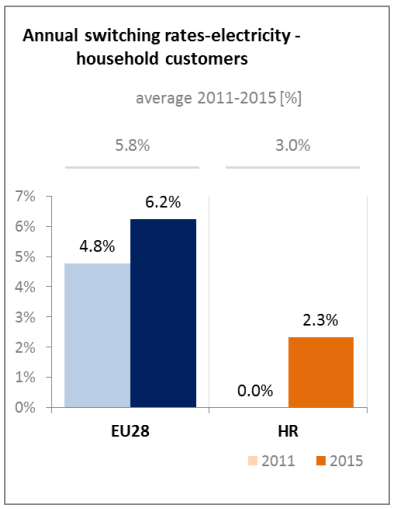
(source: ACER for the left graph and EC services based on on Platts, gas hubs, Eurostat for the right graph)

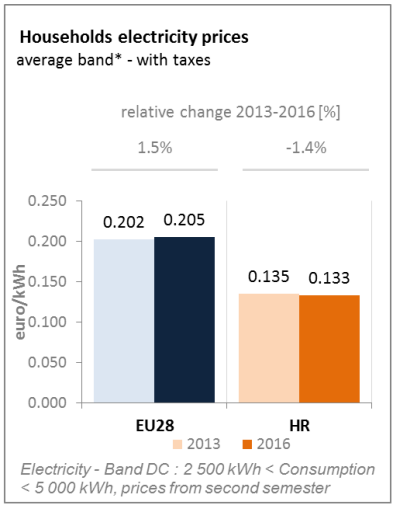
3.3. Retail electricity and gas markets

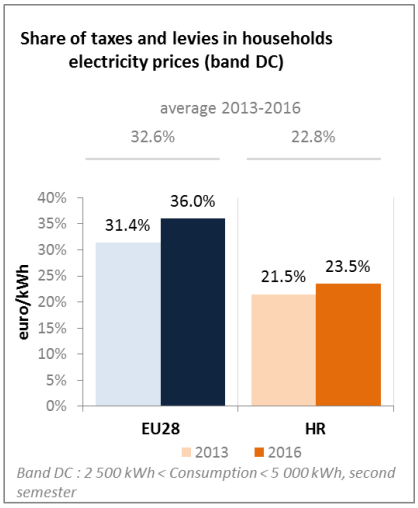
Competition in Croatia's energy market is still limited. Prices remain regulated on both electricity and gas retail markets creating a barrier to market entries. While competition in the retail market for households is slowly emerging, further market opening is needed to improve the investment climate and create incentives for new entrants.

3.3.1. Electricity

In 2016, household electricity prices in Croatia were below the EU average but remained at about the same level as three years earlier, due to price regulation. In fact, over the period 2013-2016 electricity supply costs decreased but the share of taxes and levies in household electricity prices slightly increased. Competition in the household electricity market is emerging, though annual switching rates are still far below EU average.



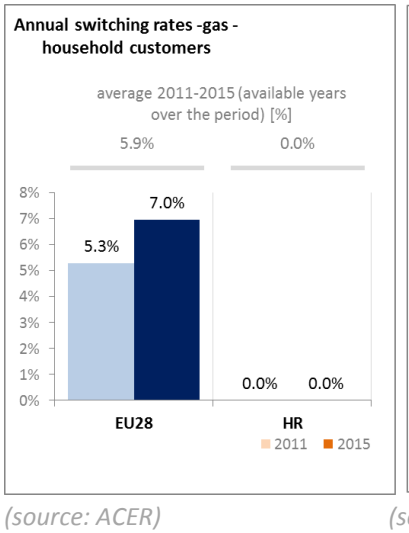


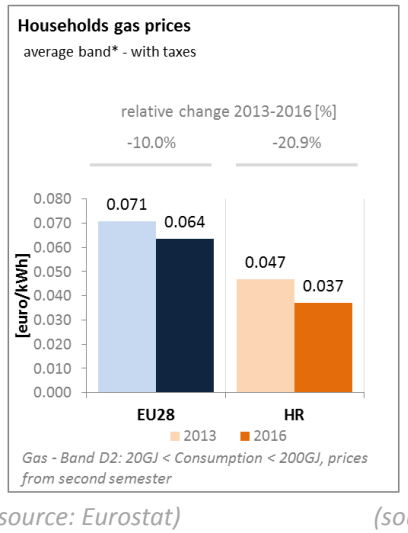


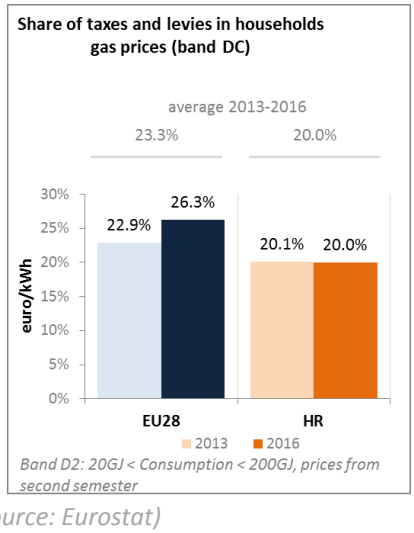
(source: ACER) *(source: Eurostat)* *(source: Eurostat)*

3.3.2. Gas

There is currently no competition in the retail gas market in Croatia. Prices remain regulated, significantly below the EU average, and decreased by 21 % in 2016 compared to 2013.



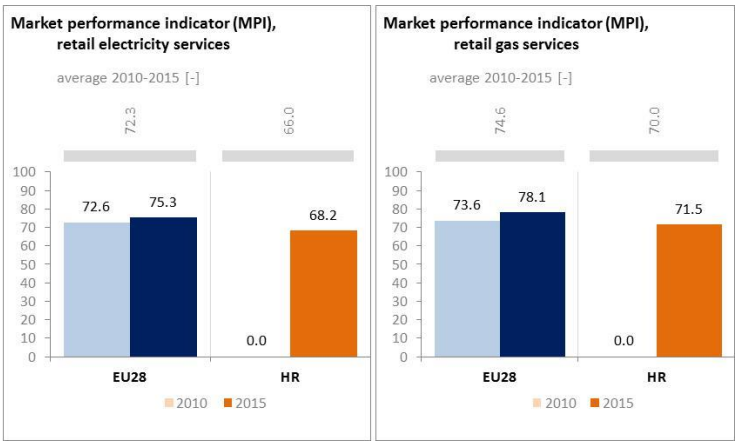




(source: ACER) *(source: Eurostat)* *(source: Eurostat)*

3.3.3. Market performance indicators

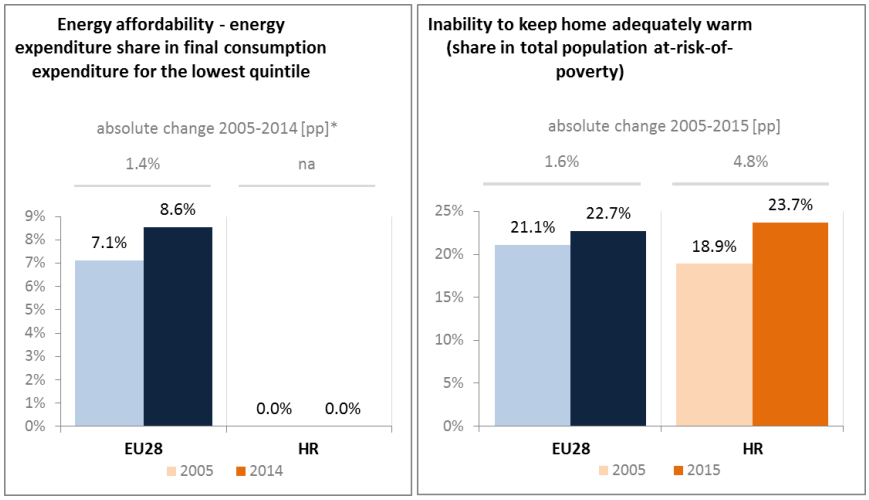
According to the periodical survey of DG JUST, Croatian consumers are less satisfied than the EU average about the services received on energy retail markets.



