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Energy market reform in Europe

European energy and climate policies: achievements and challenges to 2020 and beyond

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Executive summary

For more than 20 years, the European Union has consistently been at the forefront of global action to combat climate change. It has developed ambitious energy and climate policies, including the target of reducing its greenhouse gas (GHG) emissions by 80% by 2050. In a century where the environment will be challenged and the price of energies will be high, the EU's view is that the winners will be energy-sober and low-carbon economies.

As an interim step for 2020, the EU set a number of ambitious climate and energy targets known as "20-20-20 targets by 2020" or the "3 x 20" policy. This included pledges to reduce GHG emissions by 20% from 1990 levels, raise the share of EU final energy consumption[1] produced from renewable resources to 20% and improve energy efficiency by 20%. This 3 x 20 package is part of a wider European energy strategy aimed at achieving energy sustainability, competitiveness and affordability, and security of supply.

The EU energy and climate package has attracted criticism in recent years, however, for failing to bring the expected results and for having had numerous unexpected, or unintended, impacts on energy markets and the industry.

3 x 20: Are we going to make it?

Many countries are on track to meet their 3 x 20 targets and the EU-28 as a whole has made considerable progress towards realising the objectives. But whether this is mainly due to dedicated policies or to external factors is highly questionable. **The economic crisis has meant achievements look better than they otherwise might** in countries such as Italy, the Netherlands and Spain because the crisis has reduced the demand and consumption levels against which the targets are measured.

Any improvement in EU business activity could rapidly push CO_2 emissions up and reverse the good trajectory that most countries seem now to be on. Nuclear phase-outs and a potential rise in coal-fired capacities are creating uncertainties that could also make the achievement of the CO_2 target problematic as 2020 approaches.

Today, **it is hard to see** how the objective of reaching 20% of renewable energy use in final consumption **will be met: major EU economies (including France and the UK) still need to make significant efforts to meet their targets**. In addition, since the final REN target for 2020 is expressed as a percentage of final energy consumption in 2020, r**eaching the renewable energy target will depend critically on** the denominator of the ratio, i.e. **final energy consumption in 2020**, something which it will not be possible to determine until after 2020.

Moreover, **policies supporting renewable energies have been very costly**: in Germany, the renewable energy sector is currently subsidized with approximately EUR 19.4 billion per year (EUR 240 per inhabitant in 2014[2]); and in France, the global cost for the support of renewables in power production is estimated to be around EUR 40.5 billion for the 2012-2020 period[3]. Some of these costs still lie ahead of several Member States and will further increase tariffs in the future. And, last but not least, **the foreknowledge of this cost overhang and the decrease in public sector expenditure in the aftermath of the 2008 economic crisis have slowed progress in this area**.

The bases for measuring the energy efficiency objectives are so variable that it will be hard to say whether the target has been met or not. Currently, EU energy efficiency targets are expressed in all sorts of ways for each Member State, using different units, based on different assumptions and with varying levels of ambition. The relative targets expressed in energy savings are most often calculated ex post. In a nutshell, it took a long time to define criteria which are difficult-to-understand and measure and may not be met in the end. The key question is whether they are going to reduce EU energy consumption or the EU economy's energy intensity other than as a result of economic contraction.

Unintended outcomes in the power sector

Taking a closer look at the power generation sector, we can see that some outcomes of the 3 x 20 policy in this sector have been unintended. They have produced results which were sometime counter-productive, thereby exposing the whole climate policy to general criticism.

The 3 x 20 targets have, overall, contributed to **distorting electricity markets**. In a context of sluggish demand, the development of renewables has been driven by policy support and incentives, rather than by supply and demand adequacy, and market signals.

Abundant electricity supplies on the market have sent the wholesale price of electricity to record lows, thereby driving producers to mothball new gas-fired capacity.

1 See the definition in the 'List of acronyms' part, at the end of the document

2 http://www.wiwo.de/politik/deutschland/trotz-reform-verbraucher-werden-2015-eine-milliarde-euro-mehr-eeg-umlage-bezahlen/9414526.html

3 Cour des comptes (2013) – La politique de développement des énergies renouvelables – juillet 2013; http://www.ccomptes.fr/Publications/Publications/La-politique-de-developpement-des-energies-renouvelables

This has resulted in significant **overcapacity in arithmetic terms. At the same time, several electricity TSOs** (e.g. the UK and France) **have pointed to the risk of blackouts,** the intermittent capacity has crowded out conventional capacity and investments in new cross-border interconnections have been neglected.

Furthermore, **the decrease in wholesale prices has not made consumers better off either**. End-user prices for electricity paid by companies and households have increased over the last decade in real terms, because – *inter alia* – of the impacts of passing on to customers the high costs of the policies required to support renewable energies.

Have we ticked the three boxes of EU energy strategy?

- **Sustainability:** the EU has **considerably reduced its energy intensity** and has **decreased its carbon intensity**; the 3 x 20 targets should be achieved in a lot of countries, but this is to a significant extent because of the economic crisis;

- **Affordabilityh prices to end-consumers rose by nearly 20%** between 2008 and 2012, while wholesale electricity prices dropped by 35-45% over the same period; and

- **Security of supply:** the **energy dependence of the EU on foreign sources of supply has increased slightly** (reaching 53% in 2012, versus 52% in 2005 and 43% 20 years ago), but gas imports have had to make up for a domestic resource base that is contracting.

What has gone wrong?

- **The world has changed since the EU 3 x 20 policies were agreed:** the EU energy context has not unfolded in the way that was anticipated at the outset; the economic crisis was not expected; it caused a significant slowdown in global activity and prompted a downward review of public budgets;

- Some potential for improvement has developed less rapidly than initially expected, such as second generation biofuels or CCS (Carbon Capture and Storage), demand side response, energy efficiency in buildings etc.

- **The carbon market did not help:** the over-supplied Emissions Trading System (ETS) failed to send the right price signals to promote low-carbon technologies; the "fuel-switching" carbon price today, i.e. the carbon price, which would make it a matter of indifference whether to burn gas or coal for power generation, is in the EUR 35-45/tonne of CO2 range, a long way away from the current carbon market price of EUR 6-7/tonne; and

- **Energy policy is still a patchwork of national policies,** with limited, if any, coordination on energy mix or generation adequacy, creating energy tax based competition between Member States to protect their energy intensive industries.

Nevertheless, it is important to note that the **EU is the only great economic power in the world that is adopting a new economic model that is less carbon-intensive and more renewables-oriented**.

The road ahead and the main challenges: the path to 2030 and beyond

Many roadblocks still need to be overcome. The EU is far from achieving the carbon and energy revolution. The EU has recently decided upon new policy measures, including updated targets for 2030. **This 2030 Framework aims to address four current failures of the 3 x 20 policy actions:**

- The long-term climate objective of reducing GHG emissions by 80-95% in 2050 compared to 1990 is unlikely to be met based on current trends;

- Long-term security of energy supply remains an issue due to continuing energy import dependence;

- The energy system needs significant investments in renewables, interconnections and energy efficiency: the EC wants to send the right signal to investors in order to restore confidence and reduce regulatory risk; and

- The EU needs to achieve energy cost reduction and competitiveness.

