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Energy Union Factsheet United Kingdom

Accompanying the document

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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

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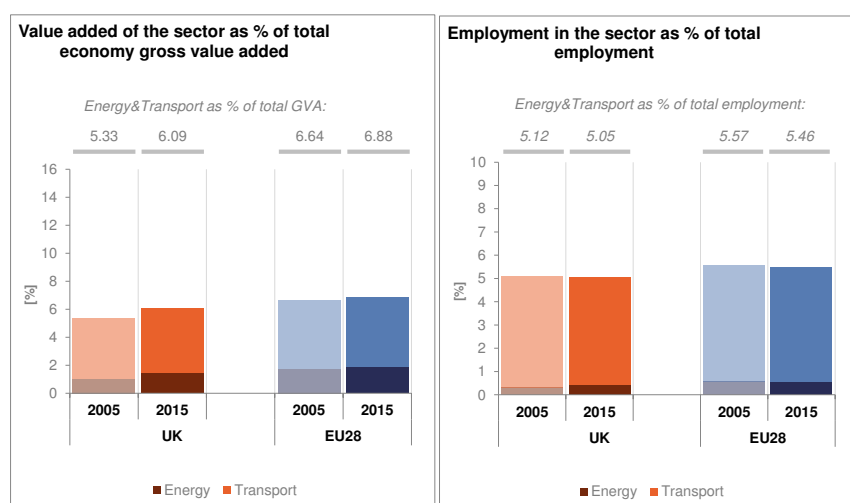


United Kingdom

Energy Union factsheet¹

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 sectors² accounted for about 6.1% of the total value added of the United Kingdom in 2015. Similarly, their share of total employment³ in 2015 was 5.0%, of which 4.6% was in the transport sector and 0.4% in the energy sector.



(source: Eurostat)

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 low-carbon and clean energy transition in sectors beyond energy can only be partially quantified and are therefore not included in this analysis.

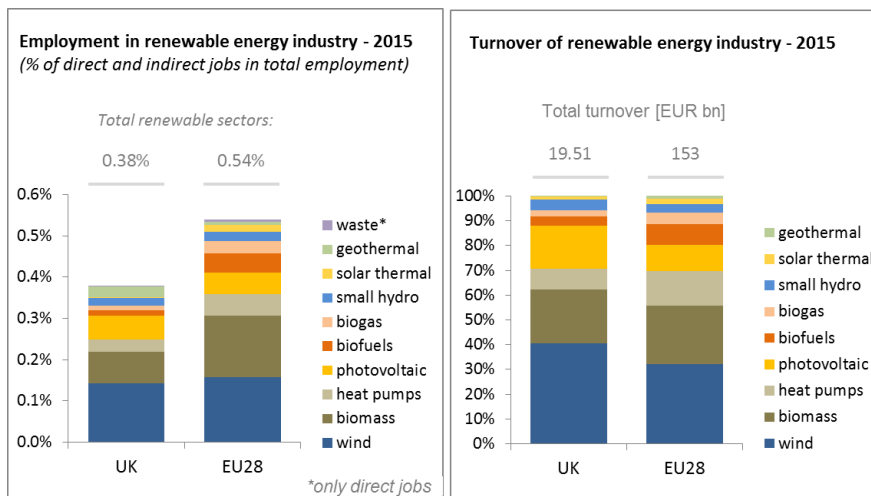
In the case of renewable energy sector, both the direct as well as the indirect effects on employment are being estimated. According to EurObserv'ER, in 2015, the share of direct and indirect renewable energy related employment in total employment of the economy in the United Kingdom was at about 0.38%, below the EU average of 0.54%. The turnover of the renewable energy industry in the same year was estimated at around EUR 19.5 billion, the biggest part being attributed to wind (EUR

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

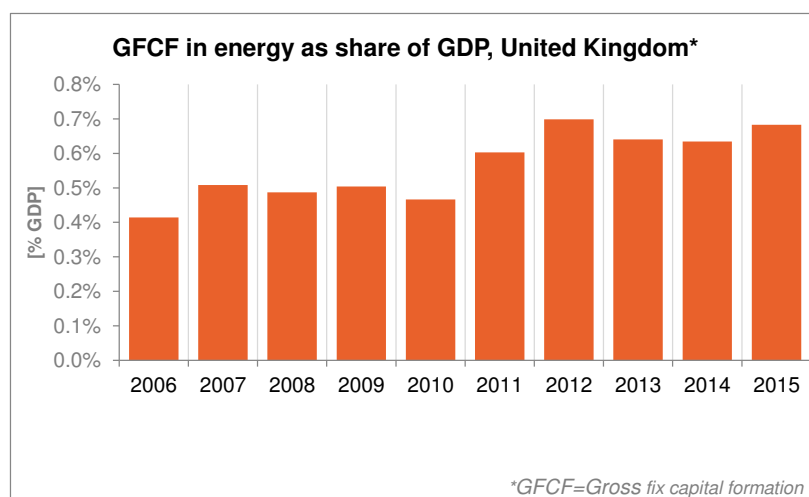
³ National accounts, Eurostat

7.9 billion), followed by biomass (EUR 4.2 billion), photovoltaic (EUR 3.4 billion) and the heat pump (EUR 1.6 billion) industries.



(source: EC based on Euroserv'Er and Eurostat)

An indication of the level of efforts and challenges encountered by the United Kingdom in the energy sector is given by the Gross Fixed Capital Formation (GFCF)⁴. The share of investments in the electricity and gas sectors in GDP increased in the period 2010–2015 to represent almost 0.7% of GDP in 2015, from around 0.56% of GDP before 2010.

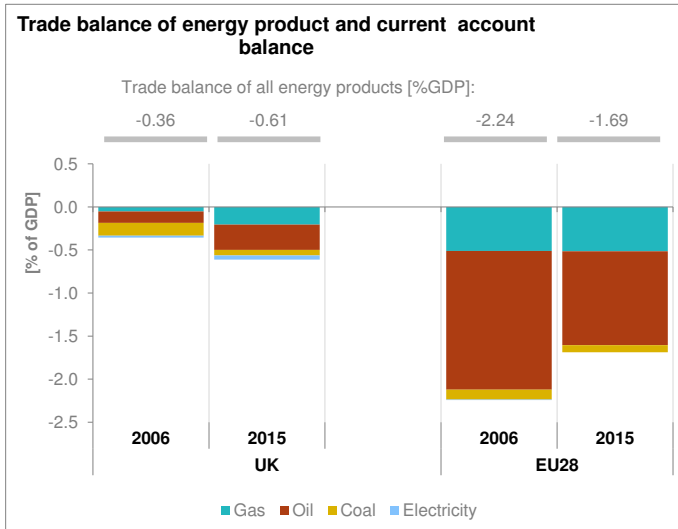


(source: Eurostat)

In terms of trade, the United Kingdom is a net importer of fossil fuels and electricity, but to a much lesser extent than the entire EU. The trade deficit in energy products has increased from 0.36% of GDP in 2006 to 0.61% in 2015, influenced by the decline in domestic (offshore) oil and gas production. Yet, it has been falling since 2013 after an increase from 2004 to 2013. The deficit increase is driven in equal measure by petroleum products and natural gas (an increase of about 0.15 percentage point in GDP for both categories) and also somewhat by electricity (the UK has increased its electricity imports via interconnectors to the continent). This deficit increase has been partly

⁴ Gross fixed capital formation consists of resident producers' acquisitions, less disposals, of fixed tangible or intangible assets. This covers, in particular, machinery and equipment, vehicles, dwellings and other buildings. It also includes foreign direct investment (FDI). Steam and air conditioning supply are also included in the figures mentioned above, as Eurostat reports electricity, gas, steam and air conditioning supply together.

offset by a reduction in the trade deficit for coal over the period due, in particular, to reduced coal consumption.

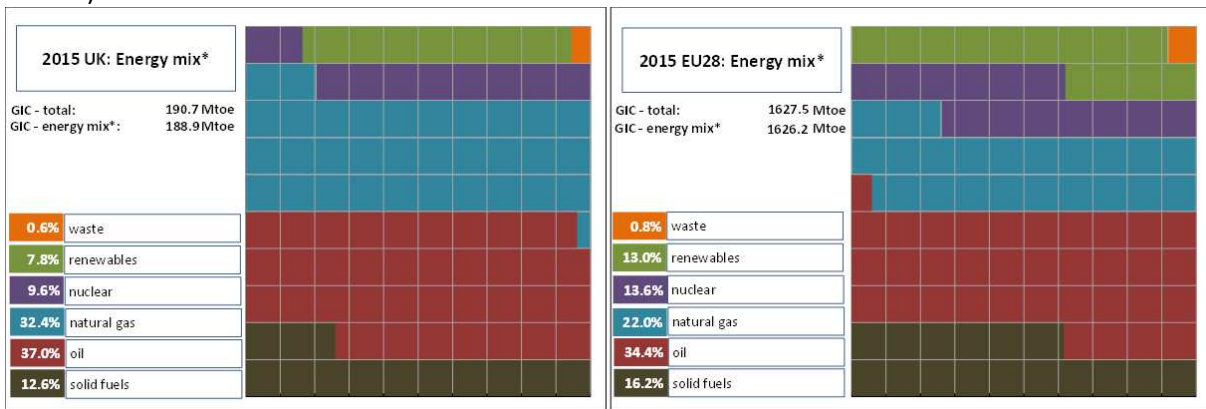


(source: Eurostat)

2. Energy security, solidarity and trust

2.1. Energy Mix

The UK has a strong reliance on natural gas (32.4% vs 22% EU average). It has a relatively low level of renewable energy in its energy mix of primary products as compared to the EU average (7.8% vs 13% share in gross inland consumption), although levels have significantly increased over the past few years. The UK has a significant portion of nuclear energy in the mix (9.6%) and has plans for a programme of nuclear new build (though this will largely replace existing capacity which will be retired).



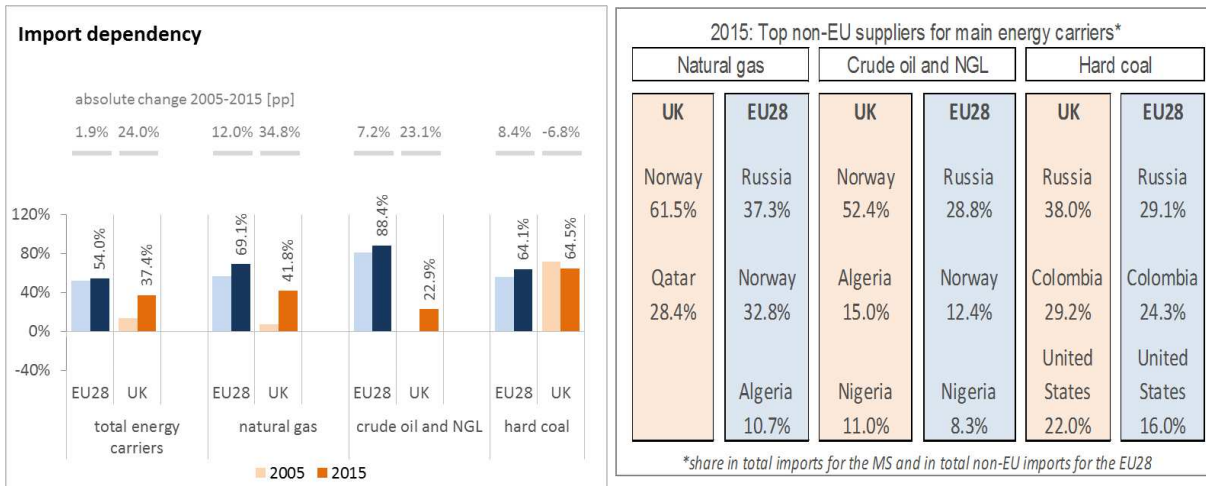
*energy mix as share share in GIC-excluding electricity and derived heat exchanges, GIC=gross inland consumption