(source: DG JUST survey)

3.4. Energy affordability

There are no data available regarding the share of energy in total household expenditures for the lowest quintile of population in Croatia. The percentage of citizens below or at the risk of poverty threshold who consider that they are unable to keep their home adequately warm is only slightly above the EU average (23.7 % vs. 22.7 %) but has significantly increased since 2005, due to the economic crisis.



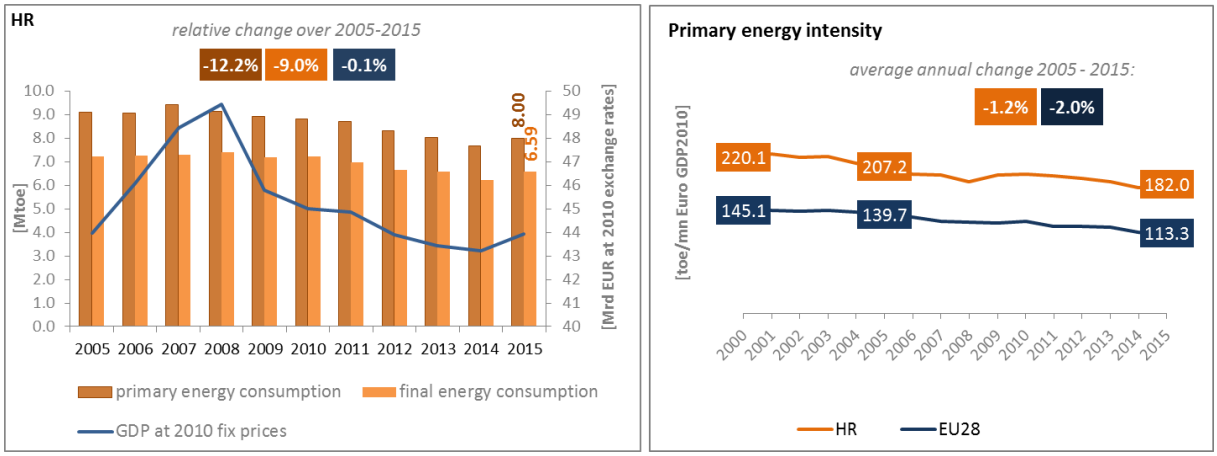
(source: ad-hoc data collection of DG ENER based on HBS with the support of Eurostat and national statistics)

4. Energy efficiency and moderation of demand

Since 2005, Croatia decreased its primary energy consumption by 12.2 % to 8.0 Mtoe in 2015. Over the same period, final energy consumption also decreased by 9.0 % to 6.59 Mtoe in 2015. Thus, Croatia's primary and final energy consumption remains below the country's 2020 energy efficiency

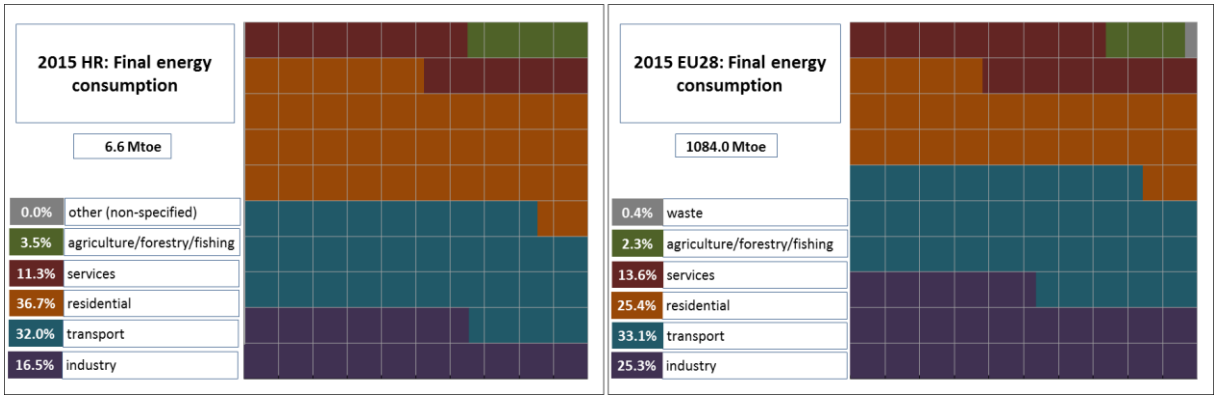
targets of 11.5 Mtoe and 7.0 Mtoe, respectively. This target was set at a level which allows both final and primary energy consumption to grow substantially in the coming years. However, additional efforts regarding energy efficiency are needed to keep primary energy consumption at this level or to minimise the effects of the GDP upward trend which is observed since 2014. In the coming years up to 2020, Croatia is also expected to step up the national energy efficiency actions and programs which are necessary to meet the cumulative saving requirements stemming from Article 7 of the Energy Efficiency Directive, since the Energy Efficiency Obligation Scheme planned is still not operational.

Although primary energy intensity decreased over the 2000-2015 period, it remains substantially above EU average (both overall and for industry, the services sector and the residential sector) which indicates the presence of unexploited efficiency potential; it decreased at a slower pace as compared to the EU average (with almost no decrease in the services sector).



(source: Eurostat)

In 2015, the residential sector was the largest energy-consuming sector representing 36.7 % of total energy consumption, well above the EU average (25.4%). The share of energy consumption of the transport sector (32.0 %) was slightly below the EU average (33.1 %) and that of industry (16.5 %) significantly below EU average (25.3 %).



(source: Eurostat)

As the building sector in Croatia accounts for 43 % of final energy consumption or 6.1 million tons of CO2eq (from 14.1 million tons in total), special attention is paid to a more intense implementation of

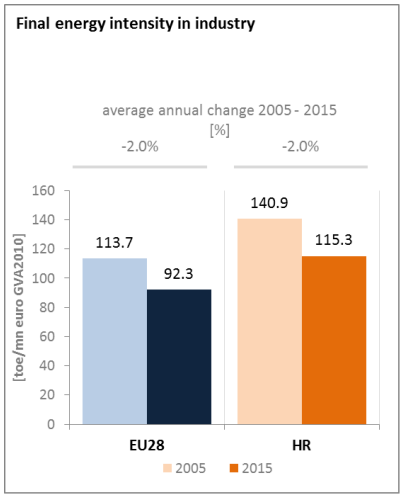
national programmes of building renovation. The Long-term Strategy for Mobilising Investment in Renovating the National Building Stock in Croatia was published in June 2014 under the authority of the Ministry of Construction and Physical Planning (MCPP). The strategy's main objective is to identify, on the basis of the established optimal economic and energy model for building renovation, effective measures for long term mobilisation of cost-effective deep renovation of the building stock by 2050, including all buildings from the residential and non-residential sectors. An updated version of the Strategy is now in the phase of adoption by the Croatian Government and strongly follows the state of the practice and possibilities for further development through plans and programs.

The annual savings (equivalent to renovating 3 % of the buildings owned and occupied by the central government) have been calculated to reach 1.36 GWh (4.89 TJ) per year.