Even though the 2030 Framework may alleviate some of the difficulties we have outlined, more challenges lie ahead:

- **The EU needs to revisit its energy market design: energy-only markets have failed to deliver a price signal that provides incentives for investment,** especially in countries with large shares of renewables with zero marginal costs. A European-wide capacity market is critical for solving the energy "trilemma" of delivering green, reliable electricity for the future at the lowest possible cost. **This implies further development of cross-border connections and more coordination amongst national Transmission System Operators (TSOs).**

- **Renewable targets versus affordability: how can we reach REN targets without pushing energy prices up for consumers? The EU needs** to find alternative ways of financing smart grids, energy efficiency and renewables while **integrating them fully into a competitive market, without leaving the burden mostly borne by household and SME electricity bills:** feed-in premia, tax incentive mechanisms, systems of Energy Investment Allowances, or a carbon price floor are among the options.

- **Are we going to fix the ETS market and have a market mechanism that produces the right price of carbon?** This must start with elimination of the credit surplus. The proposed reforms, including a "backloading" of emission quotas, the creation of a market stability reserve to be used as a "credit buffer" to regulate the price after 2020, and a CO_2 reduction target increase from 1.74% annually to 2.2%, are to take place only from 2021 onwards. **This is too late to have a carbon price constituting a driver for low-carbon technologies by 2020. Nevertheless, the ambitious 2030 GHG emissions targets** (-43% between 2005 and 2030 in the ETS sector) **should at last push the carbon price upward.** EU lawmakers are perhaps optimistic about the 2030 GHG emissions objective in believing that the EU Member States will be able to reduce their emissions collectively by another 20% in ten years from 2020, given that it took almost 30 years to reduce carbon levels to under 20%, and this was against a backdrop of severe economic contraction.

- **The potential for greenhouse gas emissions reduction in non-ETS sectors** (which represented around 60% of the European greenhouse gas emissions in 2013[4]) **seems to have been underutilised until now, especially in transportation, buildings and forestry.**

4 EEA (2014), Trends and projections in Europe 2014

- **Carbon, renewables and energy efficiency: do we need so many objectives?** Multiple targets create a very complex regulatory context with little visibility, both for investors and final energy consumers. This is relatively burdensome and in some instances may be counterproductive. **There is a case for sticking to a single GHG emissions reduction target rather than multiple targets, including for renewable energy and energy efficiency. Countries and markets would then select the technology they think makes more sense or with a better cost-benefit ratio. This could be a more efficient route to a low-carbon and innovative economy in Europe.**

- **To what extent can technology be part of the solution? One of the biggest challenges ahead may be the role that trends in technology and behaviour will be able to play to alleviate the burden required to meet the ambitious targets for 2030 and 2050.** Expectations were high in this regard when the initial targets were set. While we may have witnessed a few breakthroughs (e.g. solar PV), few successes were in sight until this decade despite the political ambitions and the millions of euro spent on research and development (R&D) (e.g. on carbon capture and storage and second generation biofuels). However, over the last few years, things may have begun to change; technological and behavioural innovation has begun to take off. Examples are hybrid and electric vehicles, car sharing, smart meters and smart grids, all of which pave the way for a better demand-side energy management etc.

According to official *ex ante* evaluations by the EC, the benefits of saving energy and resources as the single path to achieving a carbon-free society would by far exceed the cost of the investment requirements. Given the very high costs involved, it would be worthwhile to reassess this ex ante evaluation regularly, once the costs and benefits can be evaluated *a posteriori* – and to adapt policies, if necessary, before they lead us once more into unexpected and unwanted territory.

Introduction

Since the 1992 Earth Summit in Rio and the negotiation of the United Nations Framework Convention on Climate Change (UNFCCC), **the European Union has consistently been at the forefront of global action to combat climate change**, leading the world to a low-carbon economy. The EU has set itself greenhouse gas emission targets designed to produce an almost carbon-free economy by 2050 in order to make a major contribution to limiting the global temperature increase by the end of the century to 2°C, compared to the pre-industrial average.

As an interim step on the way to 2050, EU leaders in March 2007 set a number of ambitious climate and energy targets known as the "20-20-20 targets by 2020" or the 3 x 20 policy. In this, the EU committed to:

- A **20% reduction in EU greenhouse gas emissions** from 1990 levels;

- Raising the **share of EU energy consumption produced from renewable resources to 20%**; and

- A **20% improvement in the EU's energy efficiency**.

This 3 x 20 package is a part of a wider European energy strategy[5] that aims at enhancing:

- Sustainability;

- Competitiveness and affordability; and

- Security of supply.

The EU energy and climate package has attracted criticism in the last few years, as each day brought more evidence that the policy measures had **numerous unexpected, or unintended impacts on the energy markets and industry:** an excess of intermittent sources of electricity causing disruption for grid operators, surplus electricity resulting in a price collapse of the wholesale electricity market, electricity price increase at retail level, exit of gas from the fuels for power generation and the advent of coal as an electricity price-setter… At the same time, it has also become evident that EU policy has failed to solve the existing EU energy imbalances in general. Ironically, after years of huge investments aimed at achieving the ambitious policy targets, **a number of the objectives still seem to be a long way away**. Indeed some may not even be reached, although the economic crisis has placed them within easier reach.

This study aims to:

- Evaluate the **current achievements of the EU** and a few selected Member States in meeting the **3 x 20 targets** on greenhouse emissions, renewables and energy efficiency;

- Analyse **why EU policies did not live up to expectations in terms of achieving** a more secure, consistent, competitive and ultimately cleaner energy market; and

- Identify the **main challenges on the way to the post-2020 (2030 and 2050) policy targets** in the context of the EU's ultimate goal of achieving "affordability, sustainability and security of supply".

Our study is based on **global analysis at the European level and on more detailed analyses for seven countries (Belgium, France, Germany, Italy, Netherlands, Spain and UK)**. These are provided in seven dedicated country profiles (available in the appendix) in which Deloitte member firms present their view of where each country stands in achieving the 3 x 20 targets, the policies implemented and the remaining challenges.

5 See, for instance "Energy Roadmap 2050 [COM/2011/885]", "Energy 2020: A strategy for competitive, secure, and sustainable energy [COM(2010)639]", etc.

3 x 20: Are we going to make it?

1. Energy and climate 2020 targets, an interim target en route to 2050

With the emerging economies' insatiable thirst for fossil fuels showing no signs of subsiding and the rise of unconventional hydrocarbon resources, notably the shale oil and gas boom in the US, the geopolitical order of the energy world keeps changing. In the meantime, **Europe has embarked upon an unprecedented move towards a low-carbon economy, turning its back on the rest of the world**.

For Europe, generating its own renewable-based energy has considerable merit: it mitigates its excessive dependence on outside sources and it gives Europe control over production costs whilst severing (or weakening) the impact of oil prices on the European economies. The policy intention of developing large-scale renewable capacities not only opens up the prospect of a greener world. For EU leaders, it also solves the long-standing geopolitical weakness of Europe as a net energy importer vis-à-vis the resource-rich regions of the world.

Furthermore, **the EU's leaders have developed the view that the move to a low carbon economy will ensure sustainability and cost competitiveness over the mid to long-term for European business:** with the increasing development of carbon pricing mechanisms, this will penalise Europe's carbon intensive competitors.

European energy policy action is driven by the four guiding principles defined by the Treaty of Lisbon 2007[6]:
(a) ensure the functioning of the energy market; (b) ensure security of energy supply in the Union; (c) promote energy efficiency and energy saving, and the development of new and renewable forms of energy; and (d) promote the interconnection of energy networks.

