Deloitte.

European energy market reform
Country profile: UK

Contents

Current situation

Energy consumption and trade balance

In 2012, the UK's gross inland energy consumption[1] amounted to 202 Mtoe. The UK relies heavily on fossil fuels. Crude oil and gas represent 67% of its primary energy mix (35% and 32% respectively), with 86% coming from fossil fuel sources. Primary energy consumption has decreased by 4% since 1990, and more rapidly since then (-7% in 2011).

Figure 1. Gross inland consumption in 2012 (202 Mtoe)[2]

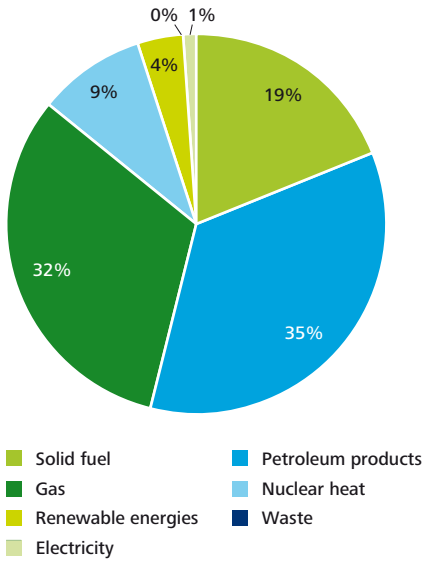
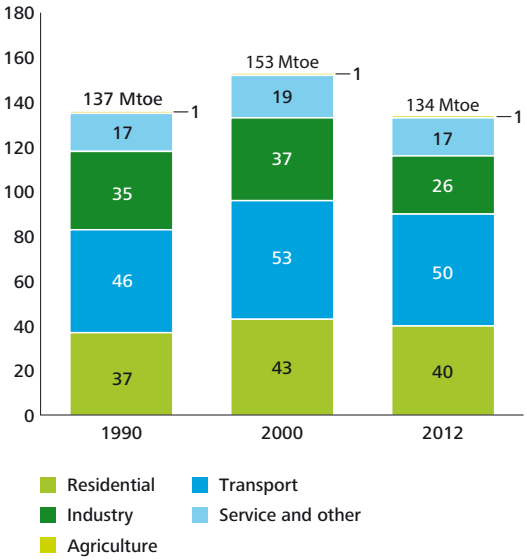
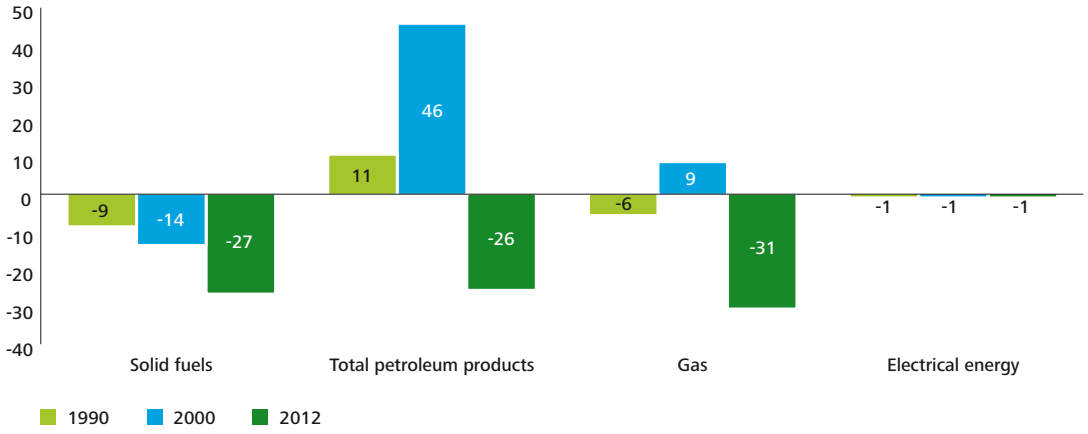


Figure 2. Final energy consumption by sector (in Mtoe)[3]



Between 1990 and 2012, final energy consumption decreased by 2% (i.e. 2.9 Mtoe) to reach 134 Mtoe. This fall mainly comes from the industrial sector (-8.6 Mtoe between 1990 and 2012, which represented a decrease of 25%).

Figure 3. Energy trade balance (Mtoe)[1]



The UK depends increasingly on fossil fuel imports and, in 2012, the energy trade deficit stood at 85 Mtoe, representing approximately £21 million.[4] A net exporter in the 2000s, the UK is now a net importer as its gas and oil production have significantly declined.[5]

Key figures:

Population (2013):
63.9 m cap.

GDP (2013):
1,613 bn €

GDP/capita (2013):
25,241 €

GDP/PEC (2012):
7.7 €/kgoe

PEC/capita (2012):
2.75 toe/cap.

Crude oil and gas represent almost 70% of the country's primary energy mix. The national production of these energies is dropping, making the country increasingly dependent on imports.

1 The gross inland energy consumption is equal to the primary energy consumption plus the consumption of fossil fuels for non-energy purposes

2 Source: Eurostat. © European Union, 1995-2015: http://epp eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc320

3 Source: Eurostat. © European Union, 1995-2015 http://epp.eurostat.ec.europa.eu/portal/page/portalproduct_details/dataset?p_product_code=TSDCC320

4 DUKES (2014), annex G, page 1

5 EC (2012), EU Country factsheet page 282 Source: http://ec.europa.eu. © European Union, 1995-2015

Having reached a record level of crude oil production in 1999 (127 Mt), production has been declining ever since, reaching 38 Mt in 2012. Similarly, the production of natural gas reached its highest level in 2000 (115 bcm, or billion cubic metres) and decreased to 41 bcm in 2012. Coal imports peaked in 2006 then fell and grew again recently due to rising gas prices. These trends highlight the country's growing reliance on non-domestic fossil fuels.