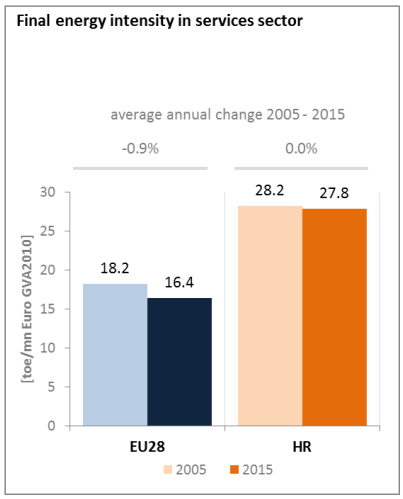
Investments that have a positive impact on the state budget are encouraged, and through the ESCO model, energy efficiency improvements in public sector buildings are implemented without the additional spending of owner/user budgeting.

For achieving the objectives of energy renovation according to Nearly-Zero Energy Building (NZEB) standards, funds for investment and operational costs are estimated at nearly EUR 7 billion up to 2050. For buildings occupied and owned by public authorities, the main design of the building should be prepared according to the requirements for NZEB if the application for building permit is submitted after 31 December 2017; for other buildings it will be after 31 December 2019.

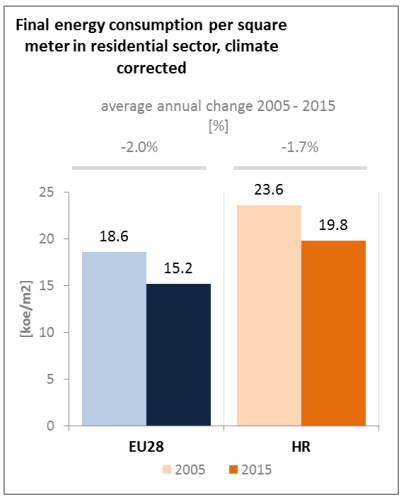
Around 1 % of buildings shall undergo integral renovation to the NZEB standard each year; up to 2020, it is envisaged that 5 % of buildings shall be renovated to the NZEB standard or to a high energy-performance level and finally in 2050, all buildings will be NZEB or high energy efficiency, reducing greenhouse gasses in buildings by 80 %.



(source: Eurostat)

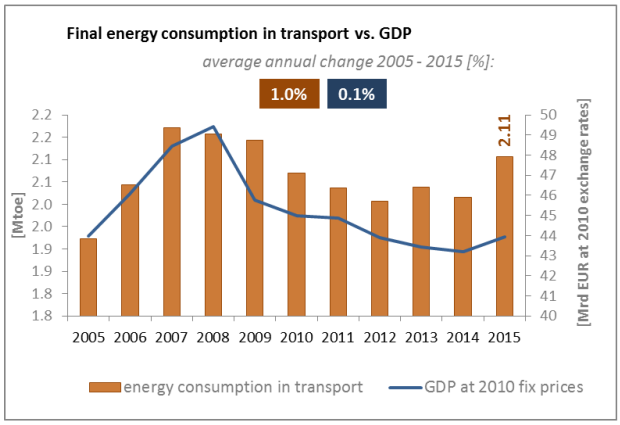


(source: Eurostat)

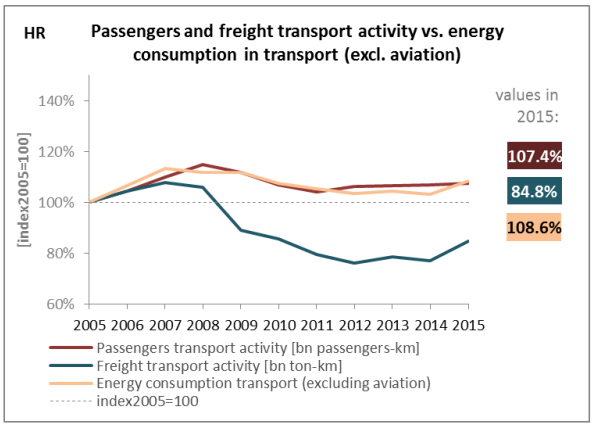


(source: Odyssee database)

Between 2005 and 2015 in Croatia, the final energy consumption in transport recorded an average annual increase of 1 %, higher than the 0.1 % average annual increase of the GDP. Final energy consumption in transport declined sharply after 2008, only to see a modest recovery in 2015. The decrease in final energy consumption was driven mostly by the decrease in freight transport activity affected by the economic context, whilst passengers transport activity followed a similar trend of the overall energy consumption in transport over the period 2005-2015.



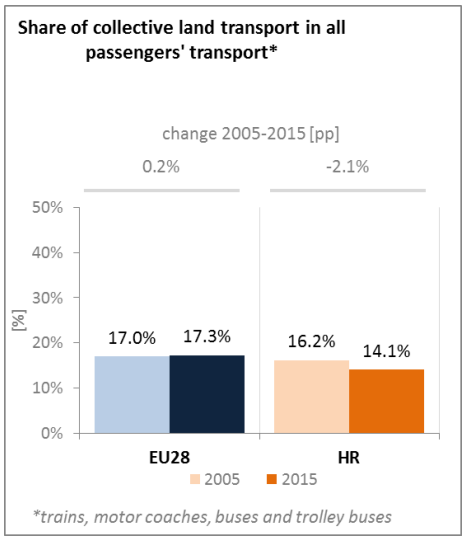
(source: Eurostat)



passengers transport activity=Private cars + bus + rail + tram & metro
freight transport activity=road+rail+inland waterways+pipeline

(source: Eurostat and DG MOVE pocketbook)

The share of collective passengers land transport in total passengers transport decreased slightly more in Croatia than the EU average between 2005 and 2015 indicating a higher increase in the use of private transport means.



(source: Eurostat)

Croatia is facing challenges in meeting the Europe 2020 target of 10 % renewable energy in transport (in 2015 the share was 3.5 %). However, the 2017 national reform programme foresees new measure which should increase the share.

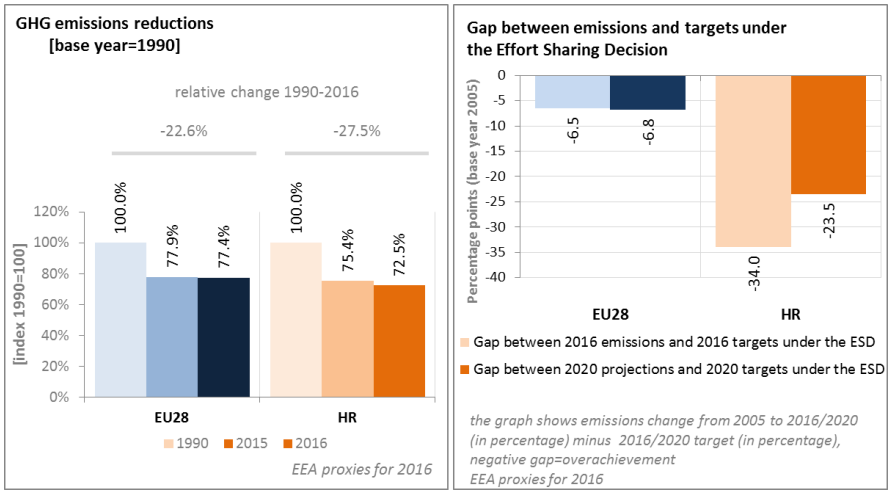
Croatia is currently finalising a new comprehensive national transport development strategy for the period 2017-2030. Once completed, it will enable Croatia to make full use of available EU funding for transport-related projects (EUR 1.3 billion for the period 2014-2020). In particular, investments in rail infrastructure are needed, where Croatia is lagging behind other EU Member States. Completion of the TEN-T core rail network stands at 5 %, compared to the EU average of 60 %.

Croatia also needs to open the market in certain transport sectors, especially the rail and the maritime cabotage markets. A regards maritime cabotage, tendering procedures which should ensure the opening of the market during 2017 are ongoing.