The EU authorities have translated this strategy into the following regulatory and policy objectives:

- Creating an **EU-wide integrated energy market**, through the development of optimised use of interconnections, as a guarantee of price transparency and cost efficiency;

- Achieving **security of supply** through an energy efficiency and renewable energy development policy, with a view to solving Europe's long-standing, excessive dependence on outside sources as well as keeping control over production costs in the face of dwindling EU hydrocarbon reserves and rising imports; and

- Moving to a **sustainable** low-carbon economy by reducing carbon emissions and increasing the use of renewable sources in order to achieve sustainability and price competitiveness, thereby weakening the impact of oil prices on the European economies.

The 2050 Energy Roadmap published in March 2011, which charts indicative pathways for EU Member States to move to a low carbon economy[6], eventually leads to an unprecedented **80% reduction in GHG emissions compared to the 1990 baseline**. This is an objective which some EU countries have already incorporated into national laws.

In addition, several interim targets have been defined between now and 2050.

6 Article 194 of the Treaty on the functioning of the European Union as amended by the Treaty of Lisbon 2007. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012E/TXT

Figure 1. European targets for 2020, 2030 and 2050 versus 1990 levels, or versus 2005 levels[7,8]

	2020[(a)]	2030[(a)]	2050[(a)]
Increase in energy efficiency	20%	30%	TBD
Share of renewable energy	20%	27%	TBD
Reduction in greenhouse gas emissions	20%	40%	80 – 95%
Emissions Trading System (ETS)	21%[(b)]	43%[(b)]	TBD[(b)]
Non-ETS sectors	10%[(b)]	30%[(b)]	TBD[(b)]

[(a):] Comparison with the 1990 levels [(b):] Comparison with the 2005 levels

In January 2014, the EC proposed **a new framework up to 2030** which aimed to assess the 20-20-20 policy achievement, coordinate Member States' action and give investors highly needed reassurance. The 2030 targets include a **carbon emission abatement to arrive at a 40% reduction compared to 1990 levels**, a **27% share of renewables in final energy use** (binding at European level) and **energy savings of at least 27%** (this target being indicative). These were agreed upon by EU leaders in October 2014.

2. The 20-20-20 Member State achievements

In March 2014, European Commission President, José Manuel Barroso, speaking to the European Council, underlined that the EU as a whole was on its way to meeting, or exceeding, the 3 x 20 targets with an estimated reduction of 24% in greenhouse gas levels by 2020 and a share of renewables of 21%, and a reduction in energy consumption of 17%.

However, the situation varies considerably across Member States. Before looking at this more closely, however, it is important to understand how the targets per Member State were arrived at.

a) Reduction in greenhouse gas (GHG) emissions

How was the greenhouse gas emissions target defined per Member State?

The greenhouse gas emission reduction targets at EU level are consistent with the undertakings of the EU under the Kyoto Protocol to the UNFCCC, i.e. a 20% cut below 1990 levels by 2020. However, each EU Member State has individual CO_2 reduction targets. These were agreed by the European Council.

They vary markedly from one to another in line with the Effort Sharing Decision (ESD)[9], but are consistent with the EU's global obligation under the 3 x 20 package.

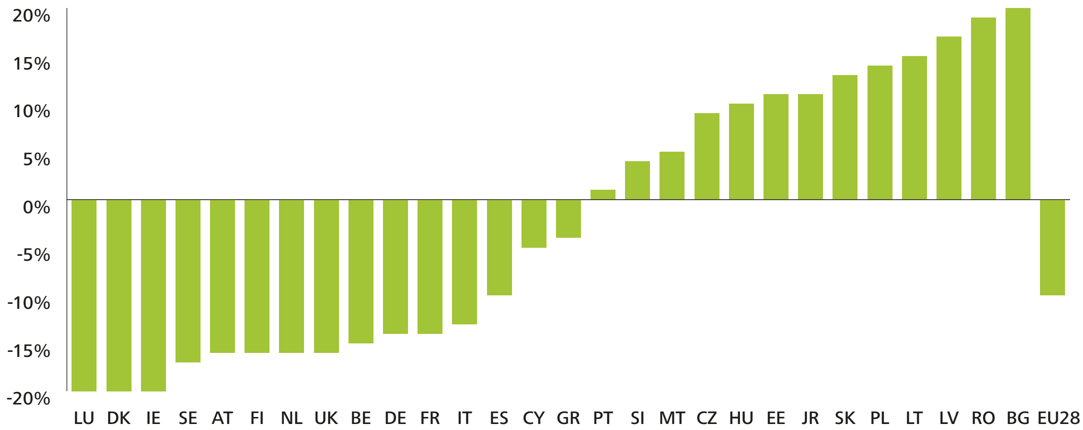
7 For the definition of the "ETS", see below.

8 Source: http://ec.europa.eu. © European Union, 1995-2015, these targets were made public by the European Commission:

- http://ec.europa.eu/energy/en/topics/energy-strategy
- https://ec.europa.eu/energy/sites/ener/files/documents/energy.pdf
- http://europa.eu/legislation_summaries/energy/index_en.htm

9 Source: ©European Union, http://eur-lex.europa.eu/, 1998-2015, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2009.140.01.0136.01.ENG

Figure 2. GHG emission reduction national targets in the non-ETS sector, compared to 2005 levels[10]



By 2020, the national targets will collectively deliver a reduction of around 10% in total emissions from the non-ETS sectors (CO_2 emissions from sectors outside the Emissions Trading System) and a 21% reduction in emissions for the sectors covered by the ETS (both compared to 2005 levels).

In 2013, according to the European Environment Agency (EEA), all installations covered by the EU ETS emitted 1,908 $MtCO_2eq$, which represents about 40% of total GHG emissions[11]. More ambitious reduction targets were set for the ETS sectors than for the non-ETS sectors partly because the ETS sector is more concentrated (a relatively low number of major industrial installations), and partly not to penalise the industrial development of new Member States in particular. The split between ETS and non-ETS GHG emissions varies greatly amongst Member States and so do national reduction targets.

In the non-ETS sector, targets range from -20% for Denmark and -17% for Sweden, to +14% for Poland and +20% for Bulgaria. Several policy measures are tackling GHG emissions from transport. The Fuel Quality Directive (FQD)[12] requires that transportation fuel suppliers reduce life cycle greenhouse gas emissions per unit of energy from fuel and energy supplied by up to 10% by 31 December 2020.

Additionally, a 2009 Regulation[13] set CO_2 emission limit values for new cars: it set legally-binding emission targets for new cars (fleet average) of 130 gCO_2/km by 2015 and of 95 gCO_2/km by 2021.

In the ETS sector, targets are set by way of a GHG emission quota allocation for each industrial site covered. As a result, ETS abatement is not reported at national level, but at manufacturing sector level or globally at EU level. Any European citizen will find it hard to understand the rationale behind the ETS objectives at EU Member State level: a country like Poland, with more than 90% coal-based electricity, is allowed to increase its emissions whilst Sweden, which is almost half hydro and half nuclear, is committed to reducing its emissions by 17%. The main rationale behind ETS objectives, when they were decided upon at national level in 2005, was to allow Eastern European countries to catch up with the West and avoid impeding their economic development.