Power generation

In 2013, the UK's total power capacity was 85 GW, 4.9% less than in 2012, mainly due to the closure of coal-fired plants. This decline was partially offset by the opening of new renewable power plants.

In 2012, gas-fired generation was responsible for 27% of total electricity production and coal's share was 39%.[6] In total, fossil fuels accounted for 68% of electricity production in 2012 and represented 74% of total generation capacity. Nuclear generation capacity was 9,946 MW, or 10% of the electricity mix in 2012, and produced 19% of the country's electricity. Its share is down from 23% in 2000 and is expected to decrease further by 2020 as the operating lifetime of current power plants comes to an end.

Renewables represented 16% of installed capacity and provided 12% of power generation, while 45% came from wind, 34% from biomass and 18% from hydro.

Figure 4. Electricity capacity – 90 GW (2012)[7]

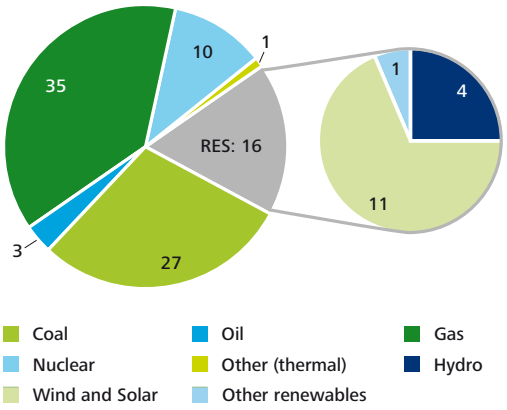
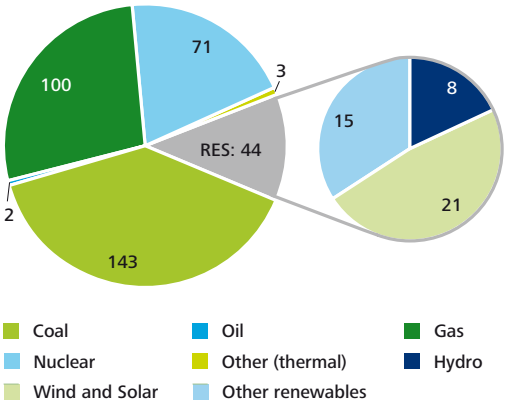


Figure 5. Gross electricity generation – 364 GWh (2012)



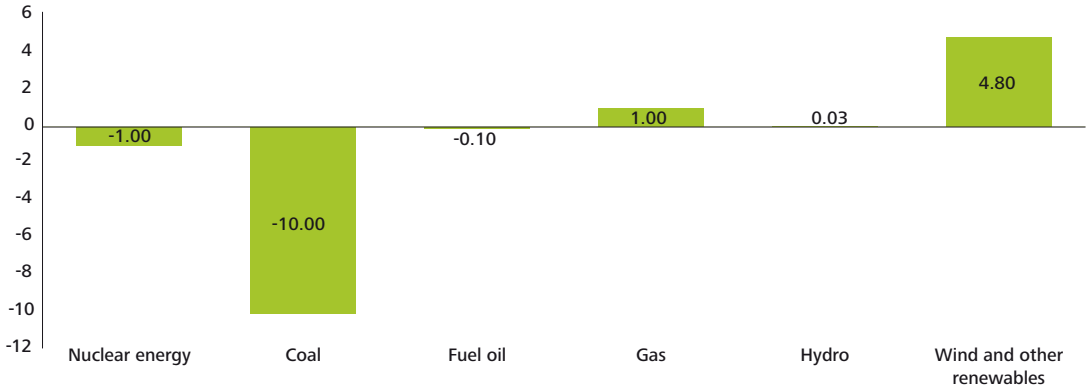
Source: http://ec.europa.eu © European Union, 2014

The country's electricity capacity decreased significantly over the last three years: -13 GW between 2011 and 2014.

6 Source: http://ec.europa.eu. © European Union, 1995-2015, EU Country factsheet page 286

7 Source: EU Energy in figures. Statistical pocketbook 2014. © European Union, 2014

Figure 6. Electricity capacity change from 2010 to 2013 (in GW)[8]



Although UK power generation relies on a high share of fossil fuels, there has been a growing shift towards renewables in recent years.

This fall is due to power plant closures (mainly oil, coal and combination), reduced capacity and the conversion of several large plants to biomass. The EU Large Combustion Plant Directive (LCP Directive) will lead to additional closures of coal and oil-fired plants before 2016, as they are considered too polluting.

That said, the lost capacity was partially offset by an increase in renewables production.

In 2013, the capacity of renewable sources increased by 4.8 GW.

This capacity, however, is expected to decrease over the next few years through 2020/21 due to plant closures driven by the LCP Directive, limiting the availability of new installed capacity. Specifically, roughly 5 GW of conventional power will be permanently lost in the next two years, with an additional one GW decline in the same period as gas plants are mothballed. At the same time, a 7.6 GW decline in nuclear power generation is expected as plants are decommissioned through 2019. In fact, by 2023, all of the country's nuclear power reactors (except 1200 MW) are expected to reach the end their lifetime. This lost capacity will be partially offset by a new 3.2 GW nuclear plant in Hinkley Point which, when built, will meet approximately 7% of the country's electricity needs.

Power market: main actors

The power market in the UK is highly competitive and dispersed.

At the end of 2013, there were 37 major power producers (MPPs). Yet, in 2010, more than 60% of the country's power was generated by six companies (Scottish Power, SSE, E.ON UK, Centrica, RWE and EDF Energy).

A competitive and dispersed market.

Thirty-seven major power producers operate in the UK. Despite this number, six big companies dominate the generation and the retail markets. Their competitive position is under scrutiny by the Competition and Markets Authority.