5. Decarbonisation of economy

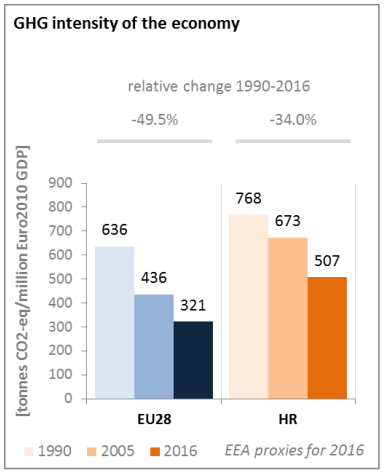
5.1. GHG emissions

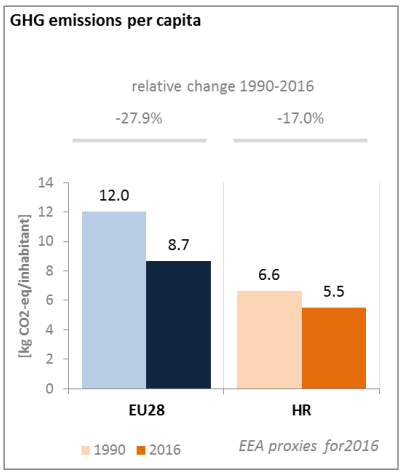
Total emissions in Croatia have been reduced by 27.5 % from 1990 to 2016. Based on the latest national projections submitted to the Commission, and taking into account existing measures, it is expected that Croatia will meet its greenhouse gas emission target by a wide margin (-12.5 % between 2005 and 2020 as compared to +11% target).



(source: EC and EEA)

Croatia has a higher GHG intensity in the economy than the EU average while emissions per capita are among the lowest in the EU.





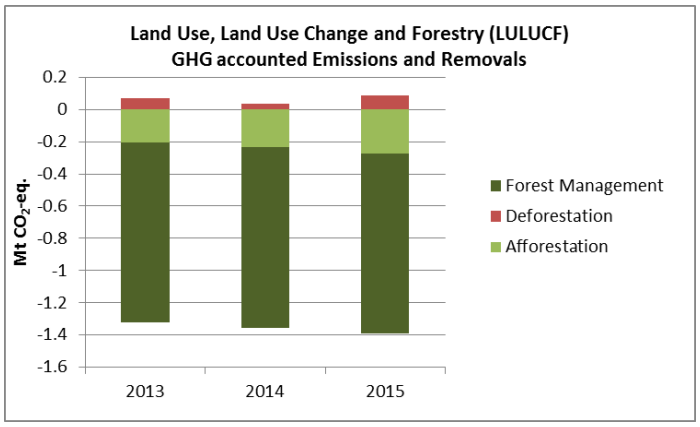
Largest Sectors of GHG Emissions in 2015	HR	EU28
Energy/power industry	22.7%	30.9%
Transport	25.3%	21.0%
Industry	20.8%	19.9%
Agriculture (incl. forestry & fishery)	13.9%	12.0%
Residential & Commercial	10.7%	12.8%
Waste	6.6%	3.2%
Other	0.0%	0.2%

(source: EC and EEA)

Preliminary accounts under the Kyoto Protocol for Croatia show overall removals of -1.3 Mt CO_2-eq. as an annual average in the period 2013-2015. For comparison, the annual average of the EU-28 accounted for removals of -119.0 Mt CO_2-eq. It should be noted that in this preliminary simulated accounting exercise, removals from Forest Management were capped to -1.1 Mt. CO_2-eq per year,

due to slightly exceeding the limit of the difference between the reported sink and the accounting forest management reference level.

Removals by Afforestation are notably higher than emissions by Deforestation; however, removals by Forest Management contribute the highest share. Overall, there is a slight increase in removals mainly due to increasing removals by Afforestation. Emissions by Deforestation show a varying pattern over the course of the three-year period.

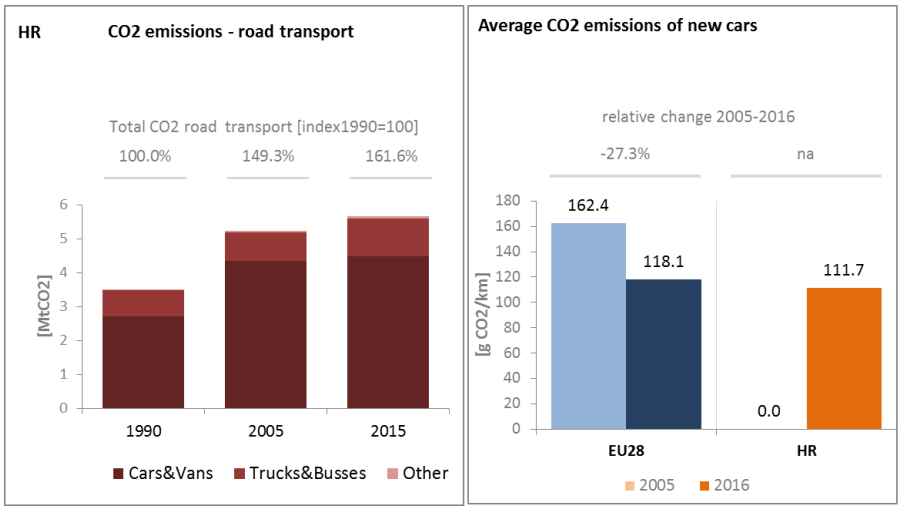


Note: Forest Management credits are capped and presented as yearly averages when the total Forest Management credits of the considered period exceed the simulated cap over the same period.

(source: EC and EEA)

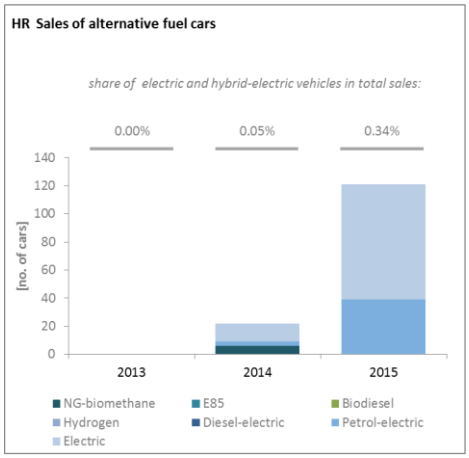
CO_2 emissions in transport and alternative fuelled vehicles

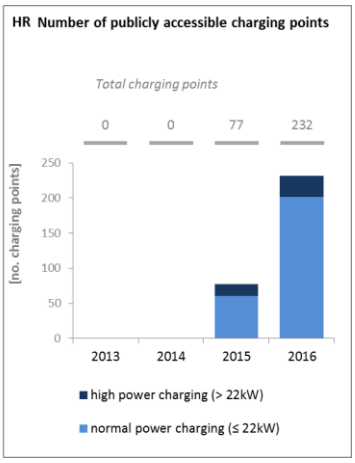
CO_2 emissions from road transport have increased by 61.6 % from 1990 to 2015. The average CO_2 emissions of new cars in Croatia were in 2016 below the EU average; due to lack of data no trend for 2005-2016 can be indicated.



(source: European Environment Agency)

The number of electric charging points in Croatia has more than tripled, from 77 units in 2015 to 232 units in 2016. Sales of alternative fuel cars were at 0.34 % in 2015, up from 0.05 % in 2014 and practically zero in 2013.





(European Environment Agency) *(European Alternative Fuels Observatory)*

National Policy Frameworks under Directive 2014/94/EU on alternative fuels infrastructure have to establish targets, objective and measures for the development of the market of alternative fuels in the transport sector and the deployment of the relevant infrastructure. Croatia has submitted its National Policy Framework as requested under article 3 of the Directive 2014/94/EU.