EU Emissions Trading System (ETS)

Launched in 2005, the **EU ETS (Emissions Trading System)** is the cornerstone of the European Union's drive to reduce its **emissions of greenhouse gases (GHG)**. It covers more than 11,000 power stations and manufacturing plants in the 28 EU Member States as well as Iceland, Liechtenstein and Norway. Aviation operators flying within and between most of these countries have also been included since 2012. In total, around 40% of total EU emissions were limited by the EU ETS in 2013[14]. In 2020, emissions from sectors covered by the EU ETS are due to be 21% lower than in 2005. By 2030, the Commission proposes that they be 43% lower.

10 Source: http://ec.europa.eu. © European Union, 1995-2015, European Commission, chart available here: http://ec.europa.eu/clima/policies/effort/index_en.htm

11 EEA (2014), Trends and projections in Europe 2014

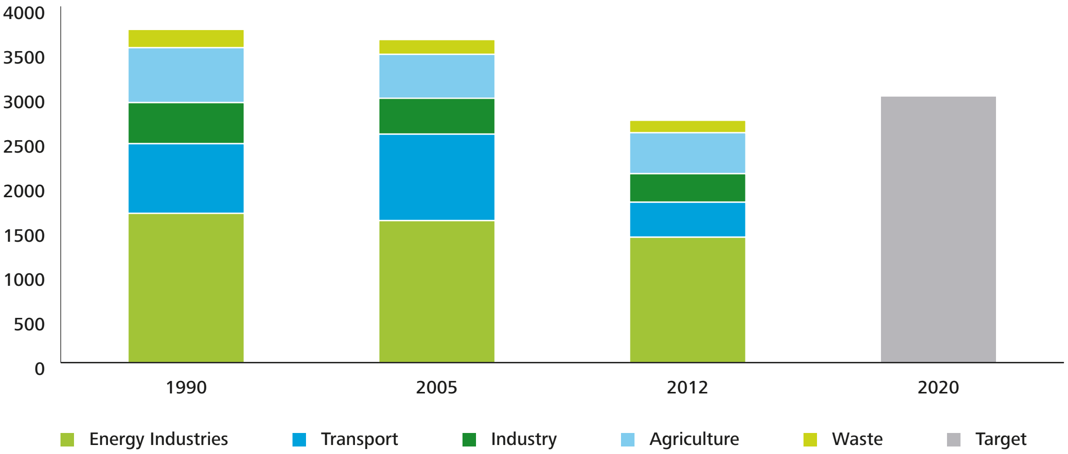
12 Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0030)

13 Regulation No 443/2009 of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles

14 EEA (2015), Trends and projections in Europe 2014

Where do we stand with greenhouse gas emissions targets?

Figure 3. EU-28 GHG emissions by sector, 1990-2012, and 2020 target ($MtCO_2eq$)[15]



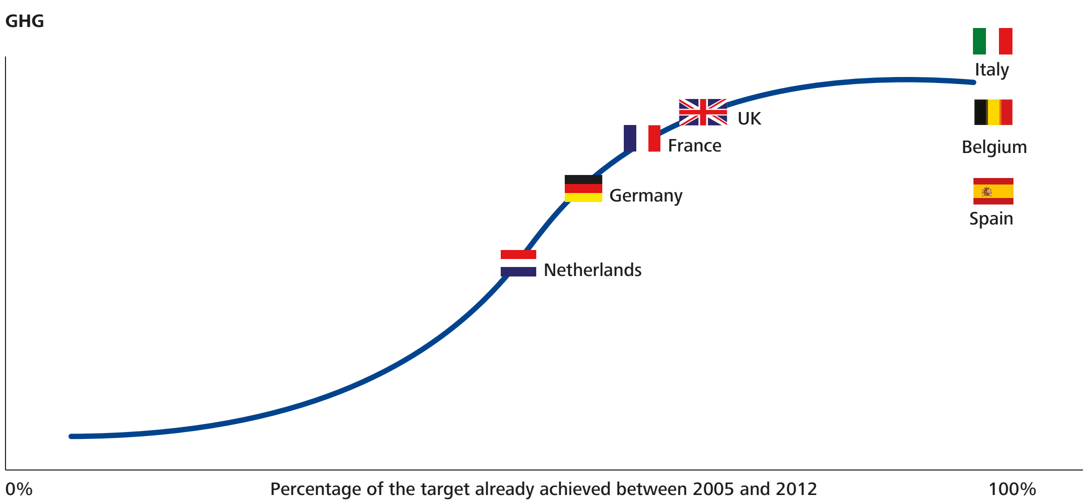
The EU-28 are well on their way to meeting their overall GHG emissions target, especially thanks to a reduction in emissions during the last few years: GHG emissions decreased by 3% in the 15 years between 1990 and 2005, and by 11% in the seven years between 2005 and 2012. A reduction of 7% is still needed between 2012 and 2020.

The graph below measures the positions of our EU Member State sample relative to each other. It depicts the results achieved by each country in meeting their 2020 objective and the distance each still has to go.

Partly due to the economic crisis, three countries (Belgium, Italy and Spain) have already met their GHG emission targets. The UK and France seem to be well on the way to reaching theirs, but there is a high level of uncertainty still about Germany and the Netherlands.

As of 2012, the Netherlands was till 53% short of the target. However, there was a significant decrease in non-ETS GHG emissions in 2013 (from 117 $MtCO_2eq$ in 2012 to 108 $MtCO_2eq$ in 2013).

Figure 4. Percentage of the GHG emission target already achieved between 2005 and 2012 for seven countries[16]



15 EEA GHG emissions Data Viewer

16 This percentage of achievement is calculated as the ratio between the “current” distance to target (i.e. the distance to target between 2012 and 2020) and the “initial” distance to target (i.e. the distance to target between 2005 and 2020). The calculations are based on the data presented in the country profile of each of the seven countries. These country profiles are available in appendix.

In Germany, the phasing out of nuclear power combined with the commissioning of more coal fired capacity could lead to a notable increase in CO_2 emissions, thus jeopardising reaching the GHG emission target.

According to the European Environment Agency (EEA)[17], a comparison of national non-ETS GHG emissions in 2013 relative to the indicative 2013 target (calculated on the basis of a linear decrease between 2005 and the 2020 target) shows that most countries have reached their target. The exceptions are Germany, Luxembourg and Poland.

Figure 5. Reducing greenhouse gas emissions: achievements in seven countries in 2012

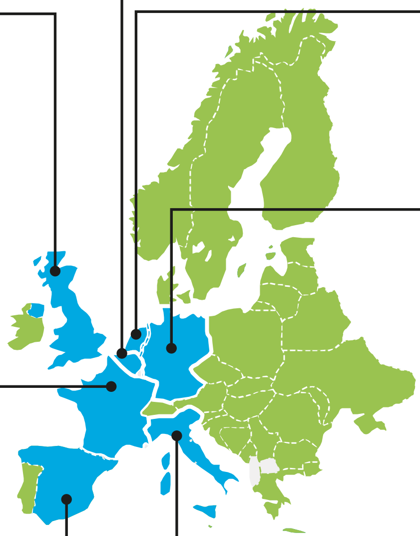
Greenhouse gas emissions

UK:
- 81% of the objectives already achieved in 2012.
- Under the 2008 Climate Change Act, the UK has set highly ambitious targets in a bid to be a champion in the fight against climate change.
- Numerous policies affect energy pricing mechanisms, including Carbon Price Floor.