(source: ESTAT)

2.2. Import dependency and security of supply

The UK's import dependency is 37.4% of overall energy consumption, which is lower than the EU average, but has increased considerably since 2005 (by 24 percentage points). This increase is due to declining production of natural gas and oil in the North Sea. The UK now imports 41.8% of its natural gas consumption, 61.5% of which comes from Norway (via pipeline) and 28.4% from Qatar (by LNG shipment). Similarly 22.9% of crude oil and NGL are imported, 52.4% of which from Norway. The UK's hard coal imports are similar to the EU average at 64.5%. It is noteworthy that coal's contribution to the UK energy mix has diminished considerably over the last few years and that the UK government

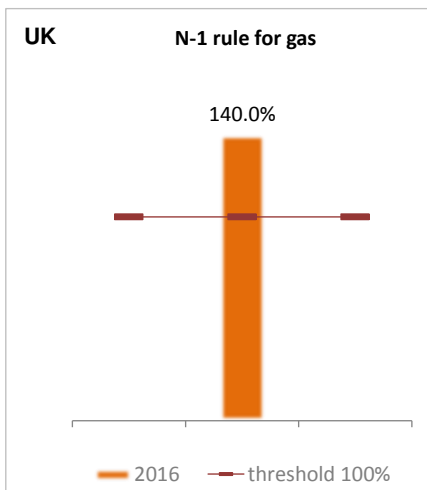
has committed to close all unabated coal electricity generating plant by 2025. The UK experienced its first 'coal-free' day of electricity generation in April 2017.



(source: Eurostat)

Imports of uranium and nuclear fuels are not included in Eurostat's energy balances and import dependency can therefore not be illustrated in the same way as for the main fossil fuels. However, the UK has a diverse supply chain in nuclear fuel, including significant domestic capacity for important elements of the supply process (e.g. in uranium conversion and fuel assembly).

The Regulation concerning measures to safeguard security of gas supply (EU 994/ 2010) 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. This condition is met if the value of the N-1 indicator is equal to or above 100 %. The UK complies with this rule as it has numerous import pipelines and LNG import facilities.

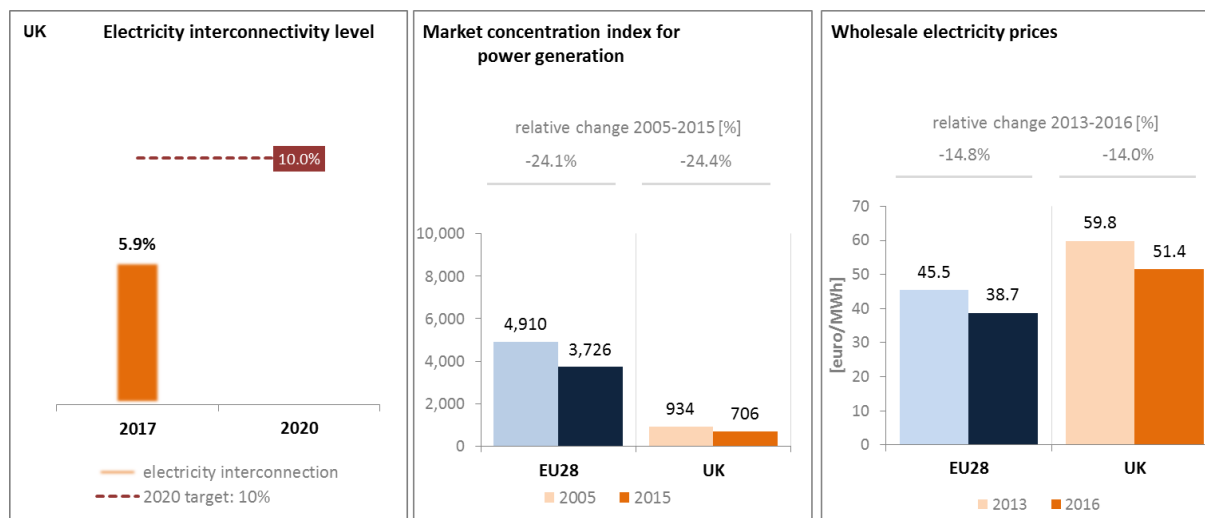


(source: Gas coordination group)

3. Internal market

3.1. Interconnections and wholesale market functioning

3.1.1. Electricity



(source: EC services based on ENTSOE

source: EC services based on Eurostat⁵

source: EC services based on Platts and European power exchanges)

With an interconnection level⁶ of about 6% of installed capacity, the UK is below the interconnection target of 10% of installed capacity by 2020. The Great Britain (GB)⁷ market has low levels of interconnection with the rest of Europe (the Northern Irish electricity market is fully integrated with the Republic of Ireland and thus addressed in the Irish country factsheet). However, since the UK undertook a policy to actively promote interconnection and Ofgem, the Energy Regulator, launched the 'cap and floor' regulatory regime in 2014, eleven new interconnectors are currently in various planning phases. Out of these, the projects under construction⁸ are anticipated to be completed by the early 2020s and to more than double the GB's interconnected capacity.

The UK's power generation is much below the average concentration levels of the EU (at 706 vs 3,726) due to the UK's early moves to liberalise its energy markets. However, wholesale prices are above the EU average (56.1 vs 40.6 €/MWh), which is linked to the UK's high dependence on natural gas; an aging generation fleet; the small size of the GB market compared to the interconnected European market; and the Carbon Price Floor. The higher levels of interconnection foreseen should help bringing wholesale prices down in the future.

3.1.2. Gas

Similarly to electricity, the GB market concentration in the gas sector is much below average (1,073 vs 4,771). In fact, in 2015, the GB was one of only five Member States⁹ that had a concentration index below ACER's gas target model threshold indicating a well-functioning market. Wholesale gas

⁵ Herfindahl-Hirschman Index (HHI)

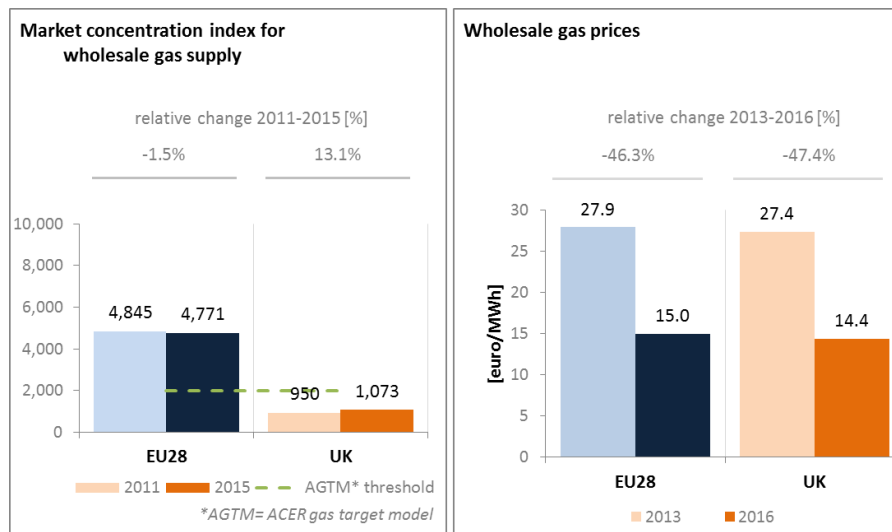
⁶ The interconnectivity level is calculated as a ratio between import interconnection and net generation capacities of the country (i.e. the 2017 value is the ratio between simultaneous import interconnection capacity [GW] and net generating capacity [GW] in the country at 11 January 2017, 19:00 pm as resulted from ENTSO-E Winter Outlook 2016/2017)

⁷ The GB market does not include Northern Ireland which is part of SEM (Single Electricity market), the wholesale electricity market arrangement for Ireland and Northern Ireland.

⁸ These are Eleclink (1GW to France); Nemo Link (1GW to Belgium); North Sea Link (1.4GW to Norway) and IFA2 (1GW to France)

⁹ The other ones are Belgium, Ireland, Luxembourg and Sweden

prices (unlike electricity) are on a par with the EU average, likely due to the UK gas supply options and extensive trading on the NBP gas hub, which is well integrated to other gas hubs on the continent.



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

3.2. Retail electricity and gas markets

3.2.1. Electricity

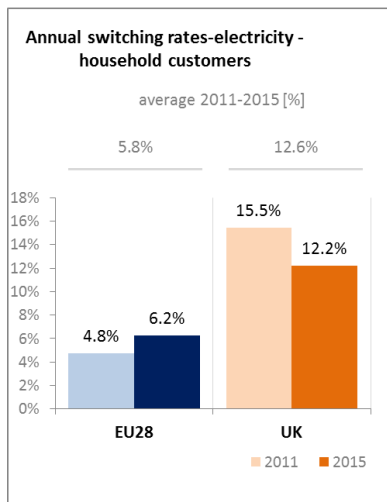
UK household electricity prices in 2016 were below the EU28 average, although prices increased more rapidly than the EU28 average (1.9% between 2013 and 2016).

The UK has a high rate of switching between electricity providers compared to the EU average (12.2% vs 6.2%). However, it is to be noted that around two-thirds of households are on expensive standard variable tariffs with many customers rarely or never having switched supplier or tariff. The Energy Regulator, Ofgem, estimates that each household could save around £200 or more per year by switching to a more advantageous tariff/supplier.

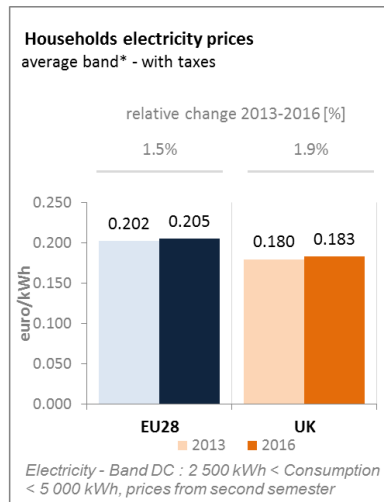
The market share of the 'Big Six' energy suppliers has decreased from a level of 90-95% in 2013 to around 85%, particularly as a result of new small and medium size suppliers entering the market.

The UK has decided in favour of the large-scale roll-out in Great Britain of smart meters by 2020¹⁰. The expected diffusion rate by 2020 is 99.5% which would entail installing nearly 32 million metering points. Unlike other Member States, in which the distribution system operators are responsible for the roll-out of smart meters, in the UK-GB energy suppliers are responsible for planning and installing smart meters for their customers.

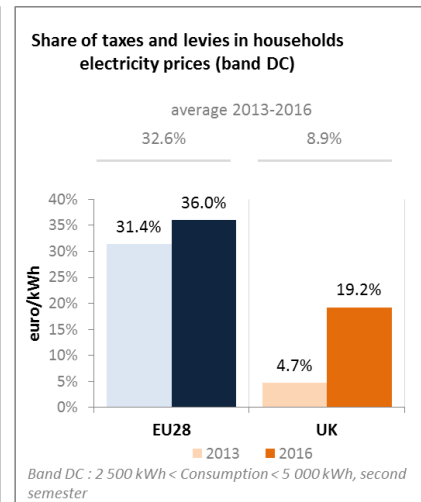
¹⁰ Commission Staff Working Document of 17.6.2014, "Cost-benefit analyses & state of play of smart metering deployment in the EU-27", SWD(2014) 189 final.