A detailed assessment of the Croatian National Policy Framework in terms of its compliance with the requirements of Directive 2014/94/EU on alternative fuels infrastructure, its contribution to achievement of long-term energy and climate objectives of the Union and coherence of its targets and objectives in terms of cross-border continuity has been published as part of the Communication on Alternative Fuels Action Plans (COM(2017)652) and the related staff working document SWD(2017)365.

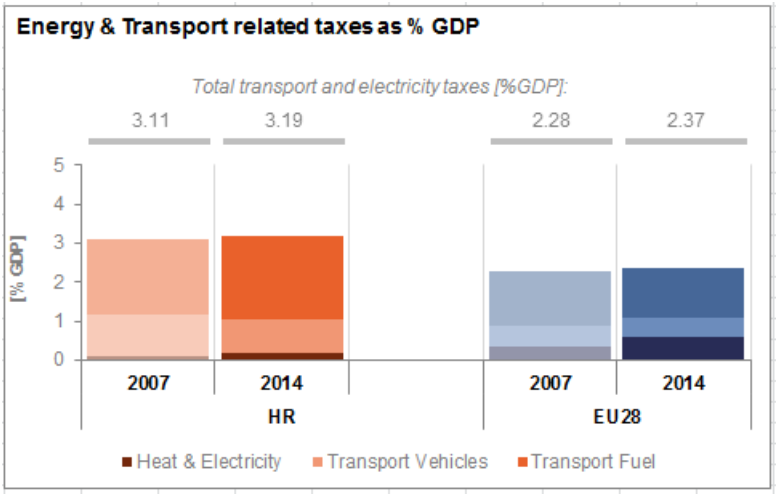
5.2. Adaptation to climate change

Croatia's National Adaptation Strategy (NAS) is being developed and is due to be completed and prepared for adoption by the end of 2017. A parallel National Adaptation Plan (NAP) will also be developed, covering a five-year period. Recognized vulnerable sectors are the following: hydrology and water resources, agriculture, forestry, biological diversity and natural inland ecosystems, biological diversity and marine ecosystems, urban and coastal areas, tourism, and human health. No reports on adaptation at the central or sectorial level have been published since the NAS and NAP are yet to be adopted.

5.3. Taxes on energy and transport

The overall tax burden on energy and transport in Croatia amounted to 3.2 % of GDP in 2014, i.e. nearly 0.8 %. higher than the EU average. It is particularly the tax burden on transport vehicles and

fuel that was higher. While taxation of heat and electricity almost doubled between 2007 and 2014, it remained below the EU average. The total tax burden on vehicles and transport fuels remained stable between 2007 and 2014, keeping the same overall structure and around the same gap with respect to the EU average. There is a CO_2 component in the vehicle taxation in Croatia.

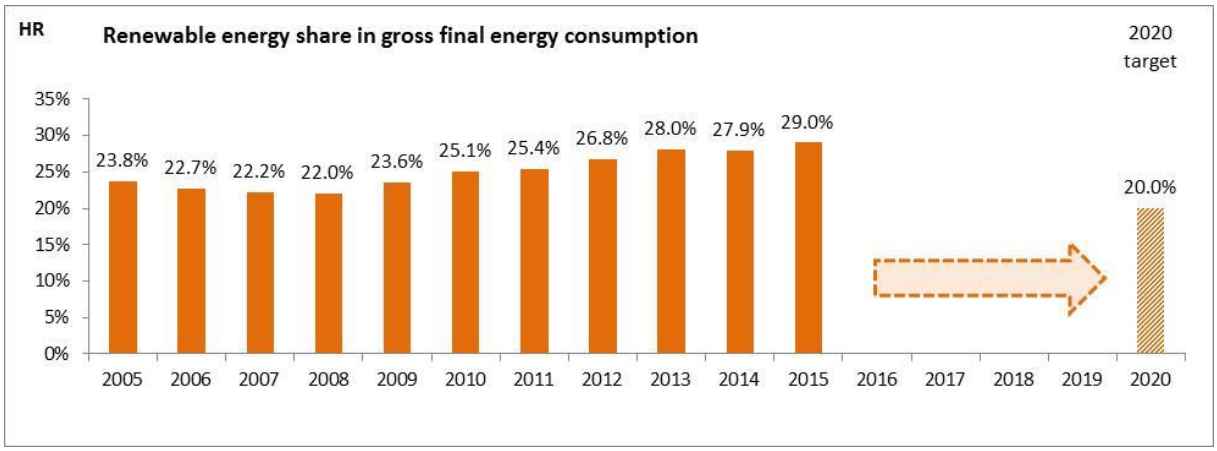


(Source: Eurostat

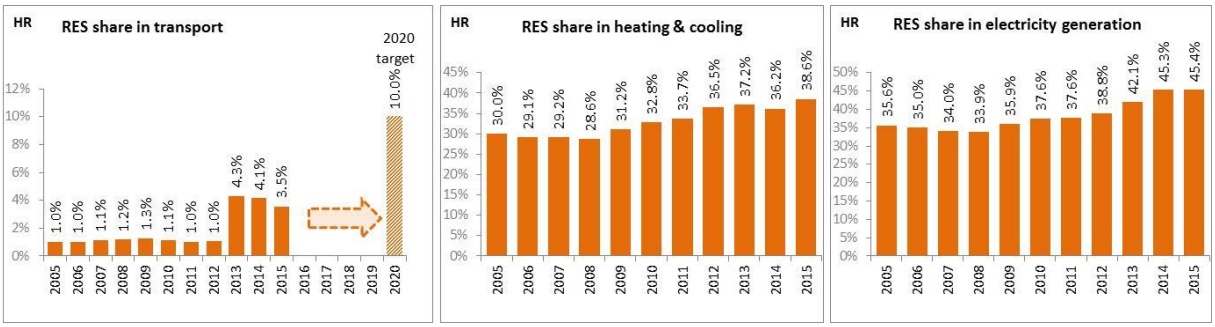
5.4. Renewable energy

Croatia is currently well above its 2015/2016 indicative overall renewable interim target as well as its 2020 target of 20 % as set under the Renewable Energy Directive (2009/28/EC). In 2015, the renewable energy share in the overall gross final energy consumption was 29%.

However, Croatia is well below the target of renewable energy share in transport, with only 3.5 % in 2015 (a slight decrease since the 4.3 % achieved in 2013). On the other hand, the share of renewable energy was 38.6 % in heating and cooling and 45.4 % in electricity generation in 2015.

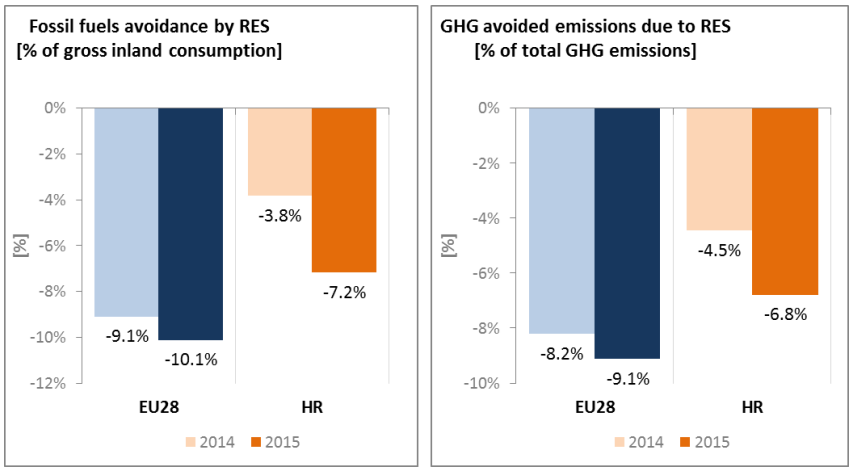


(source: Eurostat-SHARES)



(source: Eurostat-SHARES)

It is estimated that Croatia avoided in 2014 about 7.2 % of fossil fuel in gross inland consumption and about 6.8 % of GHG emissions at national level[6].