Geographically, the power marketed in the UK is split into two areas: one covering Great Britain and the other Northern Ireland. In Great Britain, the establishment of the British Electricity Trading and Transmission Arrangements (BETTA) in 2005 began to drive the integration of the electricity systems in England, Wales and Scotland. BETTA provides common rules to allow free trade across Great Britain, oversees the transmission network and provides a GB-wide system operator (SO). Northern Ireland forms an all-island electricity market with the Republic of Ireland.

As of May 1999, the domestic power market in the UK was open to competition, and price controls were removed in 2002.

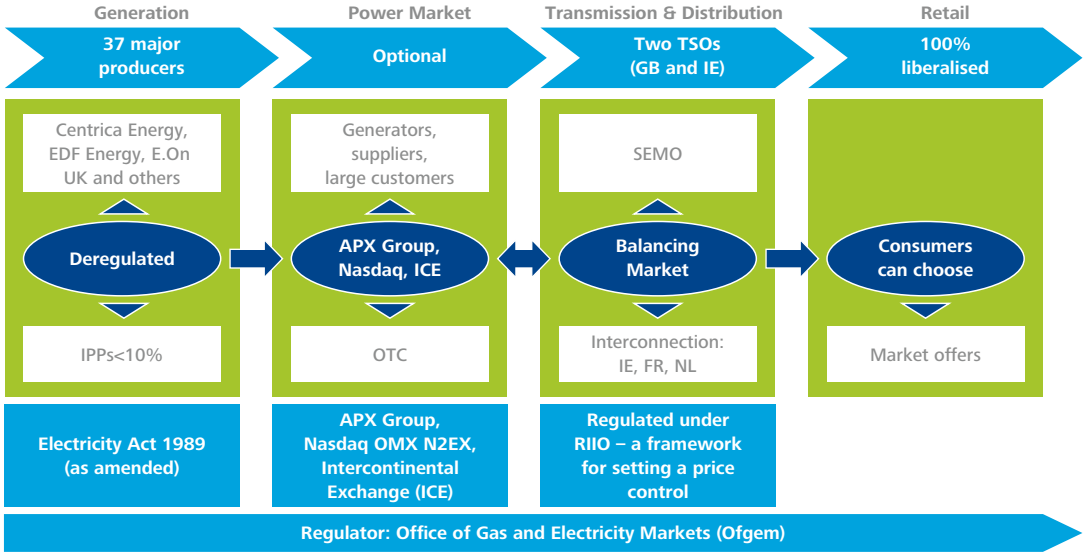
The distribution network is owned and maintained by regional companies, while the high voltage transmission system as a whole is operated by a single operator company, National Grid Electricity Transmission plc (NGET). NGET owns and operates the transmission system in England and Wales, and operates but does not own the Scottish network.

8 DUKES 2014.

There are 14 distribution system operators, owned by six different groups.

Ofgem, the price regulator for gas and electricity, regulates the prices of network system operators, which have the monopoly on the control of the electricity networks. In the UK, electricity transmission and distribution licences must be unbundled. As a consequence, TSOs and DSOs operate independently of energy generators and suppliers.

Figure 7. Market mechanism



The major producers integrated vertically and became part of groups which operate both in the retail and wholesale markets (excluding transmission and distribution activities, which are ownership unbundled).

Although the market seems competitive, **a full competitive inquiry into these six energy companies was launched in 2014** and will be carried out by the Competition and Markets Authority. This inquiry is driven by public and political concerns over rising energy prices for end-consumers in recent years and aims to answer questions about the mounting retail profits these six companies have seen. It will also examine the benefits to customers of vertical integration. Depending on the verdict (expected at the end of 2015), it could have big implications for the make-up of the UK energy industry, potentially resulting in a price review or a price freeze, or spurring a further business split between generation and supply (on the grounds that the contracts between the two make it hard for new entrants to break in).

Introduced in 2013, Electricity Market Reform (EMR) promotes measures to deliver low carbon energy, in an effort to safeguard the UK's security of supply and minimize costs for consumers. Two key elements of the reform are the Contracts for Difference (CFD), which promotes long-term price stability for low carbon generation projects, and the capacity market, which pays an annually determined retainer fee for reliable forms of capacity. The UK government believes that increasing revenue certainty for low carbon generation will spur greater investment at lower capital costs, ultimately reducing energy costs for consumers.

Power prices

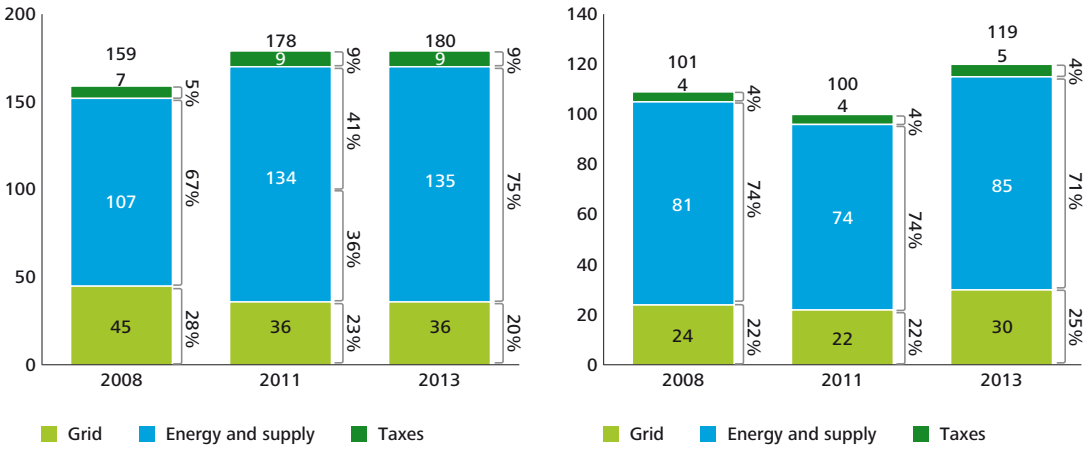
UK market liberalization began in 1990 with the intent to develop a wholesale market free from administrative prices and other regulatory interventions. **In 2010, 91% of the power traded in the UK was traded through over-the-counter trades (OTCs).**

As a result of this system, electricity prices in the UK are imperfectly linked with continental prices. Globally, **the electricity wholesale price is mostly set by gas plants**, which can explain a rather high energy + supply price component compared to the European average.