(source: ACER)



(source: Eurostat)

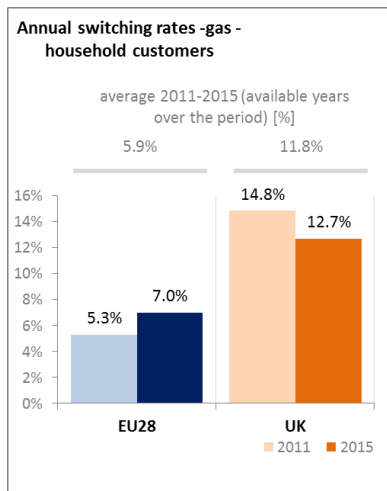


(source: Eurostat)

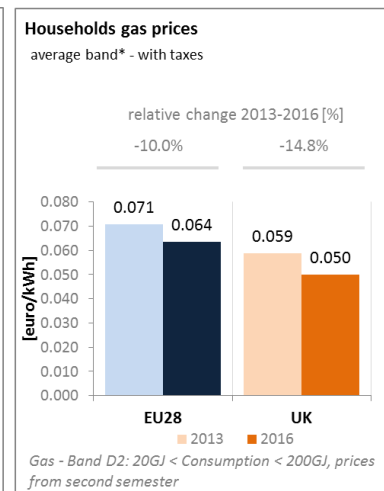
3.2.2. Gas

The gas retail sector largely mirrors the electricity sector in the UK. Household gas prices are similar to the EU average, with the share of taxes and levies being very low (7.0% compared to 26.3% EU28 average) and with higher than average switching rates (12.7% compared to 7.0% EU28 average).

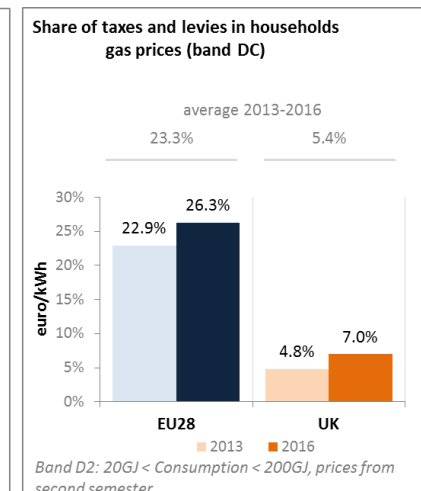
As mentioned in section 3.1, the UK has opted for a large-scale roll-out of smart meters in Great Britain, and this also covers smart gas meters.¹¹



(source: ACER)



(source: Eurostat)

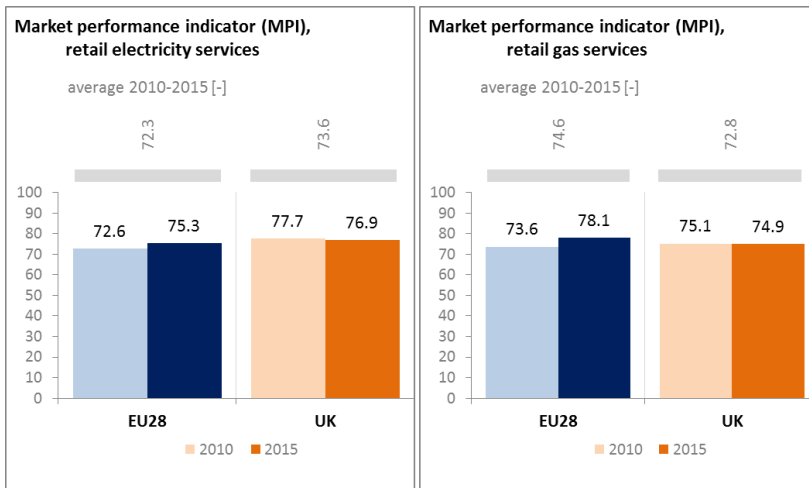


(source: Eurostat)

3.2.3. Market performance indicators

According to the periodical survey of DG JUST, UK consumers show levels of satisfaction with their energy retail service that are in line with the EU average.

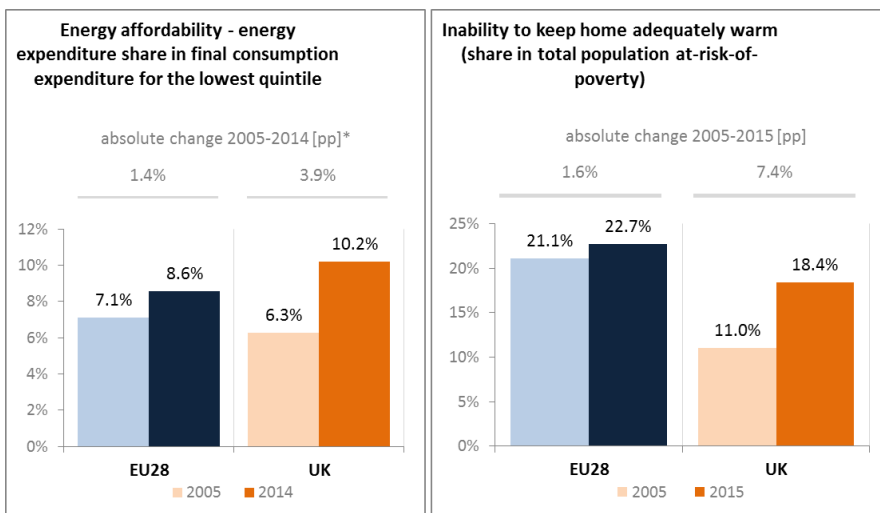
¹¹ Commission Staff Working Document of 17.6.2014, "Cost-benefit analyses & state of play of smart metering deployment in the EU-27", SWD(2014) 189 final.



(source: DG JUST survey)

3.3. Energy affordability

Energy affordability is understood as consumers' ability to pay for their energy needs without this negatively impacting their comfort and standard of living. Affordability can be measured by looking at how much people in the lowest income bracket have to pay for their energy needs (or, in other words, by calculating the share of energy expenditure in total household expenditure for the quintile of population with the lowest income). According to such measurement, in the UK, the share of the population unable to keep their homes adequately warm is below the EU average at 18.4% (compared to 22.7%). However, energy expenditure as a share of final consumption for the quintile of the population with the lowest income is above the EU average at 10.2% (compared to 8.6%). It is also notable that both of these figures indicate a significant increase in the UK since 2005; more people are at risk of being unable to keep their homes warm and the poorest quintile is spending more on energy as a proportion of their overall expenditure. These shifts are above the EU average.



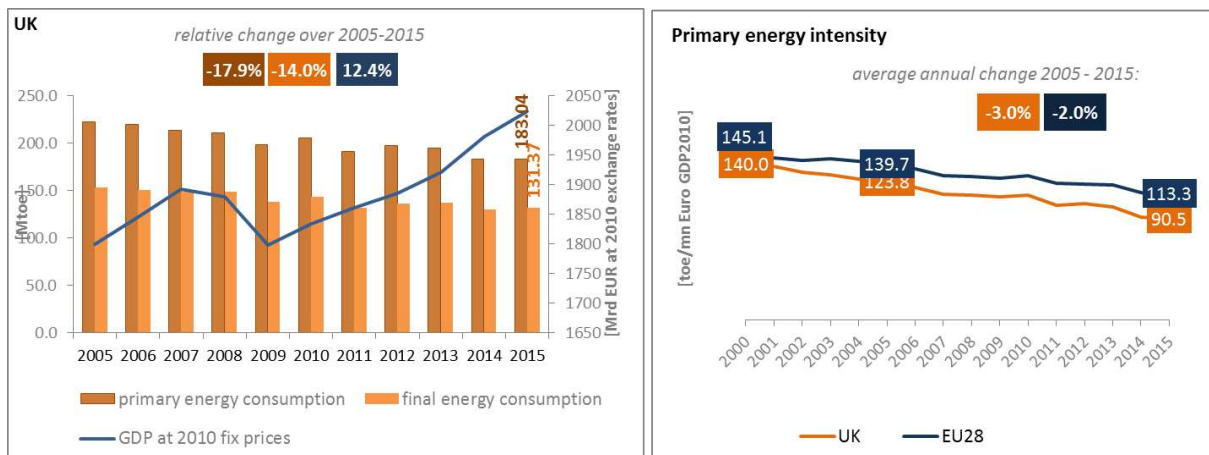
(source: ad-hoc data collection of DG ENER based on HBS with the support of Eurostat and national statistics)

A number of measures are in place targeting vulnerable customers, notably through the benefits system and a universal winter fuel payment of £100 - £300 to older people, irrespective of their income. Furthermore, energy suppliers are asked to take all reasonable steps to avoid disconnecting certain categories of vulnerable customers during the winter period.

4. Energy efficiency and moderation of demand

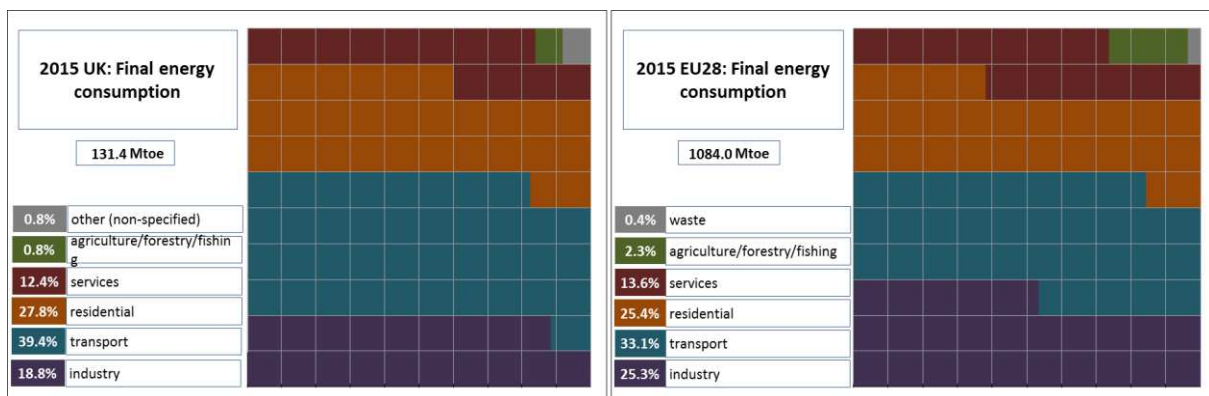
Between the years 2005 and 2015, primary energy consumption in the UK decreased by 17.9%, to reach 181 Mtoe in 2015. Over the same period, final energy consumption also decreased by 14% to 129 Mtoe in 2015. Primary energy consumption in 2015 fell by 0.2% compared to 2014, but final energy consumption was 2% higher. Compared with 2007, consumption was 15% and 11% lower respectively. The UK should continue the efforts on energy efficiency in order to meet its indicative 2020 targets in primary and final energy consumption (177.6 Mtoe in primary energy consumption and 129.2 Mtoe in final energy consumption).

Between 2005 and 2015, the primary energy intensity of the economy (expressed by the ratio of energy consumption over GDP) has decreased annually by 3%, more than the EU average decrease of 2%.