Belgium:
- In 2012, GHG emissions were already below the 2020 target but emissions might rise.
- The nuclear phase-out might prove to be counter-productive to keep carbon and energy prices, low.

Netherlands:
- 47% of 2020 target met in 2012.
- Will need a number of additional measures to meet 2020 targets.

France:
- 76% of the target already achieved in 2012.
- With its large nuclear and hydro power base, the 2020 GHG emissions target for France seems reasonably attainable', especially in the ETS sector.
- In the non-ETS sector, reaching the target mostly depends on energy efficiency measures applied to buildings and Light Duty Vehicles as well as the development of more renewables.



Germany:
- Already 62% of target achieved in 2012, but GHG emissions are on the rise.
- Emissions have gone up since Germany shut down eight nuclear plants in 2011.
- With its planned phase out of nuclear power, its high dependence on coal and 11.5 GW of coal plants under construction, it is highly questionable if the remaining 38% of CO_2 reduction can be achieved by 2020.

Spain:
- In 2012, GHG emissions were below the targets for 2020, because of the economic contraction.
- Achieving targets could prove problematic if the economy picks up.

Italy:
- 2020 target already over-achieved in 2012, partly because of the economic crisis.
- But Italy committed to more ambitious emission reduction targets.
- Additional reductions in GHG emissions are expected through energy efficiency and renewable energy measures.
- Economic recovery might result in an emissions increase.

17 EEA (2014), Trends and projections in Europe 2014

The EU-28 are well on their way to meeting their overall GHG emissions target, especially thanks to a reduction in emissions during the last few years.

However, the key challenges in greenhouse gas emissions reductions in the next few years will be:

- **Economic recovery:** It should be borne in mind that the relative success of a few EU Member States in reducing their carbon emissions is a result which was made easier by (if not entirely attributable to) the sharp economic decline resulting from the financial crisis. A European economic recovery could wipe out part of the GHG emissions reductions that have already been achieved.
- **Nuclear phase-out:** Several European countries have decided during the last few years to phase out nuclear power, either completely or partially. Most substitutes for this carbon-free generation technology are likely to generate an increase in carbon emissions.
- **Coal dilemma:** The low cost of generation and plentiful supply are tempting to investors, but coal has a high environmental impact and most CCS (carbon capture and storage) projects have stalled, or have been cancelled.

b) Share of renewable energy in final energy consumption

How was the REN target defined per Member State?

The Renewable Energy Directive (RED)[18] sets legally binding individual targets for each Member State (art. 3.1). **Individual targets differ considerably from one country to another.** They are however consistent with a 20% share of energy from renewable sources in final energy consumption at European Union level in 2020. They range from 11% for Luxembourg to 30% for Denmark and even 49% for Sweden, where the share of renewable energy use is already high, however for Germany it is only 18%.

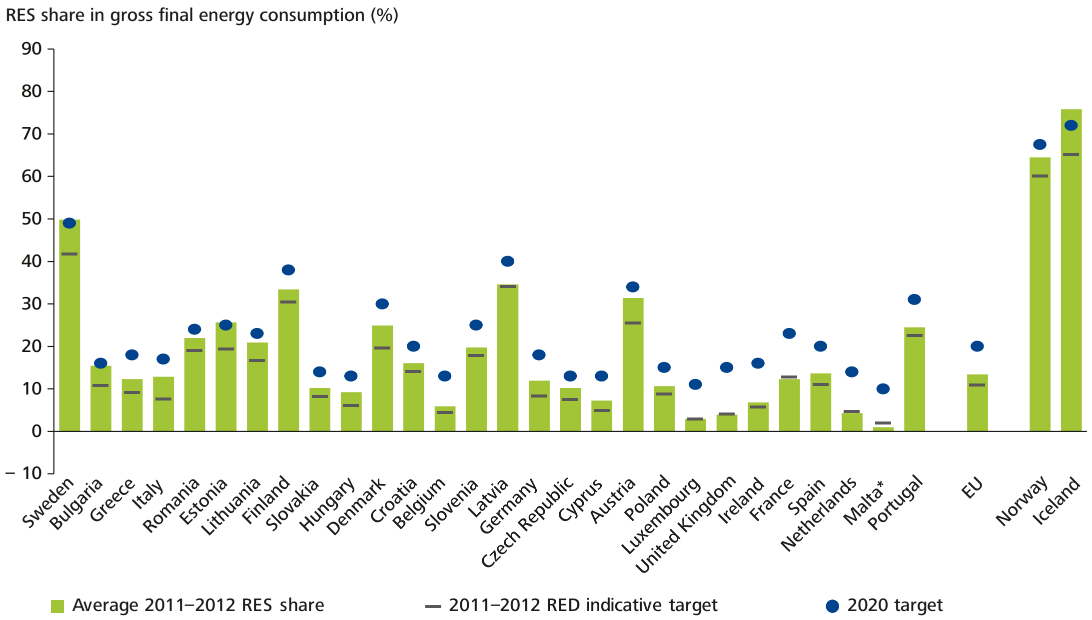
The rationale for these differentiated objectives reflects the diversity of national energy mixes and the potential for development of renewable energy sources across the EU, the discrepancy in economic development of Eastern and Western Europe, as well as the capital investment which would be needed to meet these policy targets. But the RED also sets a target for the share of energy from renewable sources in transport in 2020, which is identical for all Member States: at least 10% of the final consumption of energy in transport (art. 3.4).

It is worth noting that the REN target is expressed as a percentage of final energy consumption in 2020. **As a consequence, the percentage of REN will critically depend on the denominator of the ratio, which is final energy consumption in 2020. The latter will not be determined until after 2020.**

Where do we stand with the renewable energy target?
At EU level, the target is for renewable energy to account for 20% of the overall energy consumption mix by 2020 (vs. 8.7% in 2005 and 14.0% 2012).

18 Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Figure 6. RES[19] share in gross final energy consumption (%)[20]



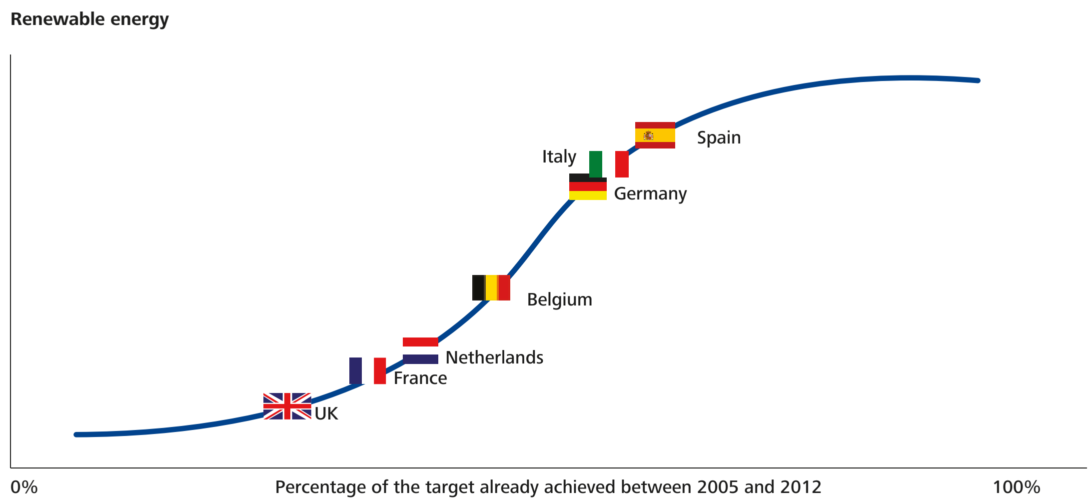
The figure above compares the share of renewable energy sources in final energy consumption in 2011-2012 with the targeted share in 2020.