In 2013, **residential customer retail price**s reached 180 €/MWh, which is lower than the European average (200 €/MWh in 2012). Since 2008, grid costs have dropped by 21%. This reduction, while significant, was offset by an increase in taxes (+16%) and generation and supply costs (+26%), leading to an overall rise of 13%. To help keep prices under control, Ofgem implemented RIIO (Revenue = Incentives + Innovation + Outputs), a regulatory price control framework aimed at encouraging network companies to put stakeholders at the heart of their network investment and management decisions (see 'Renewable energy targets' below). Companies receive incentives for delivering on certain measured outputs, including safety, reliability, environmental and customer satisfaction outputs. It is estimated that the scheme will have an impact on household bills, which are currently expected to increase on average by £9.60 per year by 2021.[9]

In 2012, the **electricity price for industrial consumers** was 119 €/MWh, slightly below the European average (125 €/MWh). Between 2008 and 2012, the price increased by 10%, driven by rising grid costs (+24%), taxes (+23%) and generation and supply costs (+5%).

Figure 8. Retail prices for residential and industrial users (€/MWh)[10]



UK prices are comparatively lower than those in the rest of the EU. VAT is particularly low (5%) and is refunded to industrial consumers. **However, increases in wholesale costs, environmental initiatives and the rising carbon price** (Carbon Price Floor, or CPF; see the section on 'CO_2 emissions and targets' for more detail) **introduced by Energy Market Reform are expected to push up energy prices in the near future. The same effect can be expected from the high investments required to replace decommissioned nuclear and coal capacity.**

Mid-level power prices, slightly below European averages.

Power prices are not regulated in the UK and are instead set by a competitive market that does not recognize either maximum or minimum limits. As such, prices in the UK reflect the global prices of fossil fuels, especially gas. Since 2003, power prices follow the world's rising price trends.

Thanks to low taxes and grid prices, retail prices in the UK are slightly lower than European averages, even though wholesale prices are higher than European averages.

9 Ofgem, https://www.ofgem.gov.uk/ofgem-publications/76230/riio-controls-come-effect.pdf

10 Source: Eurostat. © European Union, 1995-2015: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_205_c&lang=en

Targets for 2020

20-20-20 EU targets: what is the UK committed to?

- 18% energy savings versus a 2007 business as usual scenario.
- 15% renewable energies in final energy consumption by 2020.
- The GHG emissions target is divided into two targets:
  - EU-wide target of 21% for ETS (emission trading scheme) related GHG emissions in 2020 vs. 2005.
  - -16% for non-ETS related GHG emissions in 2020 vs. 2005.

Energy efficiency: the UK is on course to exceed its commitment (only 21% of the target remains to be achieved).

The UK has set ambitious measures to reduce its energy consumption in various sectors.

The building stock in the country is one of the oldest in Europe, which is why energy efficiency measures such as the Green Deal and the Energy Company Obligation target efficiency improvements in existing stock.

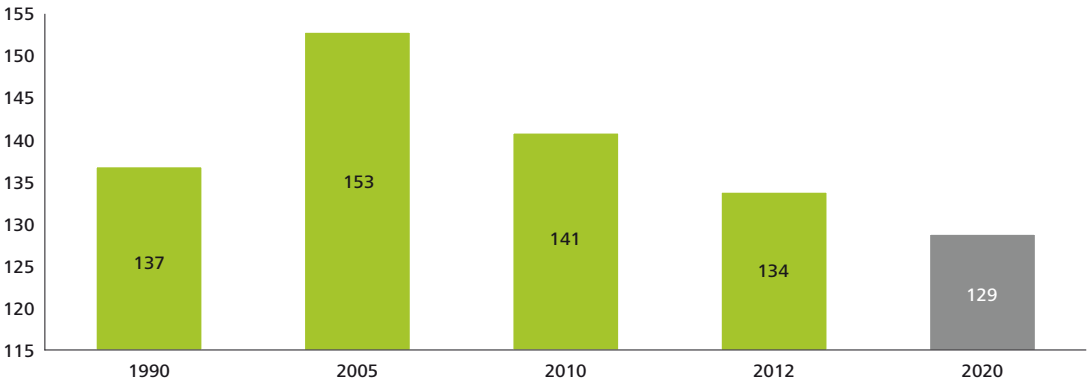
The UK is implementing the EU Energy Efficiency Directive through 19 policies, which include the following three energy company obligation schemes: the Carbon Emissions Reduction Target (CERT), the Community Energy Saving Programme (CESP) and the Energy Company Obligation (ECO). While the UK target is to realize 324 TWh of savings by 2020, the country's energy efficiency policies are expected to deliver 467 TWh of savings.

Simultaneously, the country is aiming to increase the share of renewables in its final energy consumption to 15% by 2020. To reach this target, a mix of measures have been adopted, including the Renewables Obligation (RO) initiative, which provides incentives to increase large-scale electricity generation from renewables. In parallel, the Feed-in Tariffs (FiT) scheme supports small-scale low-carbon generation. The UK Renewable Roadmap also sets a specific plan for the increased deployment of offshore and onshore wind, marine energy, photovoltaics and renewable transport.

In the final analysis, the UK's Climate Change Act 2008 and its carbon budget framework set the ambitious target of reducing GHG emissions by at least 80% by 2050.

Energy efficiency targets

Figure 9. Final energy consumption (Mtoe)[11]



The indicative energy efficiency target for 2020 is a final energy consumption of 129 Mtoe in 2020, which corresponds to an 18% reduction compared to the country's 2007 business-as-usual scenario. This means final energy consumption must drop by approximately 25 Mtoe between 2005 and 2020. By 2012, the UK had already achieved 79% of this target.