(source: Eurostat)

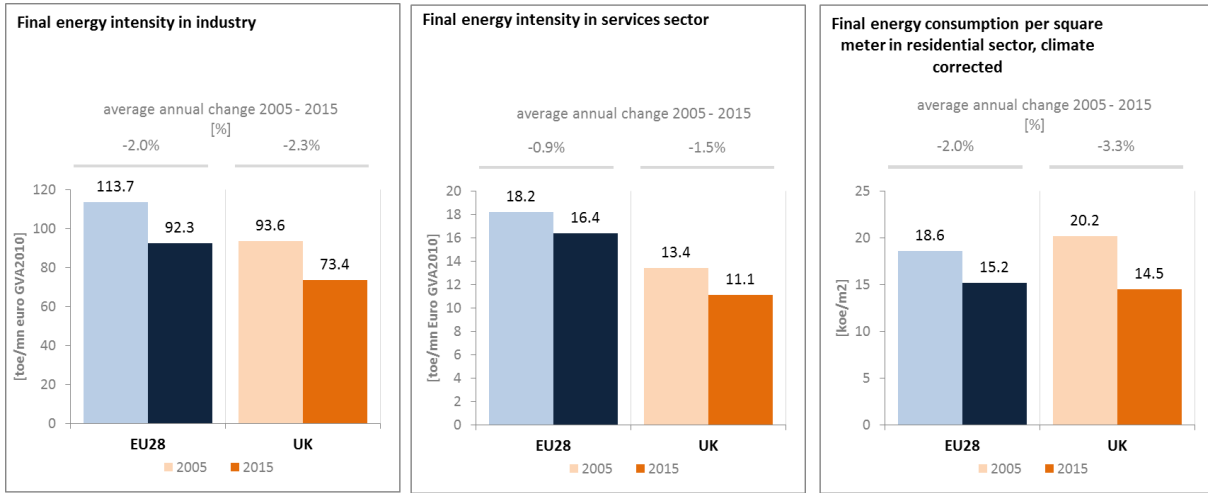
In 2015 in the UK, transport was the biggest energy consuming sector representing a 39.4% share in the total final energy consumption, which is well above the EU average (i.e. 33.1%). On the other hand, the UK's industry sector is somewhat below EU average in terms of its share of the final energy consumption (18.8% compared to 25.3%). Other sectors are largely comparable, with the residential sector taking a somewhat larger portion at 27.8% (compared to 25.4%) and agriculture taking a lower portion at 0.8% (compared to 2.3%) of final energy consumption.



(source: Eurostat)

Energy intensity in industrial and services sectors is lower than the EU average, with the UK making considerable strides for further reductions between 2005 and 2015. Industrial energy consumption fell by 1% since 2014 and by 23% since 2007. For example industrial energy intensity decreased by 2.3% over this period, more than the EU average of 2%. The reduction in industrial energy intensity can be linked to improvements in energy efficiency (largely driven by the rising price of energy),

structural change (the transition away from more energy intensive industries) and fuel switching (from coal and oil to electricity and gas). For the residential sector the UK has had historically higher levels of energy intensity than the EU average; in 2005 UK intensity was at 20.2 koe/m² compared to the EU's 18.6 koe/m². However, the annual rate of change in the years to 2015 was higher in the UK than the rest of the EU, resulting in the UK levels reaching 14.5 vs 15.2 koe/m².

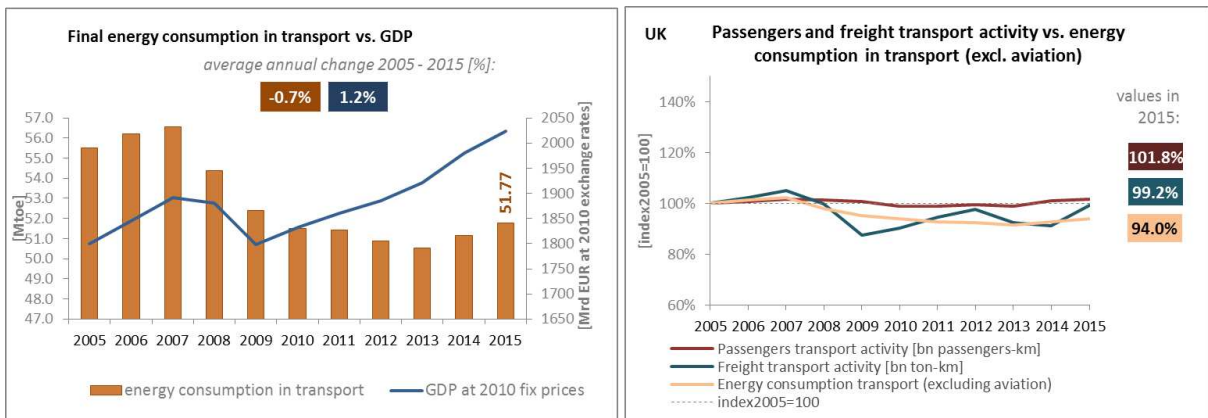


(source: Eurostat)

(source: Eurostat)

(source: Odyssee database)

Between 2005 and 2015, the overall final energy consumption in the transport sector in the UK decreased by an annual average of 0.7%. Between 2005 and 2015, the overall energy consumption in the transport sector has fallen by 6.7%. Both freight activity and energy consumption levels recorded a reduction in levels, whereas passenger transport levels were almost flat. The pattern of overall reduction in energy consumption is likely connected to the pattern of GDP, which decreased following the crisis of 2007 and 2008, but has been increasing steadily since. Energy consumption levels in transport similarly peaked in 2007, however they continued to decline until 2014 when they started to rise again. This could also be linked to oil prices or to various other factors such as vehicle tax¹².

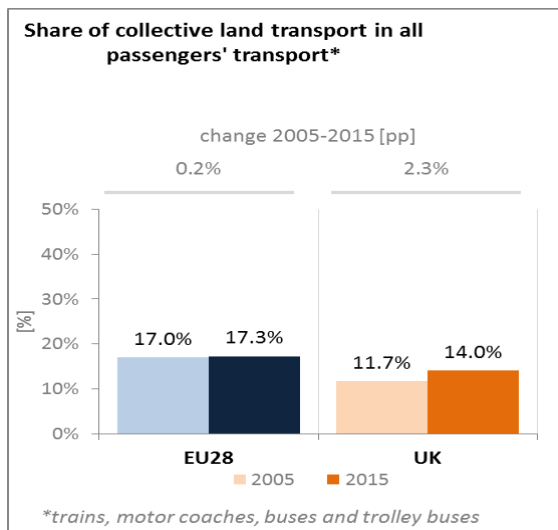


(source: Eurostat)

(source: Eurostat and DG MOVE pocketbook)

¹² The UK taxes cars according to CO₂ emissions, increasing the level of tax with increased emissions. The policy was moderated in 2017 to only differentiate the tax level for the initial tax on registration, as opposed to the annual rate (although electric cars continue to be exempt from the annual road tax).

The share of collective passengers land transport in UK is slightly lower than the EU average (14.0% compared to 17.3% in 2015), although the level increased between 2005 and 2015 by 2.3% (while EU levels remained almost constant).



(source: Eurostat)

Whilst there has been a modest uptick in the level of infrastructure investment since 2010¹³, historically the UK has dedicated relatively low rates of public investments to infrastructure, particularly as regards transport¹⁴. In particular, the UK suffers from a high level of road congestion both in urban and intra-urban areas¹⁵, and must deal with high and increasing costs of the maintenance of their transport infrastructure.

The government has ambitious plans to drive up the provision of infrastructure as set out in the National Infrastructure Plan (NIP) which displays infrastructure needs across the UK economy and the strategy for meeting them. The long term, overarching approach taken with the NIP should help giving clarity to industry and potential investors. At the same time, the UK has set up or refocused dedicated bodies and structures to provide oversight of infrastructure needs assessment and planning, including more practical assistance with project financing and delivery. According to UK Government analysis real annual (public and private) infrastructure investment was 17% higher in 2010-15 than the preceding five years.¹⁶ However, as discussed below, pressure on network capacity continues to build across multiple sectors.

5. Decarbonisation of economy

5.1. GHG emissions

According to greenhouse gas inventory data, in 2016 UK greenhouse gas emissions were 37% lower than 1990 levels. The UK is currently on track to meet its Europe 2020 target for greenhouse gas emissions that are not covered by the EU Emissions Trading Scheme (ETS). Projections based on

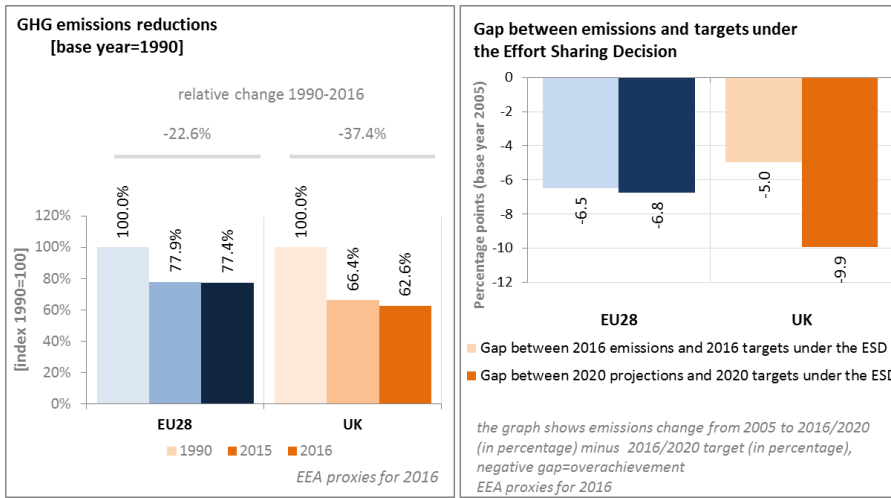
¹³ £47 billion in 2010-11 to 2013-14, compared with £41 billion in 2005-06 to 2009-10 (in 2013-14 prices). UK National Infrastructure Plan 2014.

¹⁴ In the period 1995-2013, transport infrastructure investment varied from between 0.6-0.8% of GDP (https://stats.oecd.org/Index.aspx?DataSetCode=ITF_INV-MTN_DATA) compared to the OECD average of 0.9-1% of GDP (<http://www.internationaltransportforum.org/Pub/pdf/13SpendingTrends.pdf>)

¹⁵ Improving Infrastructure in the United Kingdom, ECO/WKP(2015)62, OECD

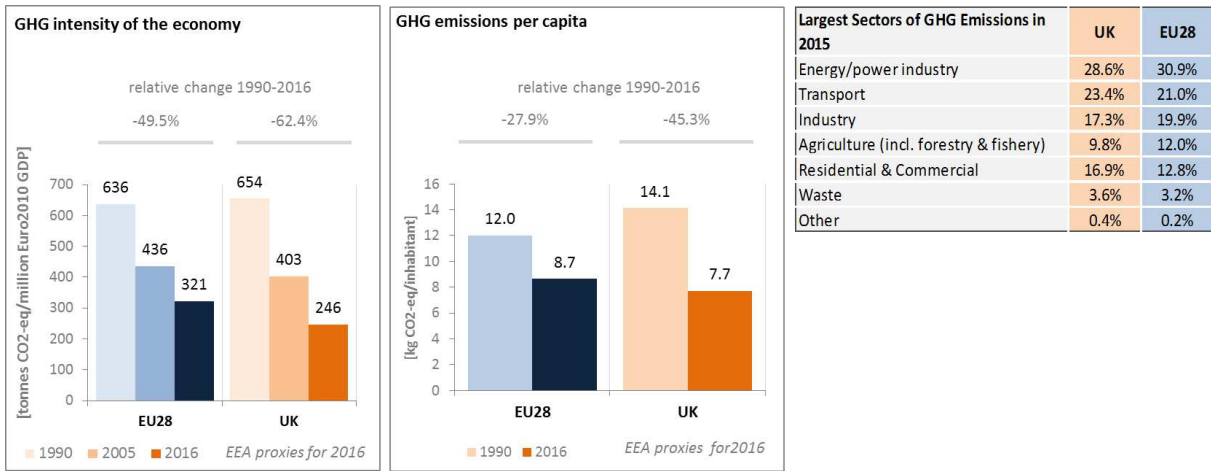
¹⁶ Methodology and Sources for National Infrastructure Delivery Plan 2016-21.

existing measures indeed indicate that emissions from non-ETS sectors will be 26 % below 2005 levels by 2020, over-achieving the 16 % Europe 2020 target.