The picture is different if we compare the efforts made by individual countries between 2005 and 2012 with what needs to be done between 2005 and 2020, as the graph below shows.

This figure makes it possible to visualise the achievement between 2005 and 2012 and the effort to be made between 2005 and 2020. **France, the Netherlands and the UK need to make an additional effort equivalent to increasing their existing (non-hydro) renewable energy share in final energy consumption by 50%, 220% and 320%** respectively.

Despite all of its efforts to develop and finance renewable electricity generation, **a country like the Netherlands needs to decarbonise its energy mix by 5 Mtoe**, essentially through offshore wind development. This is equivalent to 60 TWh of renewables or more than 20 GW of wind capacity.

Figure 7. Percentage of the renewable energy target already achieved between 2005 and 2012 for seven countries[21]



19 RES stands for Renewable Energy Source

20 Figure extracted from: EEA (2014), Trends and projections in Europe 2014, available online on: http://www.eea.europa.eu/publications/trends-and-projections-in-europe-2014

21 This percentage of achievement is calculated as the ratio between the "current" distance to target (i.e. the distance to target between 2012 and 2020) and the "initial" distance to target (i.e. the distance to target between 2005 and 2020). The calculations are based on the data presented in the country profile of each of the seven countries. These country profiles are available in appendix

With its large hydropower base, France already had a high Renewable Energy Source (RES) share in 2005. However the distance to the goal, which will inevitably have to be covered by developing the non-hydro base, is significant. It will be a challenge for France to reach the 2020 target. **France needs to increase its carbon-free share of final consumption by 11 Mtoe/year. This represents over 70% of the efforts to be achieved** under the 2020 renewables target. With its vast biomass and wood potential, and forestry industry, **France** is under-utilising a major potential source of REN development and job creation. If France is to meet its target, the deployment of a "biomass-to-heat" industry on a large scale (target: +8 Mtoe between 2011 and 2020) could be an important contribution, especially if it is to keep its cogeneration capacity afloat. This is conditional on enough biomass being available, as access to biomass has often been a major hurdle in development for heating projects. Additionally, the development of onshore wind power is hindered by the administrative permitting process.

The UK is in an even worse situation in relation to the 2020 target, with as much as 220 TWh of renewable electricity, around 100 GW of wind power capacity, to be developed if the obligation is to be met solely from electricity generation capacity. Ambitious policies have been implemented (10 TWh additional electricity production from renewable sources in 2013 compared to 2012, i.e. approximately a 30% increase in only one year), but may not be sufficient to allow the country to reach the target in time.

A climate-conscious country like Germany needs to add another 8.5 Mtoe of renewables in its final energy consumption mix. This is equivalent to some 100 TWh of CO_2-free electricity[22], or replacing some 15 GW of coal-fired power generation with some 40 GW of wind power.

22 The conversion factor is that used in the BP Statistical Review, i.e. 12 MWh per Tep

Figure 8. Renewable energy achievements in seven countries in 2012

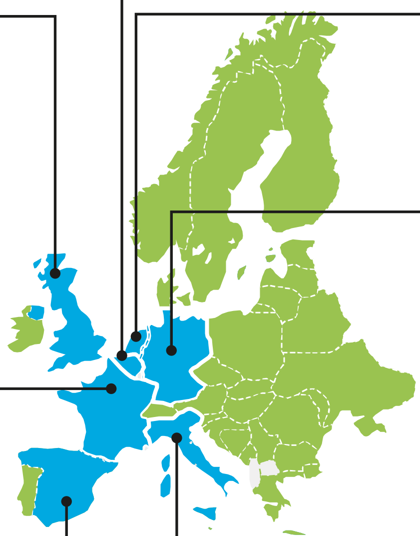
Renewable energy

UK:
- Only 20% of the target achieved in 2012.
- UK is implementing a very ambitious policy to support renewables development but meeting target on time is unlikely.

Belgium:
- 49% of the target achieved in 2012.
- New capacities will come mainly from offshore wind and, to a lesser degree, biomass.
- Difficulties in meeting the targets will require more ambitious measures in the next few years.

Netherlands:
- 31% of the target achieved in 2012.
- Wind power is expected to contribute to closing part of the gap.
- The effectiveness and timeliness of the latest policies remain to be demonstrated.

France:
- Only 29% of target achieved in 2012.
- Options to reach the target could include large-scale deployment of biomass for heating (subject to biomass availability) and increased development of wind power.



Germany:
- 66% of its target achieved in 2012.
- New capacities will come mostly from wind and solar.
- Recent changes in the Erneuerbare-Energien-Gesetz ("EEG") may slow down the future development of renewables.

Spain:
- Around 70% of the target already achieved in 2012.
- But budget cuts in the aftermath of the crisis have considerably reduced financial support to renewable energies.

Italy:
- 68% of the target already achieved in 2012.
- Thanks mainly to a sharp increase in non-hydropower renewable power production capacity between 2008 and 2012, Italy is on the right path to reach, or even exceed, the EU targets.

The increase in the share of renewables in the energy mix has been supported by heavy public financial packages (financial or fiscal incentives, feed-in tariffs based on a guaranteed price for a given number of years, frequently 20 years and green certificates) which have attracted significant investment. For instance, in Germany, the renewable energy sector is currently subsidized with approximately EUR 19.4 billion per year (EUR 240 per inhabitant in 2014[23]); in France, the cost of supporting renewables in power production was estimated to be around €14.3 billion for the period 2006-2011 and is expected to be around € 40.5 billion for the 2012-2020 period[24]. **Some of this capital expenditure was passed through to energy prices, thus pushing up prices significantly for final consumers in most countries** (e.g. around +32% in Germany between 2008 and 2013).

It is hard to see how the renewables objective will be met:

- **Some major economies in the EU (including France and the UK) still need to make significant efforts to meet their targets.** They need to consider serious capacity development in a short space of time. This will result in more public spending or support, or another electricity price increase in a context of ailing European business.

- **The development of biofuels on a large scale could help in** getting closer to target, but concerns about biofuel sustainability (the food versus fuel debate), biomass availability or the development of mature and economic processes for producing second generation biofuels have led European legislators to put any evolution of biofuel incorporation rate on standby; there is no sign today that the legislation on incorporating a higher share of biofuels in gasoline or diesel will be modified any time soon.

- **Achieving the renewables objective will therefore depend on the baseline against which the percentage of renewables is ultimately based, i.e. what the final energy consumption will actually be for each Member State by 2020.** If the recovery drives energy consumption up, energy production from renewable sources will have to increase further to reach the targets expressed as a share of energy consumption.

c) Reduction of final energy consumption: energy efficiency target

How was the energy efficiency target defined per Member State?

EU energy efficiency targets are expressed in all sorts of ways for each Member State, using different units, based on different assumptions and with varying levels of ambition. The relative targets expressed in energy savings are most often calculated ex post.