The UK has implemented both horizontal and sectorial measures to improve energy efficiency.

Horizontal measures include the establishment of energy efficiency obligation measures and/or alternative policy measures. Two other initiatives, the Green Deal and the Energy Company Obligation scheme, promote and finance the uptake of energy efficiency measures in buildings. Introduced in 2013 and complementary to the Green Deal, the Energy Savings Opportunity scheme places new legislative requirements on large enterprises (approximately 7,300 assets in the UK) to carry out energy audits.

11 Source: Eurostat. © European Union, 1995-2015 http://epp.eurostat.ec.europa.eu/tgmtabledo?tab=table&init=1&language=en&pcode=ten00095&plugin=1

Sectorial measures target energy efficiency in the transportation, building, heating and cooling, and industrial sectors.

The **transportation** sector is the country's primary energy consumer (36% of final energy consumption in 2013), and consequently has a particularly important role in the country's efforts to improve energy efficiency. Between 2002 and 2012, the energy efficiency of cars improved by 27%. Since 2009, regulations have required reduced fuel consumption in cars. The cars sold in 2013 should have achieved savings equivalent to 15 pence per litre. By 2020, this will rise to 42 pence per litre. The UK government also financially supports the uptake of Ultra-Low Emissions Vehicles (ULEVs) and promotes eco-driving by including fuel-efficient techniques in driving tests and by supporting training in businesses. A Green Bus Fund has been established and is expected to achieve energy savings of approximately 404 TJ in public transport.

In 2012, energy consumption in **buildings** represented approximately 32% of the total final energy consumption. Despite a number of previous measures taken to improve energy efficiency, household energy consumption increased by 22% between 1970 and 2007. This could be partly due to the increase of dwellings stock (approximately 1% per year). Nevertheless, it has been estimated that, without the existing energy efficiency measures, this increase would be more than double. The Building Renovation Strategy estimates that there is potential for further improvements, which could result in additional savings of 54 TWh between 2013 and 2020. Beginning 2016, the UK will be implementing a "zero carbon homes" policy. In addition, building regulations, which promote energy efficiency in buildings, have been set. Specifically, the building regulations in England, Northern Ireland, Scotland and Wales respectively require average CO_2 emission reductions by 6%, 25% and 20%, compared to 2010 levels. Another initiative, the Code for Sustainable Houses, sets common standards at the national level to promote the construction of energy-efficient houses.

Heating accounts for approximately one-third of GHG emissions in the country. The potential of combined heating and power (CHP) in terms of energy and GHG savings has been estimated at 30%. The UK financially supports the development of heat networks in local authorities. The growth of natural gas CHP capacity faces financial barriers as the potential revenues and energy savings are not sufficient to ensure financial viability.
The UK plans to implement policies to support these types of installations.

The **industrial** sector was responsible for 16% of final energy consumption in 2013. This consumption is expected to drop by 12% in the next two decades, mainly thanks to developments in CHP, and improvements in process and material efficiency.

In the UK, measures to improve energy efficiency also target **electricity and gas networks**. Transmission and distribution companies are encouraged to improve the management of system losses through Ofgem's RIIO regulatory price control framework, which, among other things, will promote the connection of small-scale renewables, as well as microgeneration. Specifically, the scheme promotes efficient outputs by setting conditions within an eight-year timeframe. These conditions include measures to reduce network losses and limit the use of the network during peak demand times (i.e. through the tariff structure and localization of tariffs at different areas of the network). Specifically, on gas distribution, Ofgem requires a reduction of 15% to 20% in transport losses.

In the case of renewable energy, the UK is still far from reaching its target (80% to go) but is implementing a very ambitious policy to support renewable development.

Nonetheless, and despite encouraging progress, these policies may not be sufficient to allow the country to reach the target in time.

Renewable energy targets

The target is to have a 15% renewable share of final energy consumption by 2020 vs. 1.2%[12] in 2005 and 4.1% in 2012.[13] Between 2005 and 2012, approximately 20% of the target was achieved. An interim target was set for 2010 at 10%, but was not met (7.2% instead). This failure can be partly attributed to non-economic barriers (e.g. low load factors in hydro and wind power, and public acceptance constraints).

If the abovementioned energy efficiency target (129 Mtoe of final energy consumption in 2020) is reached, **approximately 19 Mtoe of final energy consumption should come from renewables in 2020, compared to two in 2012.**[14] **This means an additional 17 Mtoe is needed between 2012 and 2020.**

Figure 10. Renewable energy share of final energy use (2012)[15]