(source: EEA)

In Croatia, electricity from renewable sources is mainly promoted through a premium tariff and a guaranteed feed-in tariff for small installations allocated through tenders. Bank and funds provide special loans and additional financial incentives. The main instrument to promote renewable energy use in transport is a biofuel quota obligation. For the promotion of renewable energy in heating and cooling, the main document is the Programme for usage of the potential for heating and cooling for period between 2016 and 2030 (*Program korištenja potencijala za učinkovitost u grijanju i hlađenju za razdoblje 2016. – 2030.*)[7]. Also, the potential in this sector can be seen through the STRATEGO project that aims at helping national and local authorities develop enhanced Heating & Cooling plans. About 40 % of the need for heating in Croatia is satisfied with central heating system and more of 45% of heating needs could be produced from renewable energy till 2050[8].

5.5. Contribution of the Energy Union to better air quality

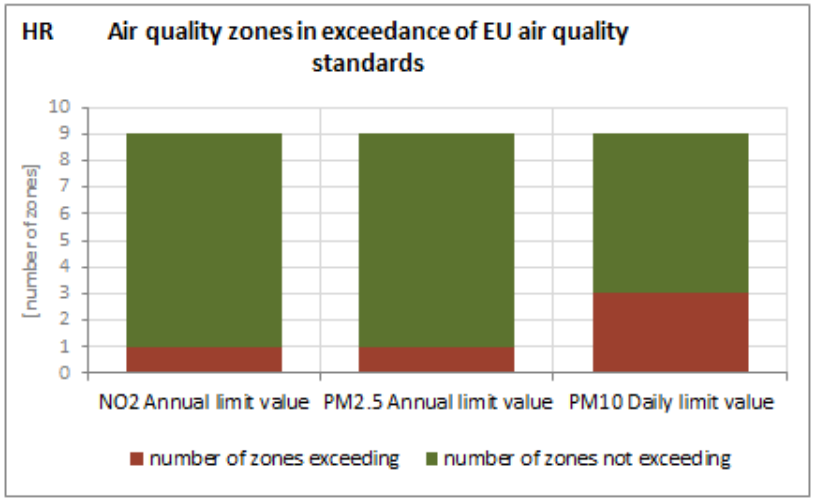
[6] Avoided GHG emissions mentioned here have a theoretical character as these contributions do not necessarily represent 'net GHG savings per se' nor are they based on life-cycle assessment or full carbon accounting.

[7] https://ec.europa.eu/energy/sites/ener/files/documents/croatia_report_eed_art_141_hr.pdf.

[8] http://stratego-project.eu/hr/

Air quality in Croatia is giving cause for concern. For 2013, the European Environment Agency estimated that about 4,820 premature deaths were attributable to fine particulate matter ($PM_{2.5}$) concentrations and 160 to nitrogen dioxide (NO_2) concentrations[9].

For both pollutants, Croatia reported exceedances of the binding EU air quality standards[10]. For 2015, Croatia reported exceedances of the limit value for PM_{10} in 3 out of the 9 air quality zones, while exceedances of the limit values for $PM_{2.5}$ and NO_2 were reported in 1 of the 9 zones[11].

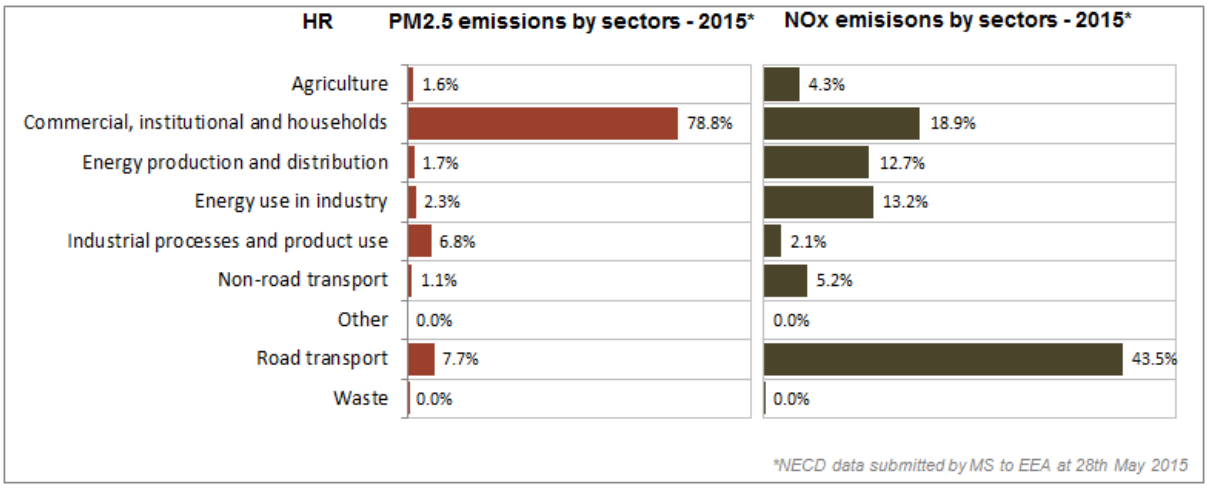


(Source: EEA)

The health-related external costs from air pollution in Croatia have been estimated to be more than EUR 2 billion/year (income adjusted, 2010), which includes the intrinsic value of living a healthy life without premature death as well as the direct costs to the economy such as healthcare costs and lost working days due to sickness caused by air pollution[12].

The Energy Union can substantially contribute to addressing these air quality problems through measures reducing emissions of both GHG and air pollutants such as PM and nitrogen oxides (NO_x) from major contributing sectors such as (road) transport, energy production, industry and residential heating (e.g. stoves and boilers)[13].

[9] European Environment Agency, 2016, Air Quality in Europe – 2016 Report, table 10.2. The report also includes details as regards the underpinning methodology for calculating premature deaths.
[10] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, OJ L 152, 11.6.2008, p.1-44
[11] Compliance data as reported by the Member States as part of their official annual air quality report for the calender year 2015 (available on the European Environment Agency's (EEA) Eionet/Central Data Repository), http://cdr.eionet.europa.eu/hr/eu/aqd
[12] See also the EU Environmental Implementation Review Country Report for Croatia, SWD(2017)45 final of 3.2.2017
[13] National emission data as reported by the Member States to the EEA (available on the EEA's Eionet/Central Data Repository), http://cdr.eionet.europa.eu/hr/eu/nec_revised



(Source: EEA. This table reflects only sources of primary $PM_{2,5}$ emissions.)

6. Research, innovation and competitiveness

6.1. Research and innovation policy

To achieve energy development goals in line with the Croatian government's Strategic Development Framework, the strategic plans of the National Science Foundation and the National Energy Efficiency Programme, the following sectors are identified as priorities in energy R&I: (a) potential for biogas from organic waste; (b) sustainability of production and use of biofuels, and distribution of biofuels; (c) new technology for renewables (solar, wind, waves, biomass, etc.); and (d) new and more efficient machinery, materials and construction technologies.

Croatia is not very active in the ongoing work of the Strategic Energy Technology (SET) Plan; it only participates in one temporary working group for the implementation of the integrated SET Plan, the one dedicated to concentrated solar power.

Regarding the Horizon 2020 programme, Croatia has so far received 0.3 % of the EU contribution devoted to the 'secure, clean and efficient energy' part of the programme. As of September 2017, 48 participations from Croatian organisations have been awarded EUR 4.6 million in Horizon 2020 energy projects. This includes two grants totalling EUR 0.4 million to Croatian beneficiaries participating in project BioVill (bioenergy villages).