(source: EC and EEA)

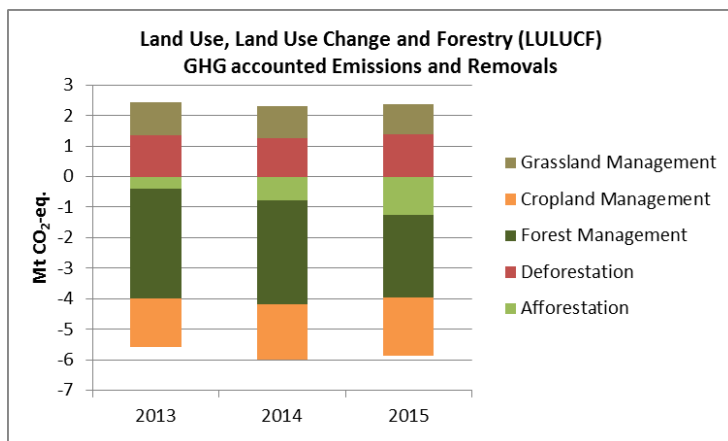
In 2015 the UK reported the largest decrease in emissions of the EU. Progress was however uneven across the sectors of the economy. Total emissions are dominated by the energy sector, which is also the main driver for the declining trend. A strong reduction in coal use and an increase in renewables and nuclear for electricity generation are the main factors behind the decrease in emissions. On the other hand, emissions from the transport sector increased by almost 2% compared to 2014, in particular increasing emissions from road transport played a major role.



(source: EC and EEA)

Preliminary accounts under the Kyoto Protocol for the United Kingdom show overall removals of 3.4 Mt CO₂eq. 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 CO₂eq. It should be noted that in this preliminary simulated accounting exercise, removals from Forest Management did by far not exceed the accounting cap.

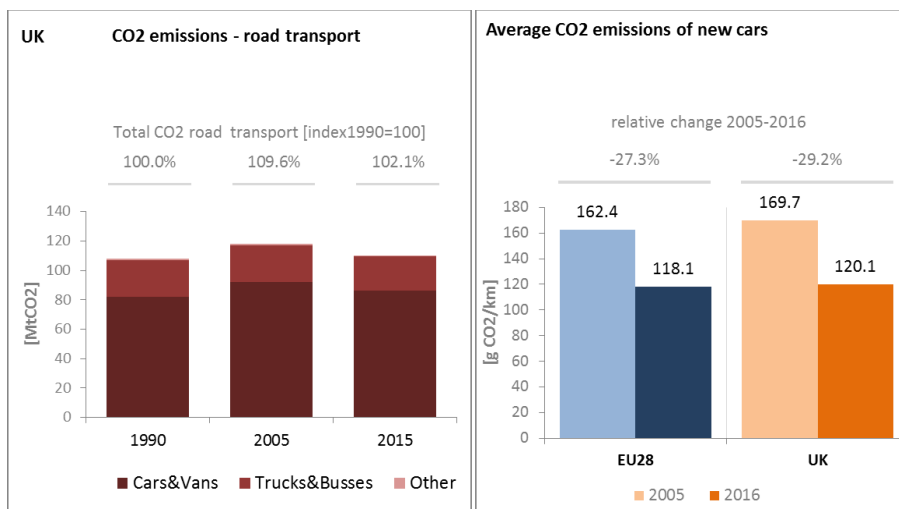
Emissions by Deforestation are notably higher than removals by Afforestation. Removals by Forest Management are highest overall but lost importance over time. There are noteworthy contributions by Cropland Management as removals and Grassland Management as emissions. Overall, there is a slightly increasing trend in removals mainly due to removals from Afforestation. Those increases were intensified by increases in removals by Cropland Management and partly offset by reductions in removals by Forest Management. Emissions by Grassland Management depict slight decreases, and Deforestation showed varying patterns 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)

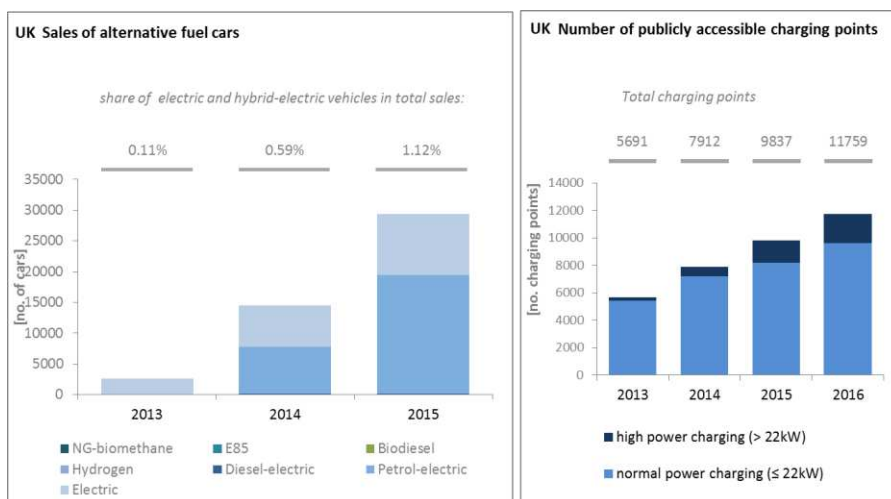
CO₂ emissions in transport and alternative vehicles

The average CO₂ emissions of new cars in the UK were in 2016 marginally above the EU average, but the relative change between 2005 and 2016 was higher than the EU average (29.2% compared to 27.3%).



(source: European Environment Agency)

Over the last four years the number of electric charging points in the United Kingdom has more than doubled, from 5 691 units in 2013 to 11 759 units in 2016.



(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. The United Kingdom has submitted its National Policy Framework as requested under article 3 of the Directive 2014/94/EU.

A detailed assessment of the United Kingdom 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

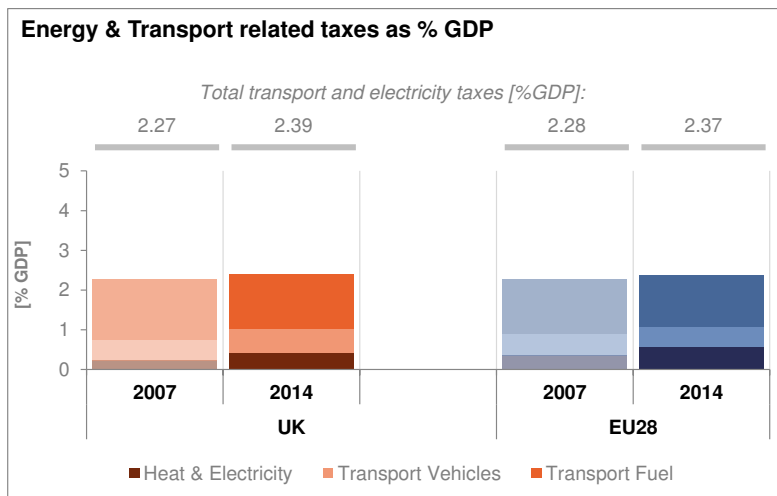
In the UK Climate Change Act 2008 sets the framework for adapting to climate change. The Act requires a climate change risk assessment (CCRA) every five years, to be followed by a national adaptation programme (NAP) to address the priority risks identified in the CCRA. UK government published the first NAP in 2013 which addressed the risks identified in the first CCRA published in 2011. The second UK CCRA was published in January 2017 and the second NAP is expected in 2018. The first NAP sets out actions for national and local government, industry and some non-governmental organisations. The actions fall within six thematic areas: the built environment; infrastructure; healthy and resilient communities; agriculture and forestry; the natural environment; and business. The Climate Change Act also gives UK government the power to require significant infrastructure sectors and public bodies to identify the climate risks that affect them and report on their actions to address them – reporting rounds began in 2009 and 2013 and the next is expected to begin when the next NAP is published. Monitoring of overall progress on NAP actions and UK’s resilience to climate change is undertaken by the Adaptation Sub-Committee of the independent UK Climate Change Committee.

5.3. Taxes on energy and transport and fossil fuel subsidies

The United Kingdom uses taxation as part of its climate policy, and has in place the "Climate Change Levy" (CCL) on business energy use and "Carbon Price Support" (CPS), which is a levy on fossil fuels used for electricity generation. The rates of the CCL vary across the different fuel types (electricity, coal, natural gas, LPG and, since August 2015, also renewable electricity), but these rates do not have a direct relation with the carbon content of different fuels. The CPS is paid by the owners of power

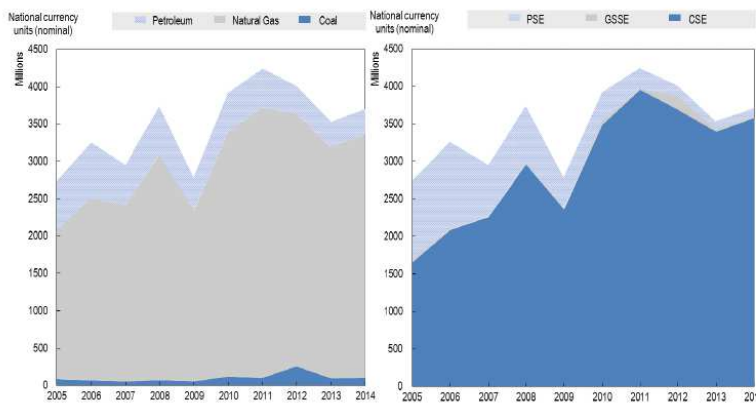
plants and operators of combined heat and power (CHP) stations. The CPS rates are levied on LPG, coal and other solid fossil fuels input on top of the EU ETS emissions price. This measure was introduced in 2013 with the aim of providing further incentives for investments in low-carbon electricity generation. The CPS rates are set as to not exceed a carbon floor price at approximately €21.5/tCO₂ (£18/tCO₂) from 2016 until 2020.

The overall tax burden on energy and transport (including carbon taxation) in the United Kingdom is nearly the same as the EU average, namely 2.4% of GDP in 2014. However, the composition of this tax burden in the United Kingdom differs somewhat from the EU. Since 2007, the tax burden on transport vehicles (which includes a differentiation according to CO₂ emission performance and fuel type) has increased to a level above the EU average (0.6 % of GDP in 2014), while fuel taxation has become more in line with the EU-average. Taxation of heat and electricity has remained below the EU-average, while the increase in both the UK and the EU has been roughly the same since 2005.



(source: Eurostat)

Total support by for fossil fuels in the United Kingdom by fuel type (left) and support indicator (right)



Note: CSE=Consumer Support Estimate; PSE=Producer Support Estimate; GSSE=General Services Support Estimate.

(source: OECD Inventory of Support Measures for Fossil Fuels 2015)

Fossil fuel subsidies in the UK have increased over the last decade. Such support mechanisms principally consists of consumer support, with heating fuel and power consumed by UK households subject to a much lower rate of VAT than the one applied to regular products.

Several non-governmental research organisations have published estimates of UK government support for production; however no data on production support are reported officially. Consequently, the above graph represents only a minor share of all existing Producer Support Estimates.