The Energy Efficiency Directive[25] set several targets for 2020 at European level:

- A target expressed in relative terms: a 20% headline target on energy efficiency (art. 1); the Directive does not define the baseline for estimating this 20% EE target.

- Targets expressed in absolute terms, i.e. in the form of a 1,474 Mtoe ceiling on primary energy consumption or a 1,078 Mtoe cap on final energy (art. 3.1.a)[26].

Savings objectives for primary and final energy consumption have been calculated for the EU only, not for individual Member States.

The Member States have set indicative, and not mandatory, national energy efficiency targets for 2020, as required by the Energy Efficiency Directive. Each Member State is at liberty to express its efforts in terms of primary energy consumption (PEC), or final energy consumption (FEC)[27], primary or final energy savings, or energy intensity. Each is required to explain how, and on the basis of which data, this has been calculated (art. 3.1).

23 http://www.wiwo.de/politik/deutschland/trotz-reform-verbraucher-werden-2015-eine-milliarde-euro-mehr-eeg-umlage-bezahlen/9414526.html

24 Cour des comptes (2013), La politique de développement des énergies renouvelables – juillet 2013

25 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

26 With the accession of Croatia the target was revised to 1,483 Mtoe primary energy or no more than 1,086 Mtoe of final energy

27 See the definition in the 'List of acronyms' part, at the end of the document

Table 1. The diversity of national energy efficiency targets

	Targets regarding PEC and FEC			Energy savings target
	Expressed in relative terms	Expressed in absolute terms		
	Relative target	Primary energy consumption target	Final energy consumption target	
Belgium	-18% of PEC, as compared to a 2020 projection (calculated using the PRIMES 2007 model)			
France	20% energy savings versus 2020 energy demand projections	236 Mtoe	131 Mtoe	
Germany	-20% of PEC compared to 2008	277 Mtoe		
Italy			126 Mtoe (indicative)	Minimum energy savings of 15.5 Mtoe in 2020 (binding)
Netherlands			52 Mtoe	Energy savings of 482 PJ (11.5 Mtoe) in 2020 compared to 2007.
Spain		119.9 Mtoe (i.e. 26.4% reduction in BAU)		
UK			129 Mtoe (indicative), i.e. -18% compared to a BAU scenario (calculated in 2007).	

BAU: Business as usual

The diversity of criteria and the number of different units and interpretations make it difficult to assess or even measure the materiality of each Member State's efforts towards reducing primary energy demand, especially as the reference dates or objectives were not defined until late. The confusion makes it very difficult for any EU citizen to understand EU energy policies and see how their individual action can help in this area.

Where do we stand with the energy efficiency target?

By 2012, the European Union had already achieved 56% of its primary energy consumption target and 83% of its final energy consumption target.

Figure 9. EU-28 primary energy consumption 2005-2012 and target (Mtoe)[28]

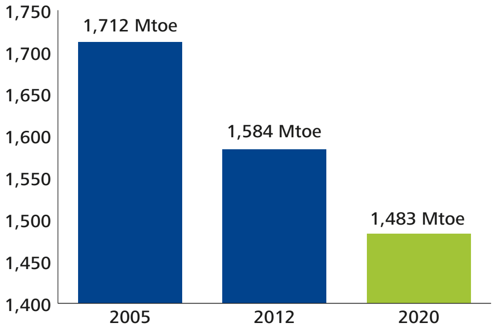
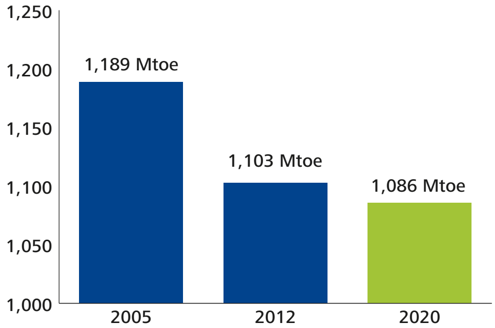


Figure 10. EU-28 final energy consumption 2005-2012 and target (Mtoe)[29]

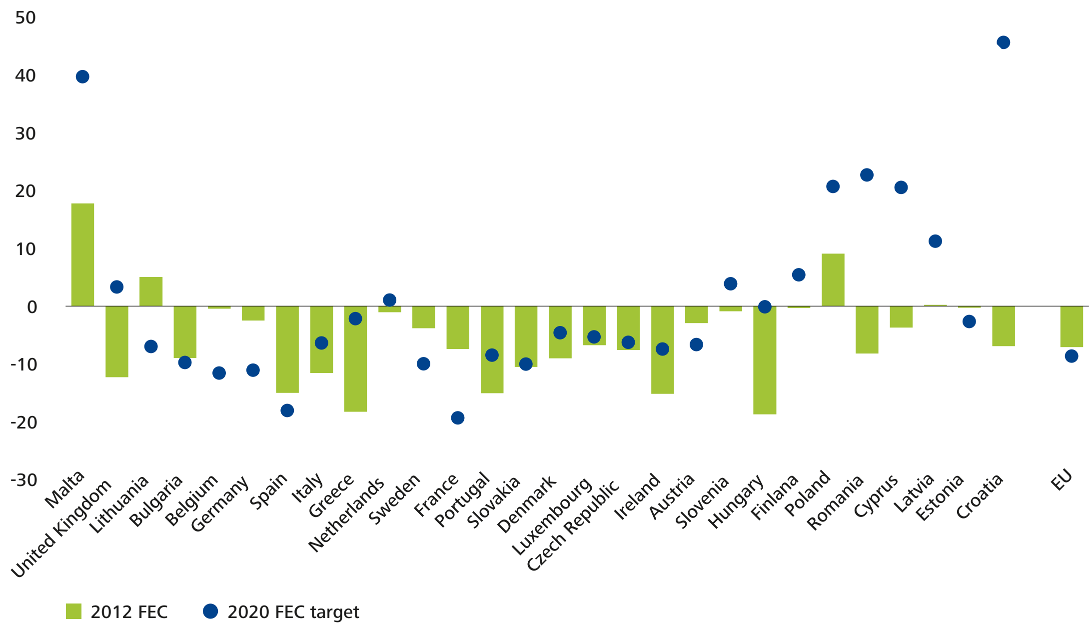


In 2012, the targets in absolute terms were reached or nearly met by a few Member States, including Spain, Italy and the Netherlands. Here again, the economic crisis and subsequent energy demand reduction played a role. But if economic recovery occurs as planned, energy consumption may rise again, endangering achievement of the target in 2020.

On the efficiency criterion, as in the case of the GHG emissions reduction or renewables targets, the major economies seem to be a long way off. **Germany is a little more than one fifth of the way towards the target and France just about a third.**

Figure 11. Change in final energy consumption (FEC) compared to 2005 (%)[30]

% change compared to 2005 final energy consumption (FEC)



It can be seen from the figure above that **the countries that have been most successful in reducing their final energy consumption** and moving this closer to the target **are those worst hit by the financial crisis**, including Ireland, Portugal, Greece, Italy, Spain and Hungary.

This picture is somewhat misleading, however, since it is based on a single criterion (final energy consumption), which most often represents only a part, or even an interpretation of multi-indicator national targets.