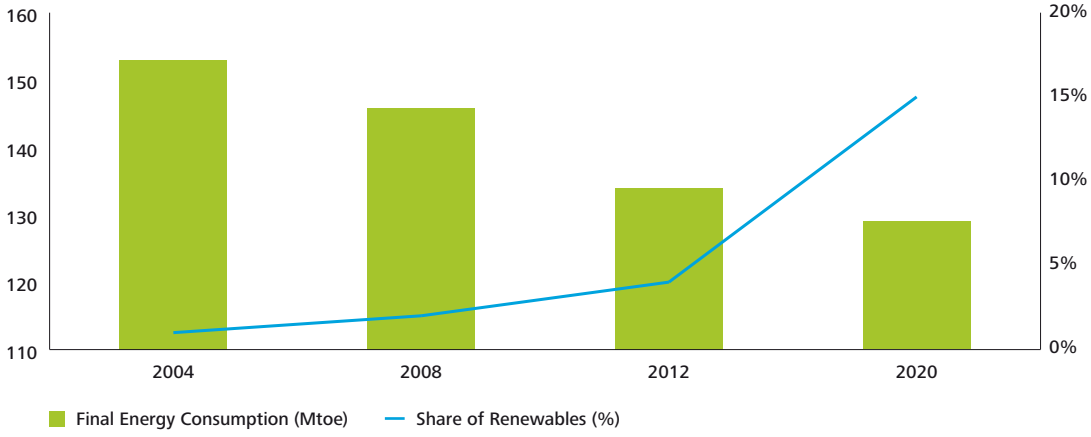
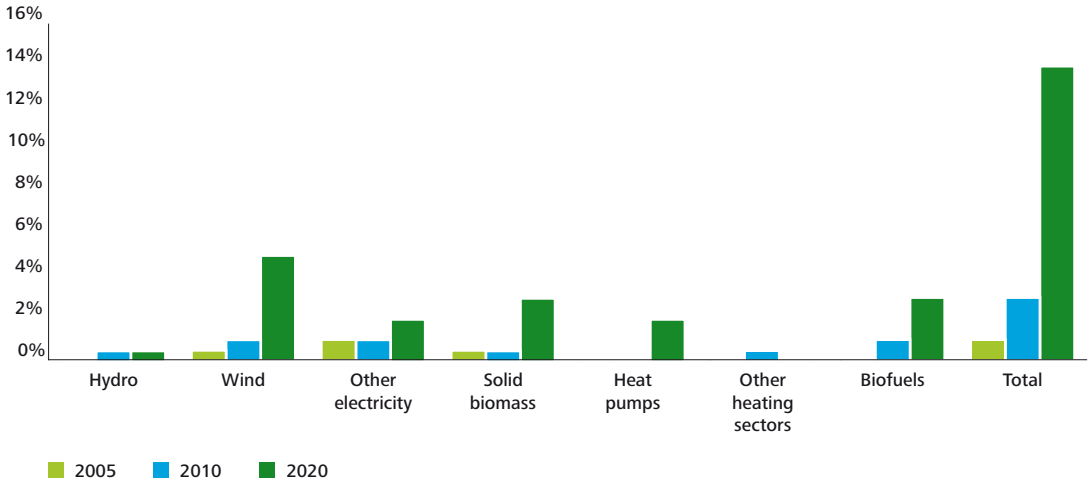


Figure 11. Renewable energy share of final energy use by type, in 2006 and 2011, and target for 2020, in %[16]



12 Source: Eurostat. © European Union, 1995-2015

13 DECC 2013

14 © OECD/IEA 2012 Energy Policies of IEA Countries – The United Kingdom, IEA Publishing. Licence: http://www.iea.org/t&c/

15 Source: Eurostat. © European Union, 1995-2015

16 Source: Eurostat. © European Union, 1995-2015

The renewable target requires an increase of power generation from renewables of around 220 TWh from 2013 to 2020. In 2013, power generation from renewables reached 54 TWh, which represented a 30% increase from the previous year. Between 2012 and 2013, the overall share of electricity produced from renewable sources increased from 11% to 15%, and renewable power capacity increased by 27%, reaching 19.5 GW. The capacity of onshore wind reached 7 GW, followed by biomass electricity (4.9 GW) and offshore wind (3.5 GW).

The **Renewables Obligation (RO)**, which came into effect in 2002, **requires suppliers to source an increasing proportion of their energy from eligible renewable resources**.[17] The system is administrated by Ofgem; it issues Renewables Obligation Certificates which are traded between suppliers and generators to enable suppliers to demonstrate that they have complied with their obligation. In 2017, the RO will close to new low carbon generation projects, and future support will be provided by the contracts for differences introduced through the Electricity Market Reform process. These contracts for differences (CfDs) will provide some revenue stability for low carbon generation and will target a strike price per MWh for generation at a level that will enable projects to be viable. This is intended to reduce the investment risks associated with new low-carbon infrastructure (including new nuclear) and will consequently reduce the cost of capital.

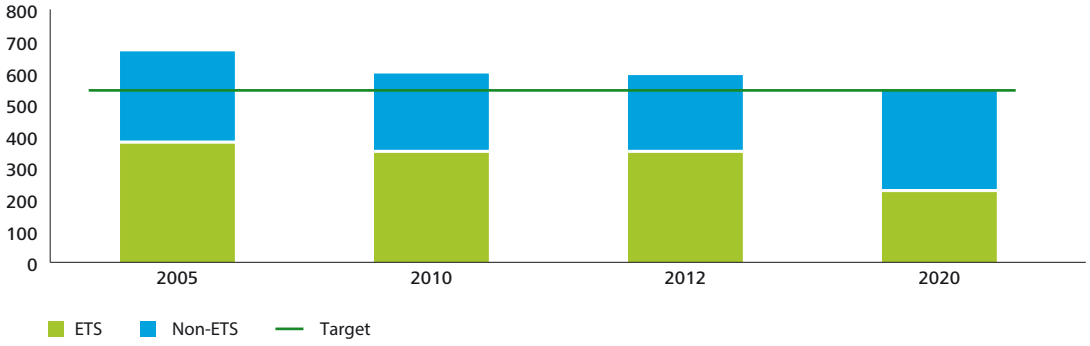
In 2013, 452 MW of renewable electricity capacity was added thanks to the support of feed-in tariffs. The total capacity promoted by feed-in tariffs reached 2.3 GW. The feed-in tariffs differ according to sector and type of installation.

Table 1. 2014 feed-in tariffs (in p€/kWh) and contract duration (years)[18]

	Anaerobic digestion	Wind	Solar	Hydro	CHP
Feed-in tariffs (c€/kWh)	9.02-12.46	3.7-17.78	6.38-14.38	2.99 – 21.12	13.4
Contract duration (years)	20	20	20	20	10

CO_2 emissions and targets

Figure 12. GHG emissions and targets in the ETS and non-ETS sectors and overall target in 2020 (Mt CO_2eq)[19]



In 2005, GHG emissions from the non-ETS sector amounted to 384 Mt CO_2eq. The target is to reduce GHG emissions in this sector by 16% between 2005 and 2020 (i.e. by 64 Mt CO_2eq). In 2012, non-ETS emissions were reduced by 335 Mt CO_2eq compared to a target of 320 Mt CO_2eq in 2020. As such, the UK is on track to achieve its non-ETS target.