However, some data is available related to state aid to coal for closure purpose (under Council Decision 2010/787/EU). According to this, in 2015, UK was granted approval to provide up to GBP 20 million aid for the closure of Hatfield coal mine.¹⁷

The same year, the UK was granted approval to provide aid to *UK Coal* (UKC) to cover exceptional costs resulting from the closure of Kellingley Colliery and Thoresby Colliery. The approval was for the provision of aid of up to a maximum of GBP 48 million, of which GBP 20 million was for cover statutory redundancy payments and termination bonuses, and a maximum of GBP 28 million are for concessionary fuel entitlements.¹⁸

In November 2015 the UK committed to consult on proposals to end unabated coal-fired power generation by 2025. This consultation was held in November 2016 and further details on the regulatory measures that will be put in place to put that into effect will be published late 2017.

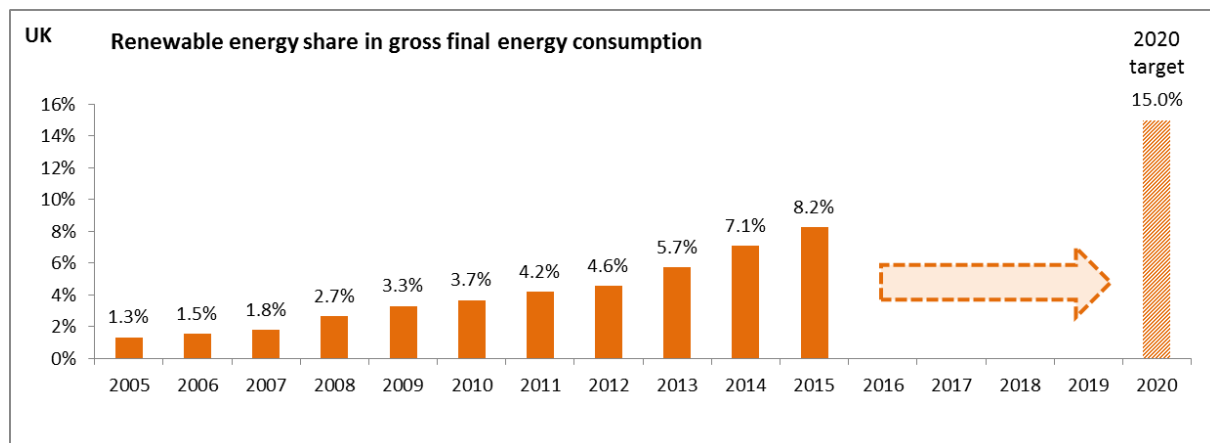
5.4. Renewable energy

The UK has a challenging task in order to meet its 2020 renewable energy target, its 2015 levels remaining at 8.2% of gross final energy consumption compared to its final target of 15%.

The UK met the indicative trajectory for overall renewable energy share for 2013/2014. The next interim target for energy from renewable sources is 7.47%, averaged over 2015 and 2016 and the UK is expected to exceed it. There are also encouraging levels of growth in the renewable electricity sector, which in 2015 reached 22.4% of electricity generation.

Levels of renewable heat and cooling are also increasing steadily. It is in the transport sector where the most substantial challenges remain, with levels in 2015 having decreased on the previous years at 4.4% (the target for 2020 is 10%). The slow uptake of renewables in the transport sector has been driven by the restriction to the use of biofuels with high indirect land-use change (ILUC) implications.

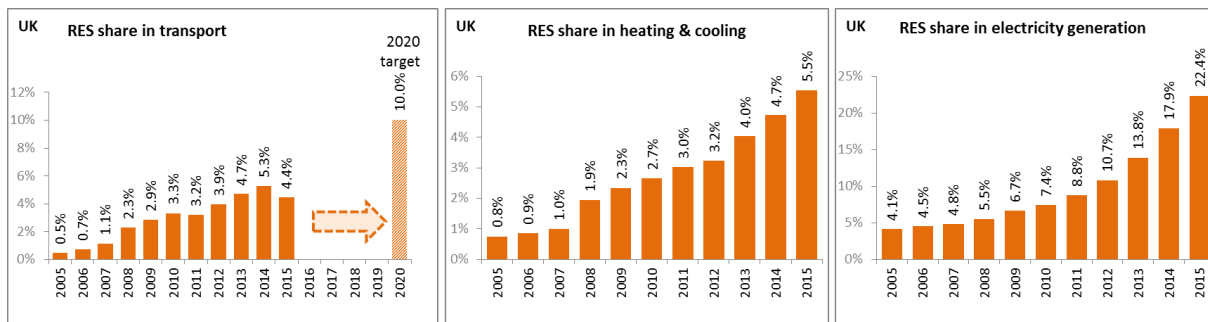
Following the adoption of measures at EU level to address indirect land use change in 2015, the UK Government has consulted on/ proposed measures that would double the share of biofuels by 2020.



(source: Eurostat-SHARES)

¹⁷ http://ec.europa.eu/competition/state_aid/cases/256910/256910_1673735_78_2.pdf

¹⁸ http://ec.europa.eu/competition/state_aid/cases/259339/259339_1722684_105_2.pdf



(source: Eurostat-SHARES)

In the United Kingdom renewable energy has been supported by various policy initiatives; a feed-in tariff, Contracts for Difference scheme, a quota system (the renewable obligation) and tax regulation mechanism. The quota system was phased out in 2017 and replaced by the contracts for difference which came into effect in 2014 (in the interim period generators could choose between the schemes). The Contracts for Difference (CfD) offers support to generators of more than 5MW via a contract for a strike price. If the “strike price” is higher than the market price, the CfD Counterparty must pay renewable generator the difference between the “strike price” and the market price. If the market price is higher than the agreed “strike price”, the renewable generator must pay back the CfD Counterparty the respective difference. Contracts for Difference are awarded through a competitive bidding process for a period of 15 years. Feed-in tariffs were introduced in 2010 and remain in place for generators of below 5MW.

Renewable electricity is connected to the grid under the principle of non-discrimination; renewable electricity plant operators are granted the right to access the grid and grid operators are obliged to expand the grid if this is necessary to accept all generated renewable electricity from a plant.

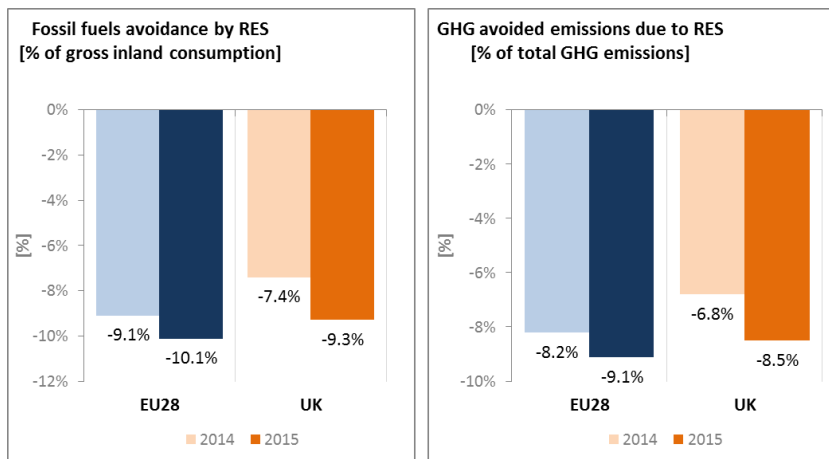
For renewable heat, the 'Renewable Heat Incentive' scheme supports (since 2011) non-domestic and (since 2014) domestic installations and provides tariff to renewable heat producers to bridge the gap between the cost of renewable heat and the market price for fossil fuel generators.

As indicated above, a quota system is in place for biofuels – the Renewable Transport Fuel Obligation (RTFO) – which obliges fuel suppliers to show that a percentage of the fuel they supply comes from renewable and sustainable sources. The quota has been raised over time and measures have also been taken to reduce the contribution from crop-based biofuels. Following a consultation process recently held on a range of measures to amend the RTFO, the UK will increase the obligation level of the share of biofuels in transport fuels to 9.75% by 2020¹⁹.

Due to a low starting level for renewable energy in 2005, the UK has avoided less fossil fuel and fewer CO₂ emissions due to renewable energy than the EU average.²⁰ However, both rates of avoidance have been increasing more dramatically than the EU average – for example the rate of fossil fuel avoidance changed from 7.4% in 2014 to 9.3% in 2015 (compared to 9.1% in 2014 and 10.1% in 2015 for the EU average).

¹⁹ According to the report "The Renewable Transport Fuel Obligations Order Government response to the consultation on amendments" - <https://www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response>

²⁰ 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.

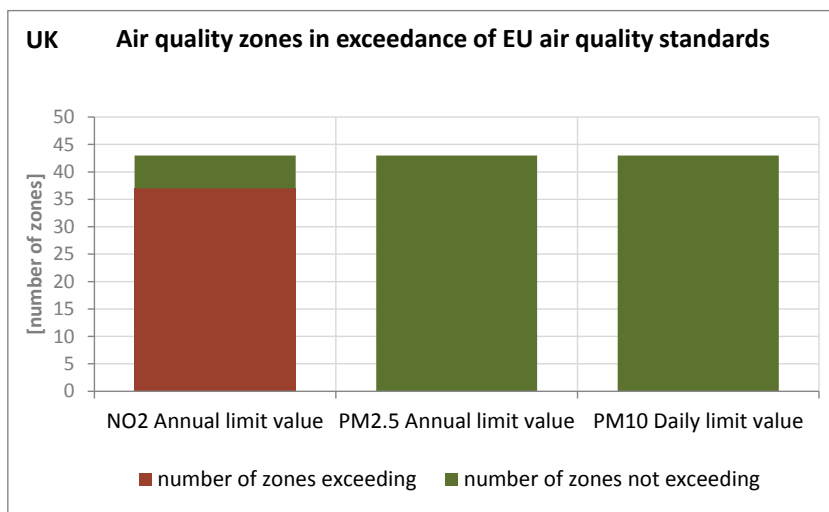


(source: EEA)

5.5. Contribution of the Energy Union to better air quality

Air quality in the United Kingdom continues to give cause for concern. For 2013, the European Environment Agency²¹ estimated that about 37,930 premature deaths were attributable to fine particulate matter (PM_{2.5}) concentrations and over 11,940 to nitrogen dioxide (NO₂) concentrations²².

For NO₂, the United Kingdom has consistently exceeded the binding EU air quality standard²³. For the year 2015, the United Kingdom exceeded the limit value for NO₂ in 37 of the 43 air quality zones across the country²⁴.



(source: EEA)

The Commission's Environmental Implementation Report²⁵ recalls that the health-related external costs from air pollution in the United Kingdom are estimated to be more than EUR 28 billion/year

²¹ 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.

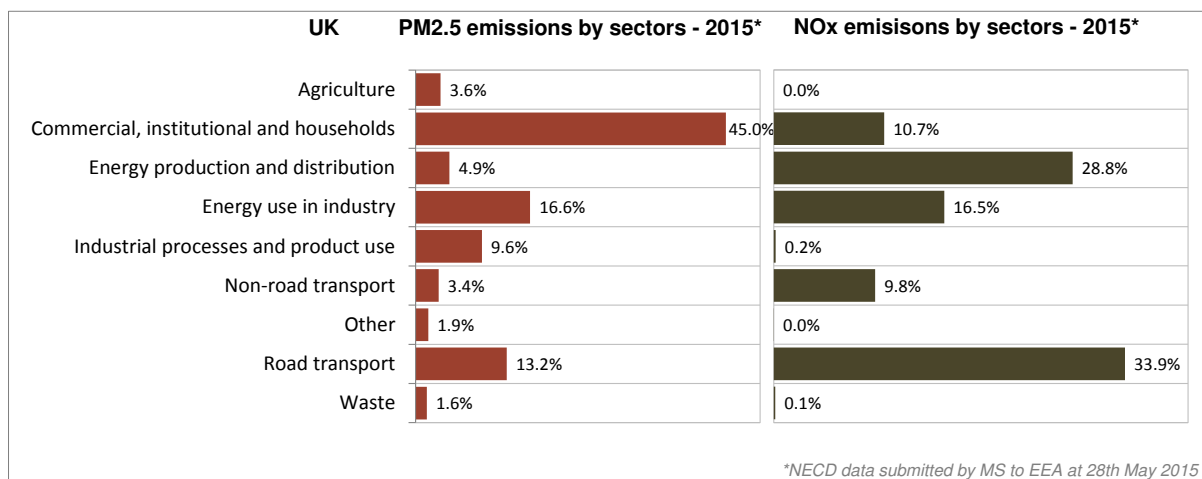
²² While the order of magnitude of premature deaths across different studies is consistent, exact numbers vary annually as well as between the UK's national (Committee on the Medical Effects of Air Pollutants (COMEAP)) and the EEA's estimates.