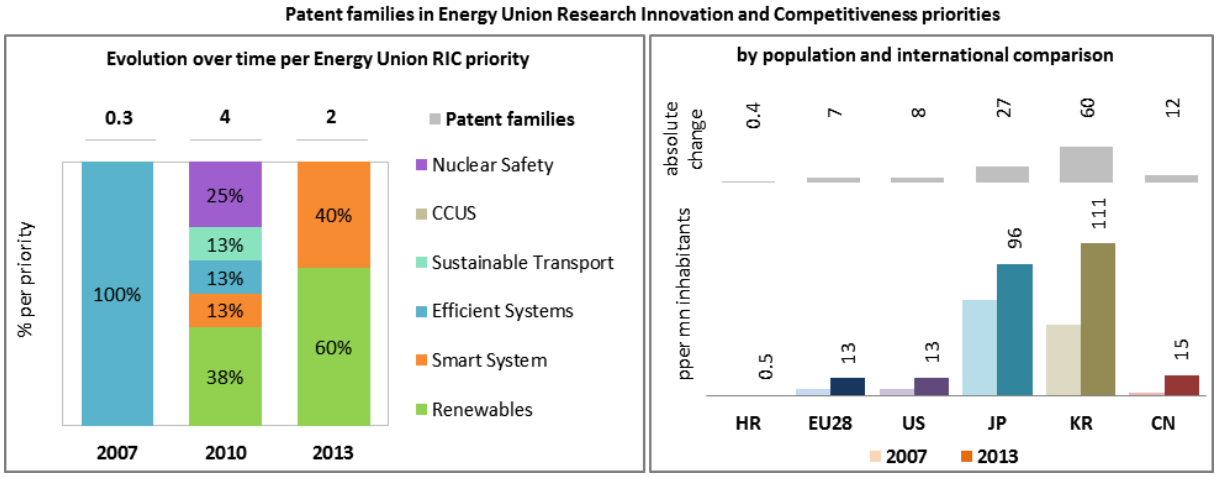
6.2. Investments and patents in the Energy Union R&I priorities

The European Commission does not have any data regarding the public (national) investments in the Energy Union R&I priorities.

Private investment in the Energy Union R&I priorities in 2013 was estimated at EUR 5 million (0.03% of the private R&I investment in Energy Union R&I priorities in the EU). The focus was on renewables, which received 56 % of these investments. The remaining 44 % was attracted by the Smart System priority.

In 2013, the latest year for which complete patent[14] statistics are available, two companies and research organisations based in Croatia filed two patents in low-carbon energy technologies (0.03 % of the EU total). The focus was on Renewables (60%) and Smart System (40%)[15].

In 2013, both private R&I investments and patents in Energy Union R&I priorities were lower than the EU average when normalised by GDP and by population respectively. In the period 2007-2013, both private R&I investments and the number of patents in Energy Union R&I priorities increased on average respectively by 37 % and 35 % per year, increasing at a higher rate than the indicators at EU level (6 % and 15 % respectively).



(Data sources: Patent data based on the European Patent Office PATSTAT database[16]. Private investment as estimated by JRC SETIS. Detailed methodology available from the JRC[17].)

6.3. Competitiveness

In 2014, the real unit energy costs (RUEC)[18] in Croatia (13.3 %) were slightly below those at the EU average (15.3 %), higher than those in the US but significantly below those in Japan, China and Russia. The electricity prices paid by industrial customers are below the EU and OECD averages. Gas prices for industrial customers, however, are above those averages.

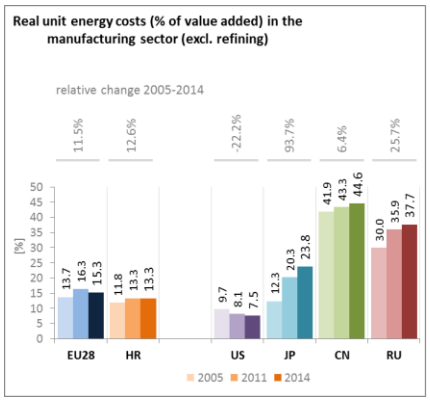
[14] In the context of this document, the term 'patent' refers to patent families, rather than applications, as a measure of innovative activity. Patent families include all documents relevant to a distinct invention (e.g. applications to multiple authorities), thus preventing multiple counting. A fraction of the family is allocated to each applicant and relevant technology.

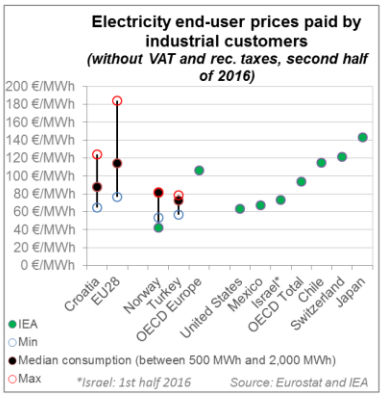
[15] according to the methodology to allocate patents under the Energy Union R&I priorities, a single patent family could be split into different priorities

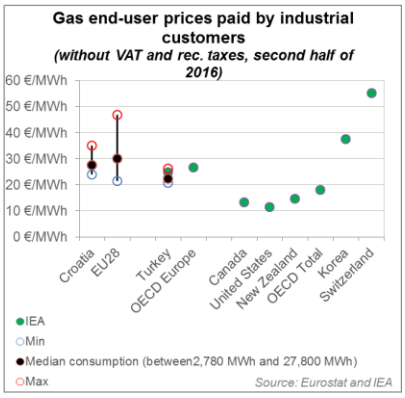
[16] https://www.epo.org/searching-for-patents/business/patstat.html#tab1

[17] https://setis.ec.europa.eu/related-jrc-activities/jrc-setis-reports/monitoring-ri-low-carbon-energy-technologies

[18] This indicator measures the amount of money spent on energy sources needed to obtain one unit of value added.

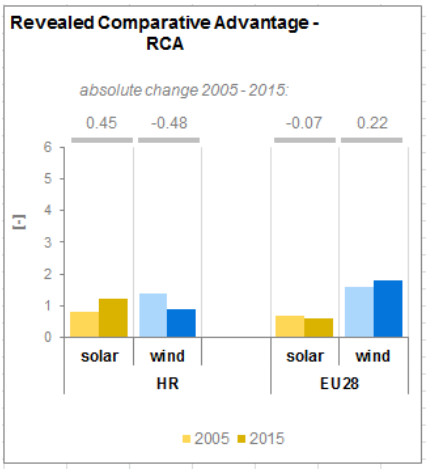


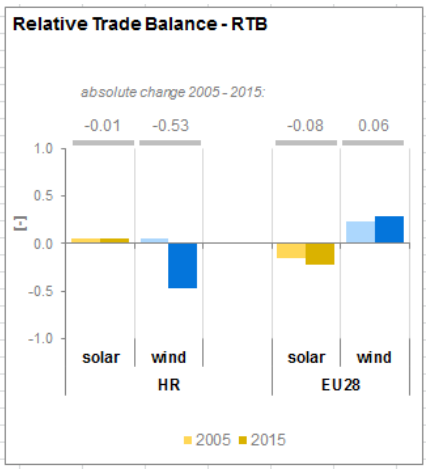




(Source: ECFIN) (Source: Eurostat and IEA)

The competitiveness of Croatia is increasing for the solar PV sector and decreasing in wind. Between 2005 and 2015, the revealed comparative advantage indicator for solar increased to a level above 1, meaning that the country gained competitiveness with respect to its international competitors. In the wind sector, the trend was the opposite and Croatia lost in competitiveness as shown by the revealed comparative advantage indicator, now below 1. The relative trade balance[19] confirms the competitiveness of the country as a net exporter of solar components, while in 2015 it became a net importer of wind energy technology components, due to a strong trade deficit in wind turbines generating sets and gearboxes.