17 Eligible sources include wind energy, wave and tidal energy, landfill gas, deep geothermal, hydro, photovoltaics, energy from waste, biomass, energy crops and anaerobic digestion

18 Ofgem 2014

19 European Environment Agency (2013) Trends and projections in Europe 2013 – Tracking progress towards Europe's climate and energy targets until 2020

CO_2 targets: the UK has already met 81% of its 2020 target.

The UK is considered to be one of the world leaders in climate change response, particularly due to the 2008 Climate Change Act which set ambitious targets. There are numerous policies which address climate change particularly as regards pricing policies. This may increase the regulatory burden of compliance.

In addition, the ETS sector in the UK is subject to an EU-wide reduction target of 21% from 2005 to 2020. In 2012, the emissions attributed to the ETS sector were reduced by 16% compared to 2005 levels.

Here too, the UK is well on its way towards achieving its 2020 GHG target.

The UK has considered that both low carbon prices and the fluctuation of EU ETS allowances may not encourage enough investment in low-carbon technologies. To reach its carbon reduction and renewable targets, **the UK government decided to set a carbon price floor (CPF) to provide an incentive to invest in low-carbon power generation**.[20] The CPF came into effect on April 1, 2013 and is calculated based on the price of CO_2 from the ETS and the carbon price support (CPS) rate per ton of CO_2 emitted, which is specific to the UK. This CPS rate applies to fossil fuels used in power generation (gas, solid fuels, LPG, fuel oils). To avoid hindering the competiveness of UK firms, it was decided in 2014 to cap the CPS at a maximum rate of £18/tCO_2 from 2016 to 2020.[21]

Table 2. Rates of the carbon price support (in £/tCO_2)[20, 21]

	Confirmed rates				Indicative rates	
	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
CPS: carbon price equivalent (£/tCO_2)	4.94	9.55	18.08	18.00	18.00 maximum	18.00 maximum

As part of the 2008 Climate Change Act, the UK has set more ambitious targets. These targets are being implemented through carbon budgets which each cover a five-year period. The first carbon budget mandates a reduction of 22% (2008-2012), the second 34% (2013-2017) and the third 34% (2018-2022). Notably, the first carbon budget was met in 2012 when emissions fell 1% below the legislated target. This achievement can be partially attributed to a significant 22% reduction in the economy's carbon intensity between 2000 and 2010 (which is higher than the IEA average, i.e. 17%), as well as to improvements in the implementation of energy efficiency policies in the residential sector, increased power generation from wind, better fuel efficiency in new cars and the economic downturn (5% reduction of GDP in 2009).

20 House of Commons' Library (2014)

21 HM Revenue & Customs (2014)

Road ahead and main challenges: the way to 2030 and beyond

The UK has set ambitious targets to 2050, especially for GHG emissions. It has also implemented ambitious measures, mostly based on market mechanisms to develop renewable energy, decrease energy consumption and reduce GHG emissions, while renewing its power plants to counteract the sharp decline in its fossil fuel reserves.

Energy transition: pressure on electricity capacity

With roughly 20% of existing plants (corresponding to approximately 19 GW) slated to shut down over the next 10 years, the UK's electricity supply and security is at risk. These closures are expected to lower the country's capacity margins and lead to a risk of blackouts during peak demand periods. While these risks are not immediate, they are heightened by the fact that more sporadic (e.g. wind) and less flexible (e.g. nuclear) options are being developed to replace the older polluting plants.

Despite the energy efficiency measures adopted in the country, **electricity demand is expected to increase and may double by 2050**, partially due to the electrification of heat and transport. This rising demand, combined with the UK's ambitious targets on decarbonization, requires a mix of new cleaner technologies and an increase in the efficiency of existing infrastructure assets.

The expansion of power generation capacity is a key component of Electricity Market Reform (EMR). The creation of a capacity market will provide an additional revenue stream for power generators to support the maintenance of a target level of capacity and mitigate the risk of loss if the load is kept at an acceptable level. In fact, the first auction for reserve power capacity took place in December 2014, as part of EMR. The capacity market aims to secure the availability of approximately 50.8 GW of electricity generation capacity, which must remain available for generation during times of system stress throughout 2018/19. The implementation of the capacity market is expected to significantly reduce the risk of costly blackouts.

The development of nuclear energy is a particularly important component of the UK's strategy to meet its GHG targets and to safeguard the security of its energy supply, especially due to the advanced age of the country's power plant stock. The UK plans to invest € 19 billion to build a nuclear plant that will generate around 7% of the country's electricity needs. This plant (built by EDF) will be the UK's first new nuclear plant since 1995. EDF and the UK government agreed on a strike price[22] for the electricity output of £92.50 per MWh and, in October 2014, the UK government agreed to terms with the European Commission for state aid approval of this project.[23] The post-Fukushima concerns on nuclear safety did not affect the UK's plans to construct new reactors. Instead, the UK has put forward improvements on nuclear safety and is simultaneously working to enhance waste management and decommission old plants. Nevertheless, the development of nuclear is subject to significant social barriers (e.g. the selection of sites for the disposal of high-level waste), as well as economic challenges (e.g. the cost effectiveness of nuclear energy compared to low-carbon alternatives).

Overall, it is estimated that new investments in power generation and transmission will reach approximately £110 billion by 2020.[24] This amount is two-times higher than the amount spent during the previous decade. EMR's mechanisms are expected to provide the required financial support, both directly (i.e. direct financing through feed-in tariffs) and indirectly (e.g. by supporting investment certainty). Nevertheless, it is expected that EMR will continue to face opposition on both cost and competitive grounds.

The power generation system is at a turning point.