²³ 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

²⁴ Compliance data as reported by the Member States as part of their official annual air quality report for the calendar year 2015 (available on the European Environment Agency's (EEA) Eionet/Central Data Repository), <http://cdr.eionet.europa.eu/gb/eu/aqd>

(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.

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)²⁶.



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

6. Research, innovation and competitiveness

6.1. Research and innovation policy

The UK has committed to doubling its relevant public funding in clean energy research and innovation (R&I) to over GBP 400 million in 2020. This expenditure will support innovation actions across the energy sector, including on innovative renewables, innovative smart energy system technologies, nuclear innovation, an innovative low carbon industry and an innovative built environment. This expenditure will also support cross-cutting initiatives such as the UK's Energy Entrepreneurs Fund, a competitive funding scheme to support the development and demonstration of state of the art technologies, products and processes in the areas of energy efficiency, power generation and heat, and electricity storage. The Fund particularly aims to assist small- and medium-sized enterprises, including start-ups.

The UK is a very active contributor to the ongoing work of the SET Plan. It provides the chair for two of its governance bodies (Bureau and Joint Actions Working Group). It also participates in ten (out of fourteen) temporary working groups for the implementation of the integrated SET Plan, co-leading the one on nuclear safety. In addition, the UK is participating in 6 ERA-NETS²⁷ launched under H2020 (CCS, Bioenergy, Wind, Smart grids, Ocean energy and Solar energy).

²⁵ See also the EU Environmental Implementation Review Country Report for the United Kingdom, SWD(2017)59 final of 3.2.2017

²⁶ 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/gb/eu/nec_revised

²⁷ The European Research Area - ERA-NET instrument under Horizon 2020 is designed to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as topping up of single joint calls and of actions of a transnational nature.

Regarding the Horizon 2020 programme, the UK has received so far 13% of the EU contribution devoted to the 'secure, clean and efficient energy' part of the programme. As of September 2017, 434 participations from British organisations have been awarded EUR 235 million in Horizon 2020 energy projects. This includes a grant of almost EUR 7.5 million to Amec Foster Wheeler for its participation in project LEILAC (CO₂ emissions reduction in lime and cement industries) and another grant for almost the same amount to Marine Current Turbines for its participation in project DEMOTIDE (ocean tidal arrays).

The UK is a founding member of Mission Innovation where its funding emphasis will be on technology readiness levels (TRLs) 3-8, i.e. applied energy R&D through to demonstration. The UK has played an active and leading role in shaping Mission Innovation activities including as Head of the Secretariat, co-Vice Chair of the Steering Committee and co-lead of the Analysis & Joint Research sub-group. The UK is involved in all seven Mission Innovation Challenges, co-leading the Heating & Cooling challenge.²⁸

The UK also expects its energy R&I programmes to accelerate technology development that will have benefits for developed and developing countries alike. It plans to use at least £100 million of its total spend in 2020/21 on projects that will help address the energy needs of developing countries.

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

In 2016, public (national) investments in the Energy Union R&I priorities reached EUR 442 million, having decreased by 2% compared to 2015. The largest share of these investments (34%) was allocated to the Nuclear Safety priority of the Energy Union, followed by the Sustainable Transport and Smart Systems priorities (28% and 17% respectively). In the period 2007-2016, the maximum annual public investment was EUR 623 million, reported in 2010. In 2014, the most recent year for which data from most Member States are available, public investment per GDP in the UK was lower than the EU average.

Private investment in the Energy Union R&I priorities in 2013 was estimated at EUR 1 165 million (7% of the private R&I investment in Energy Union R&I priorities in the EU). The focus was on the Smart System priority, which received 31% of these investments, followed by Sustainable Transport (24%) and the Efficient Systems priority (23%).

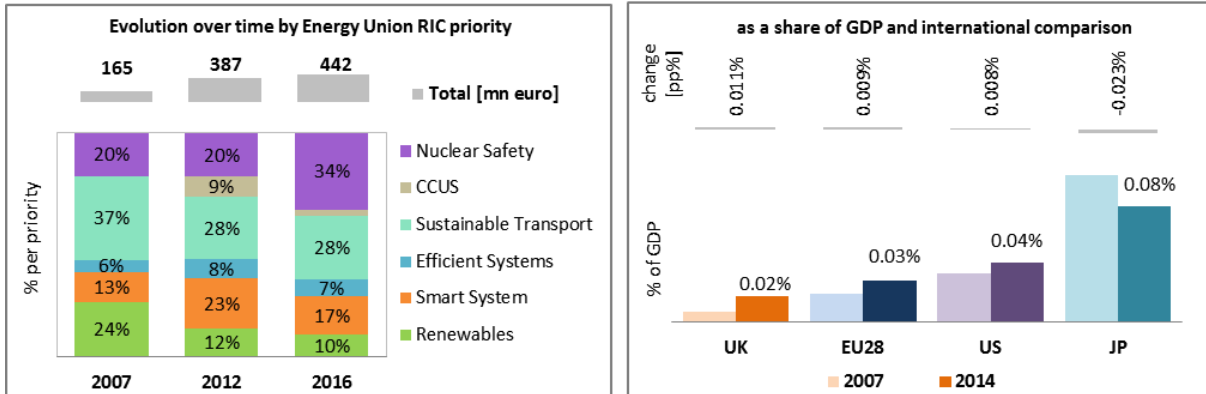
In 2013, the most recent year for which complete patent²⁹ statistics are available, 323 companies and research organisations based in United Kingdom filed 466 patents in low-carbon energy technologies (7% of the EU total). The focus was on the Smart System priority (31%), followed by Energy Efficiency (24%) and Renewables (22%).

In 2013, 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 by 3% and 14% per year, rates of increase which are lower than those at EU level (6% and 15% respectively).

²⁸ <http://mission-innovation.net/>

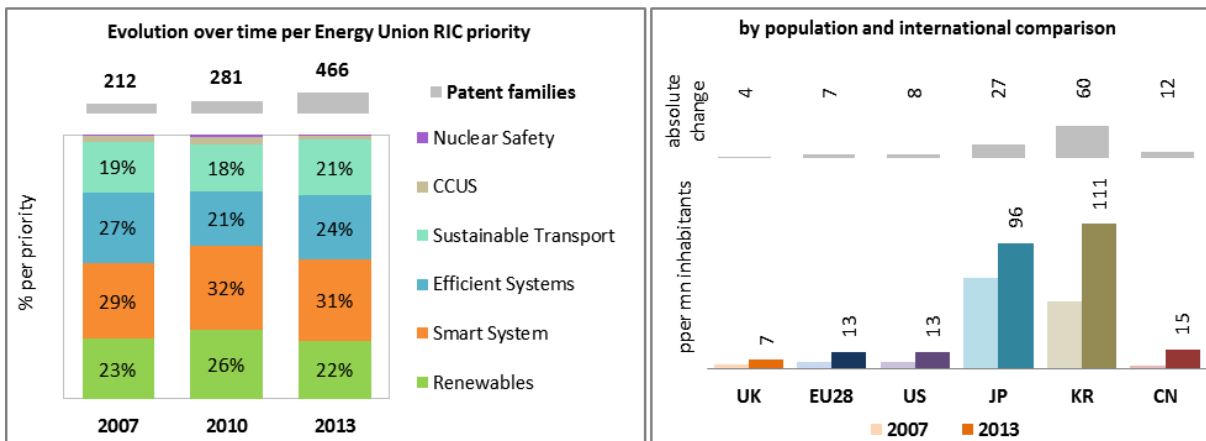
²⁹ In the context of this document, the term 'patent' refers to patent families, rather than applications, as a measure of innovative activity. Patent families include all documents relevant to a distinct invention (e.g. applications to multiple authorities), thus preventing multiple counting. A fraction of the family is allocated to each applicant and relevant technology.

Public R&I investment in Energy Union Research Innovation and Competitiveness priorities



Note: The international comparison (right) is shown for 2014 (the UK had reported EUR 420 million). Reporting at EU level is not as complete for 2015, and very few countries have reported for 2016.

Patent families in Energy Union Research Innovation and Competitiveness priorities



(Data sources: Public investment as available in the International Energy Agency RD&D Statistics database³⁰ for codes relevant to Energy Union RIC priorities. Patent data based on the European Patent Office PATSTAT database³¹. Private investment as estimated by JRC SETIS. Detailed methodology available from the JRC³²)

6.3. Competitiveness

In 2014, the real unit energy costs (RUEC)³³ in the UK were at 10.9%, which is below the EU average (15.3%), and those in Japan (23.8%), China (44.6%) and Russia (37.7%). The RUEC is however higher than the US at 7.5%.

The picture for electricity and gas end-user prices paid by UK industrial customers is less clear. For electricity, the price for median consumption is higher than the EU average although the spread is narrower (so the maximum price is lower than EU average) and for gas the opposite is true. For gas the price for median consumption is slightly below EU average while the spread is larger and the maximum price is higher. These UK prices compare favourably to countries such as Korea and Switzerland, but are substantially higher than prices in e.g. the US, Canada and other OECD countries.

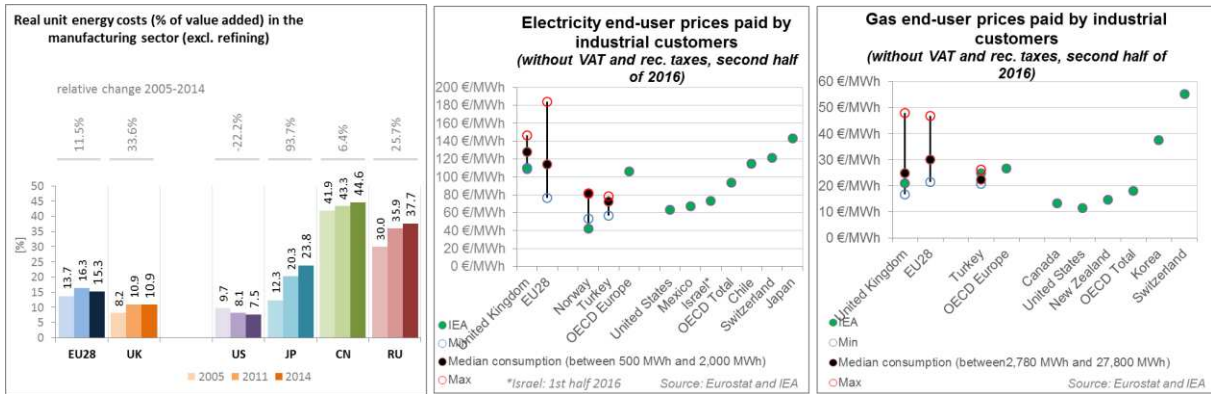
³⁰ <http://www.iea.org/statistics/RDDonlinedataservice/>

³¹ <https://www.epo.org/searching-for-patents/business/patstat.html#tab1>

³² <https://setis.ec.europa.eu/related-jrc-activities/jrc-setis-reports/monitoring-ri-low-carbon-energy-technologies>

³³ This indicator measures the amount of money spent on energy sources needed to obtain one unit of value added.