(Source: UN Comtrade)

7. Regional and local cooperation

Croatia is a member of the Regional Groups North-South electricity and Gas Interconnections in Central Eastern and South Eastern Europe.

Croatia is a member of the High Level Group on Central East South Europe Connectivity (CESEC) together with Austria, Bulgaria, Greece, Hungary, Italy, Romania, the Slovak Republic and Slovenia. The objective of the High Level Group is to establish a regional priority infrastructure roadmap and

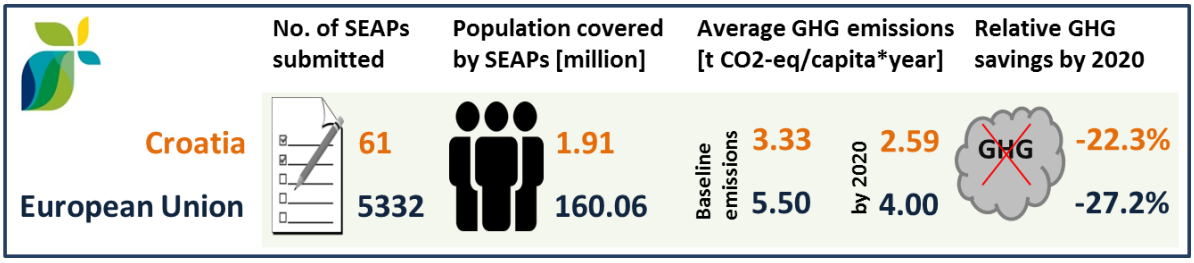
[19] The RTB indicator for product "i" is defined as follows: $RTB_i = \frac{X_i - M_i}{X_i + M_i}$ where X_i is the value of product's "i" exports and M_i imports.

advance its implementation in order to develop missing infrastructure and improve security of gas supplies. One important CESEC related project for Croatia and for the region, is the LNG evacuation pipeline towards-Hungary, which is to enable evacuation of gas from the planned Croatian LNG terminal to regional markets.

The EU macro-regional strategies for the Danube Region and the Adriatic and Ionian Region in which Croatia takes part, can be used as a basis for regional cooperation on energy. European Territorial Cooperation – 'Interreg' – under EU cohesion policy also provides further opportunities for cross-border, transnational and interregional cooperation, including in the Energy Union areas.

Cities and urban areas have a key role in the energy and climate challenge. The Urban Agenda for the EU, established by the Pact of Amsterdam in May 2016, better involves cities in the design and implementation of policies, including those related to the Energy Union. It is implemented through Partnerships, in which the Commission, Member States, cities and stakeholders work together on a number of important areas, including on Energy Transition, Urban Mobility, Air Quality, Climate Adaptation and Housing. Croatia is participating in the partnership on Air Quality, as member.

By 2016, in the context of the Covenant of Mayors, the sustainable energy action plans delivered by 61 Croatian municipalities had been assessed. Overall, these municipalities cover more than 1.9 million inhabitants representing around 43 % of the total population. All together, these municipalities committed to reduce by 2020 the GHG emissions by 22.3 % (as compared to 1990 baseline).



(Source: JRC 2016)

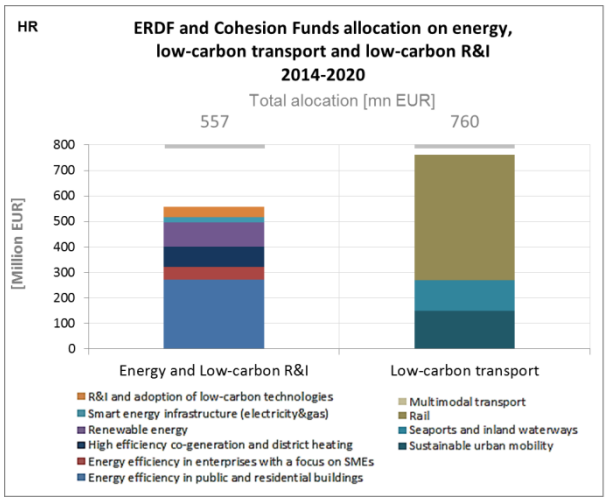
In Croatia, by September 2016, 8 cities (covering 0.13 million inhabitants) have committed to conduct vulnerability and risk assessment and develop and implement adaptation plans in the framework of the Covenant of Mayors for Climate and Energy.

8. Cohesion policy and EU clean energy investments

EU Cohesion Policy makes a key contribution to delivering the Energy Union objectives on the ground, including important investment possibilities to implement energy policy objectives in Croatia which are complemented by national public and private co-financing, aiming at optimal leverage. It also ensures integrated territorial solutions to energy and climate challenges, supports capacity building and provides technical assistance.

Over 2014-2020, cohesion policy is investing some EUR 557 million in energy efficiency improvements in public and residential buildings and in enterprises, as well as in high-efficiency cogeneration and district heating, renewable energy and smart electricity distribution grids in Croatia. Cohesion policy is also investing significantly in R&I and in SME competitiveness, based on the national strategy for smart specialisation. For Croatia, the strategy includes a focus on energy and sustainable environment as well as transport and mobility among the selected priorities. At this

stage, at least EUR 40 million are foreseen for investments in R&I and adoption of low-carbon technologies, but this might increase further in line with the evolving content of the smart specialisation strategy. A further estimated EUR 760 million is invested in supporting the move towards an energy-efficient, decarbonised transport sector.



(Source: DG REGIO)

These investments are expected to contribute to around 10 000 households with improved energy consumption classification, a decrease of around 55 100 000 kWh per year of primary energy consumption of public buildings and around 5 800 additional users connected to smart grids, as well as to around 80 km of reconstructed or upgraded railway lines and 250 km of improved inland waterways.

For example, the energy renovation of the Nikola Tesla Primary school in the city of Rijeka involved insulating the external walls, ceilings and roof and replacing the windows and the doors of a building constructed in 1934. The project delivered more than 47 % energy savings and increased the energy performance of the school from class C to class B. The total cost was EUR 800 000, of which the contribution from the European Regional Development Fund (ERDF) was about EUR 200 000.

Similar measures were implemented during the renovation of the primary school Mladost in the place Treštanovci. The school was originally constructed in 1954. The projects delivered about 80 % energy savings and the school energy performance increased from class D to class B. The total costs of the renovation were about EUR 48 000, of which the contribution from the European Regional Development Fund (ERDF) was about EUR 12 600.

Through its support to sustainable transport systems, the Connecting Europe Facility (CEF) also contributes to the goals of the Energy Union. Following participation in the CEF – Transport 2014-2015 Calls, the Croatian action portfolio comprises 17 signed grant agreements, allocating EUR 350.6 million of actual CEF Transport Funding to Croatian beneficiaries (state-of-play February 2017)[20]. The transport mode which receives the highest share of funding is rail (71.3 % of actual funding), promoting the development of an efficient and competitive railway transport along the Mediterranean corridor.

The maritime actions in the Croatian portfolio regard the port of Rijeka, a pre-identified section of the Mediterranean core network corridor. The interventions include the construction of a new

[20] Note that European Economic Interest Groups and International Organisations are excluded from the analysis.

intermodal terminal for containers, upgrade of the port infrastructure, and engineering studies for an LNG bunkering station. The latter is part of a global project, which aims to support policy-makers in EU Member States, ports and ship-owners operating in the EU Atlantic and Mediterranean countries to comply with marine fuel pollutant standards. Croatia also participates in a number of multi-beneficiary road actions which combine road with technological elements such as LNG refuelling methods or implementation of Intelligent Transport Systems and Services (ITS) on the road system. They aim to alleviate existing bottlenecks, improve safety and introduce alternative fuels on the road network.[21]

[21] Source: INEA