Old plants (a capacity of around 19 GW) will shut down in the next 10 years. They will be replaced by intermittent (wind) or less flexible (nuclear) plants.

The UK is implementing measures, such as the development of a capacity mechanism, to reduce the risk these changes may raise.

22 This means that if wholesale prices rise above this agreed strike price, payments will be returned to consumers. If they fall below this price, the generator will receive a top-up payment

23 Alex Barker, "UK agrees deal with EU on new Hinkley Point nuclear power plant", *Financial Times*, September 22, 2014

24 IEA (2012) © OECD/IEA 2012 Energy Policies of IEA Countries – The United Kingdom, IEA Publishing. Licence: http://www.iea.org/t&c/

Fossil fuels have historically been a key component of the UK's energy mix and will likely remain so, even if additional investment is required.

Fossil fuels

Oil and gas dominate the UK's energy mix and will remain crucial, at least in the mid-term.

In 2010, the UK produced 117 Mtoe of oil and gas, and ranked 17th worldwide. Although the production of oil peaked during recent years due to rising oil prices, the production of oil and gas in the North Sea is expected to drop in the coming years as reserves fall. **Despite this decline, oil and gas reserves are still expected to support the country's energy security for several years.**

The UK's energy mix has one of the highest shares of natural gas in the EU (in 2010, it comprised 42% of primary energy supply). **The importance of gas is expected to increase as gas-fired electricity plants replace decommissioned coal-fired capacity**. That said, until 2003, the UK was a net exporter of gas; after a peak in 2000, however, production has been declining and the country became a net importer in 2004.

The production of unconventional gas can be expected to reduce pressure on the trade balance. Recently, under the "14th onshore licencing round", the UK government commenced a new round of exploitation and development of shale gas, tight gas, coalbed methane (CBM) and mine vent gas. This came after a three-year suspension of hydraulic fracturing in the country due to seismic tremors. According to the British Geological Survey, a single shale formation in north England contains 37 trillion cubic meters. Nevertheless, securing licences is only the first step of several regulatory measures required before production can begin. As such, **the future share of unconventional gas remains uncertain**.

The continued exploitation of remaining oil and gas reserves will require significant investment. On one hand, the increased recovery from existing reserves offers the potential for higher revenues. On the other hand, the decommissioning of non-producing assets will impose significant costs. At the same time, the growing importance of gas in the energy mix will require significant investment to develop the required infrastructure (gas-fired plants and storage). **These challenges call for more effective initiatives to support the industry and attract the necessary investments.**

Coal also has a significant share of the UK's primary supply (16% in 2012), with a particularly high share of electricity generation (approximately 40% in 2013). According to current projections, domestic hard coal extraction is expected to decrease significantly after 2020 as there are no current plans to develop new coal mines. In addition, ambitious GHG reduction targets, stricter air quality requirements and the decommissioning of old coal-fired mines call for a reduction of coal in electricity generation. That said, coal consumption could get a boost if carbon capture and storage (CCS) becomes a more viable option and as cleaner technologies, as promoted by EMR, are developed. Although coal may be attractive from an energy security perspective, CO_2 emission costs hinder the viability of existing and new plants, limiting the coal-fired capacity that will be available in future.

Renewable energy

To date, the UK has been struggling to meet its renewable energy targets in a timely manner. Nonetheless, significant efforts are being made to accelerate the uptake of renewables. For instance, the UK is already a world leader in offshore wind, with two GW installed in 2012, and projections of up to 16 GW by 2020 and 39 GW by 2030. These efforts still need to increase significantly for the UK to meet its renewable energy target. To this end, the country is reviewing its payment schemes. At the same time, the ERM support mechanisms to increase the share of renewables in power generation, and particularly the CfD feed-in-tariff model, are expected to heighten investment certainty and contribute significantly to this effort. The Carbon Floor Price will also make low-carbon electricity (including electricity generated from renewables) more attractive and competitive.

Recently, the UK has made significant progress in meeting its ambitious renewable energy targets. Yet there are still significant uncertainties hindering the development of renewable energy.

Nevertheless, major difficulties remain, particularly in the heating sector. The ambitious target of 12% stipulated by the Renewable Heat Incentive will require significant changes in consumer behavior. In addition, the 10% target in the transport sector largely relies on biofuels, for which incorporation rates remain unsure. **This creates uncertainties in terms of sustainable performance, particularly with regards to the land use changes caused by the deployment of biofuels.**

GHG emissions

The UK has set the ambitious target to reduce GHG emissions by 80% between 1990 and 2050. This requires a significant transformation of the energy sector, together with a massive decarbonization of electricity generation. The energy efficiency measures also play a particularly important role in meeting this long-term target.

The carbon budget mechanism which sets reduction targets well in advance supports investment certainty. The country has also set financing mechanisms to improve energy efficiency in various sectors, such as the Green Deal, which supports retrofit works in buildings, and initiatives to promote Ultra-Low Emissions Vehicles (ULEVs).

Nonetheless, climate change is addressed by a large number of measures and this increases the regulatory complexity and burden. In addition, the UK has committed to commercializing CCS in power generation and energy-intensive industries in the next decade, to meet its ambitious targets in a cost-efficient manner. In addition to setting up a £1 billion capital fund, the UK government is providing operational funding through EMR. **CCS pilots are already underway, but the commercial viability of CCS remains uncertain**.

The UK government identifies policy areas where further improvements and, in some cases, extended funding are required. These areas include **energy efficiency, electrification of heat and transport, and the decarbonization of power generation**.

Conclusion

The UK will face significant challenges in the coming decades, most notably in the following areas:

- Reducing the indigenous production of oil and gas
- Securing new generation capacity to replace the one-fifth of its power capacity that will be decommissioned by 2020
- Meeting ambitious GHG reduction targets by transitioning to low-carbon power generation, commercializing CCS and improving energy efficiency

These challenges require significant investments, the establishment of investor certainty and significant flexibility to respond to changes in energy projections.

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