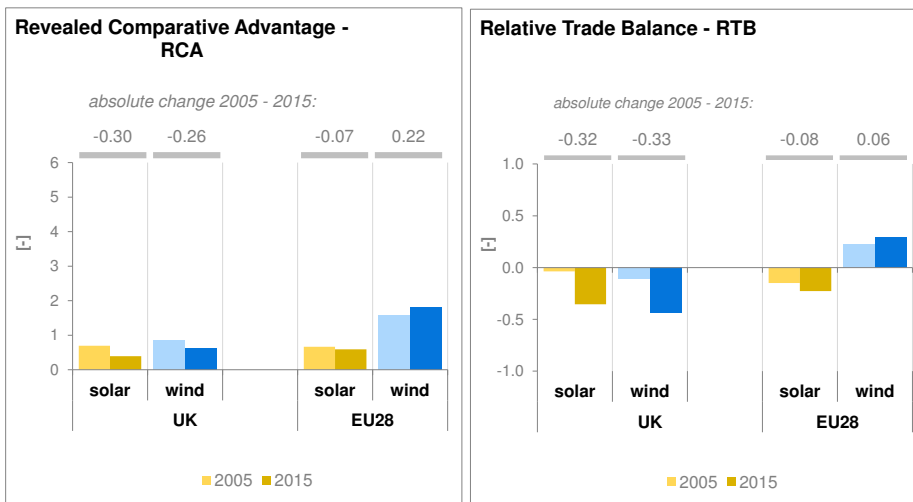
These results indicate that the UK has a good rate of energy efficiency in its industry (the RUEC is low). The UK's industry is also spread across many different sectors, rather than specialised in particularly energy intensive industrial practices. However, the tariff is at an average-to-high rate due to the higher costs of energy in UK compared to other countries of comparable economies.



(source: ECFIN)

(source: ESTAT and IEA)

Regarding the competitiveness in wind and solar energy technology, the UK performed less well than the EU as a whole. As indicated by the revealed comparative advantage indicator³⁴ below 1, the UK economy is not specialised in wind energy or solar PV technologies and the gap with the EU has become larger over the period 2005 – 2015. The UK nonetheless exhibited a comparative advantage in the manufacturing of power electronics for both technologies in 2015. The relative trade balance³⁵ confirms that the United Kingdom is a net importer of both solar and wind components, hence it is more dependent on foreign supply than the EU on average. The UK recorded trade surpluses in silicon manufacturing and in power electronics for wind turbines in 2015.



(source: UN comtrade)

³⁴ The RCA index for product "i" is defined as follows: $RCA_i = \frac{X_{j,i}}{\sum_i X_{j,i}} \div \frac{X_{w,i}}{\sum_i X_{w,i}}$ where X is the value of exports, and j is

the country and w is the reference group, the World economy. 2005 refers in the text to the indicator average over the 2000-2009 period, while 2015 represents the average over the 2010-2016 period. The same applies for the RTB indicator - see below.

³⁵ 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.

7. Regional and local cooperation





UK is part of the North Seas High Level Group launched by the Commission and Member States together with Ireland, Germany, Denmark, France, the Netherlands, Belgium, Luxembourg, Sweden and Norway. In 2016 the countries of the North Seas High Level Group signed a political declaration aimed at facilitating the further deployment of offshore renewable energy, further interconnection between North Sea countries and further integration between wholesale electricity markets.

The UK cooperates with Ireland on issues of gas security of supply. The two countries have adopted a regional approach towards obligations under the EU Regulation (994/2010) on measures to safeguard security of gas supply. This regional approach was adopted to support Ireland meet the N – 1 standard for satisfying gas demand in the event of the failure of its largest gas infrastructure. The UK and Ireland therefore produce a Joint Risk Assessment and a Joint Preventative Action Plan.

European Territorial Cooperation – 'Interreg' – under EU cohesion policy 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, further integrates cities into 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. The United Kingdom is participating in the partnerships on Energy Transition, with the city of London as co-coordinator, Air Quality, with the city of London as member, and Housing, with the Scottish Cities Alliance as member.

Concerning the Covenant of Mayors, by 2016, 33 UK municipalities had delivered sustainable energy action plans (SEAPs), which have been assessed. Overall, these 33 municipalities cover about 17.50 million inhabitants representing around 27 % of the total population in the UK. All together, these municipalities committed to reduce by 2020 their GHG emissions by 33.5% (as compared to 1990 baseline), which is above the EU average at 27.2%.

	No. of SEAPs submitted	Population covered by SEAPs [million]	Average GHG emissions [t CO ₂ -eq/capita*year]		Relative GHG savings by 2020
 United Kingdom	 33	 17.50	Baseline emissions 6.32	by 2020 4.21	 -33.5%
European Union	5332	160.06	Baseline emissions 5.50	by 2020 4.00	-27.2%

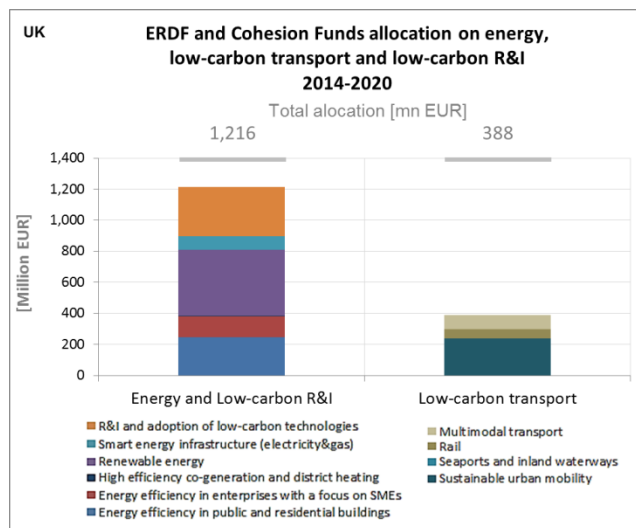
(source: JRC 2016. Notes: SEAP=sustainable energy action plan, GHG=greenhouse gas emissions)

In the United Kingdom, by September 2016, 6 cities (covering 2.29 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-supported clean energy investments

EU cohesion policy makes a key contribution to delivering the Energy Union objectives on the ground, providing important financing opportunities to the United Kingdom 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, EU cohesion policy is investing some EUR 895 million in energy efficiency improvements in public and residential buildings and in enterprises, as well as in renewable energy and smart energy infrastructure in the United Kingdom. Cohesion policy is also investing significantly in R&I and in SME competitiveness in the United Kingdom, based on strategies for smart specialisation which for the UK include a focus on research into technology and engineering. At this stage, at least EUR 320 million is foreseen to be invested in R&I and adoption of low-carbon technologies in the United Kingdom, but this might increase further in line with the evolving content of the smart specialisation strategies. A further estimated EUR 388 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 15,000 households with improved energy consumption classification, a decrease of around 5,547,000 kWh per year of primary energy consumption of public buildings, around 200 MW of additional capacity of renewable energy production, as well as to around 20 km of reconstructed or upgraded railway lines and 5 km of new or improved tram and metro lines. Overall, the EU cohesion policy investments in the United Kingdom over 2014-2020 are expected to contribute to an estimated annual decrease of GHG emissions of around 646,000 tonnes of CO₂eq.

For example, the vision of the Holyhead Deep project in Wales is to contribute to the transition from fossil fuels to renewable energy.. This is the first tidal energy project in the world targeting the power of low-velocity currents. Once fully installed, the 10 MW Deep Green array will supply local, safe and clean electricity to the equivalent of more than 8,000 Welsh households. The planned upgrade of the site to 80 MW installed capacity would increase that figure to almost 70,000 households. The investment linked to building, commissioning and operating the first commercial-scale Deep Green array will also make a significant positive contribution to the creation of new employment opportunities and stimulate long-term growth and investment in Anglesey. The total project cost amounts to around EUR 27 million, of which EUR 13 million will be funded through the European Regional Development Fund (ERDF).

As another example, Cornwall New Energy³⁶ supports the shift towards a low carbon economy in all sectors across Cornwall and the Isles of Scilly. The project aims to develop the local energy market and ensure that enterprises and communities will benefit from more local ownership and operation of energy generation and supply. The project will address market failure and create mutually beneficial relationships between local producers, suppliers and energy users. It aims to facilitate

³⁶ <http://www.cornwallislesofscillygrowthprogramme.org.uk/growth-story/cornwall-new-energy/>

small scale, local renewable energy generation thus, delivering economic, social and environmental benefits for the region. The approved contribution from the European Regional Development Fund (ERDF) amounts to EUR 3 million.

As a further example, the CETO Wave Energy project³⁷ aims to design, construct, install and operate a single 1 megawatt (MW) grid-connected CETO 6 wave energy converter device, adapted to local conditions and industrialised for large scale deployment at Wave Hub off the north coast of Cornwall. This project focusses on the implementation of stage 1 of a scheme, for which stage 2 (planned for 2020) will deliver a subsequent 15 MW commercial array at the same site, delivering 18,500,000 kWh in operation and resulting in 0.46219kg/ 1000 (tonnes) of GHG emission savings by 2020. The CETO system is different from other wave energy devices as it operates under water, delivering power back to shore through subsea cables to export into the grid. The approved contribution from the European Regional Development Fund (ERDF) for the project amounts to almost EUR 11 million.

As a final example, the LoCASE - Low Carbon Across the South East of England project aims to help businesses improve energy efficiency by adopting eco-innovative and low carbon solutions. The approach will improve business performance in terms of resilience, profitability and competitiveness, while contributing to the protection and preservation of the environment. The project is led by Kent County Council and will support 1,050 small and medium-sized enterprises and cut emissions by 6,510 tonnes of carbon dioxide equivalent. The total investment will amount to over EUR 21 million, of which EUR 10 million will be funded by the European Regional Development Fund (ERDF).

Through its support to sustainable transport systems, the Connecting Europe Facility (CEF) also contributes to the goals of the Energy Union. Following British participation in the CEF – Transport 2014-2015 Calls, the British action portfolio comprises 41 signed grant agreements, allocating EUR 331.3 million of actual CEF Transport Funding to British beneficiaries (state-of-play February 2017)³⁸. The transport mode which receives the highest share of funding is air (55% of actual funding). The UK is mainly involved in mono-beneficiary actions but also in a few multi-beneficiary actions through the Single European Sky ATM Research (SESAR) Deployment Manager, contributing to the modernisation of air traffic management (ATM) and the implementation of the Single European Sky policy.

The British action portfolio also includes successful investments in railway transport, including a ground investigation campaign for the design and construction of a new high speed railway line connecting London with Birmingham, actions aimed at improving effective connectivity in Northern Ireland, a study for electrification of existing lines, as well as an action supporting the implementation of the European Rail Traffic Management System (ERTMS). The UK is also involved in multi-beneficiary maritime actions through investments that promote the integration of maritime transport in the logistics chain by upgrading the operational and environmental performance of its maritime links. As regards alternative fuels, the UK supports the deployment of modular natural gas refuelling stations at locations in both the UK the Netherlands that will result in a business plan for the roll out of a natural gas refuelling network across Europe's road network.³⁹

³⁷ <http://www.cornwallislesofscillygrowthprogramme.org.uk/growth-story/ceto-wave-energy/>

³⁸ Note that European Economic Interest Groups and International Organisations are excluded from the analysis.

³⁹ Source: INEA