28 Calculations based on Eurostat data, Source: Eurostat. © European Union, 1995-2015, http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020_33&language=en

29 Calculations based on Eurostat data, Source: Eurostat. © European Union, 1995-2015, http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc320&plugin=1

30 Figure extracted from EEA (2014), Trends and projections in Europe 2014, available online on: http://www.eea.europa.eu/publications/trends-and-projections-in-europe-2014

Figure 12. Energy efficiency achievements in seven countries in 2012

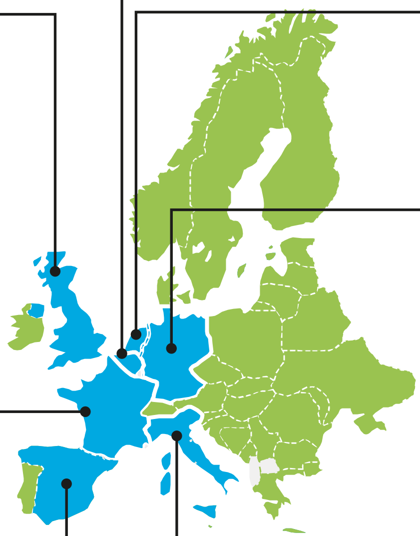
Energy efficiency

UK:
- 79% of the target already achieved in 2012.
- 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, therefore one of the major areas of efficiency gains in the future.

Belgium:
- Energy consumption almost flat in recent years.
- Belgium needs to implement new measures to reach its energy efficiency targets.

Netherlands:
- In 2012, while there is still a significant way to go to achieve the energy savings target, the indicative final energy target for 2020 was attained already in 2012.

France:
- Only 24% of its target for final energy consumption achieved in 2012.
- It is difficult to see how France can meet its energy efficiency commitment, other than by issuing additional policy objectives for buildings or resurrecting the cogeneration industry.



Germany:
- 46% of the target achieved in 2012.
- Future success will hinge on the effectiveness of its energy efficiency policies, especially in the construction sector.

Spain:
- In 2012, close to reaching its 2020 target for primary energy consumption but most of the reduction is due to economic recession.
- If the economic recovery occurs as planned, new efforts will have to be made to reach the 2020 target.
- Several measures are already planned but it is too soon to estimate whether they will be able to generate the expected savings by 2020.

Italy:
- Already over-achieved its indicative 2020 target for final energy consumption in 2012.
- Italy achieved 15% of its 2020 target for energy savings in final energy consumption in a single year between 2011 and 2012.

> In the area of energy efficiency, it took a long time to define the very difficult-to-understand criteria which may not be met in the end. The key question is whether they are ultimately going to reduce EU energy consumption or the EU economy's energy intensity other than as a result of economic contraction.

3. Conclusion

Many countries are on track to meet their 3 x 20 targets and the EU-28 as a whole has made considerable progress on the way to its targets. Whether this is predominantly due to dedicated policies or to external factors is highly questionable.

The economic crisis has played a key role in progress towards meeting targets to date. By depressing consumption, it has *de facto* reduced GHG emissions, saved energy and made the share of renewables in final energy consumption look better than it would have had the economy been stronger. Any economic recovery could represent a setback in meeting all of the targets. So could a switch to coal as a substitute for any nuclear power being phased out: the economics of coal are currently more attractive than gas, but it is environmentally more harmful. The rate of investment in renewables needs to pick up whatever the scenario, and governments will be challenged in balancing the cost of support against the effect on consumer prices.

Unintended outcomes in the power sector

Electricity accounts for around 20% of final energy consumption, a figure which has been steadily increasing (see Figure 13). Power production accounts for less than 30% of GHG emissions (see Figure 14) but for around 40% of energy production from renewable sources (see Figure 15). Its rather concentrated structure (a small number of energy-intensive, high-GHG emitting power plants) makes it an easy target for energy and climate policies.

Figure 13. EU-28 electrical energy in final energy consumption 1990-2012 (Mtoe) (%)[31]

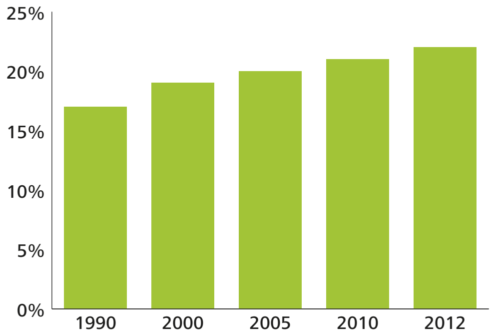


Figure 14. EU-28 GHG emissions by sector 1990-2012 ($MtCO_2eq$)[32]

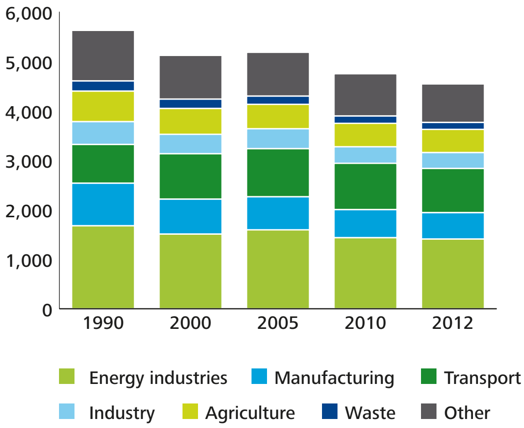


Figure 15. Breakdown by renewable technologies for electricity, heating and cooling and transport for EU-28 (Mtoe), in 2005 and 2012 and targets for 2020[33]

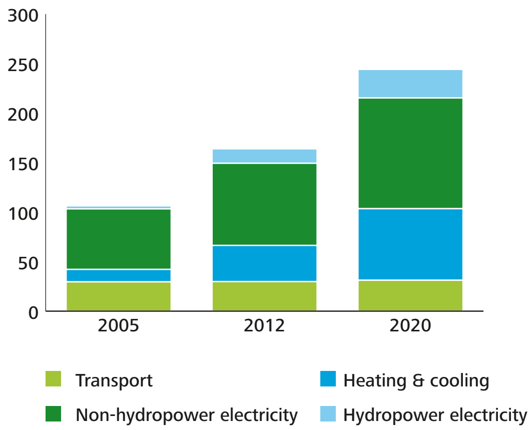
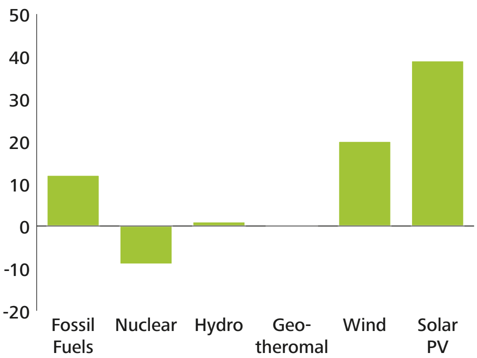


Figure 16. EU-28 change in electricity capacity source 2010-2012 (GW)[34]



Between 2010 and 2012, while nuclear capacities were shut down and consequently nuclear generating capacity at EU level decreased in the aftermath of the Fukushima disaster (-6.5%), hydropower capacity remained stable, while there was a net increase in fossil-powered capacity (+2.7%) and **wind and photovoltaic solar increased very significantly (+24% and +134%)**.

In many respects, the outcomes of the 3 x 20 policy in the electricity sector have been unintended and led to results which were sometimes counter-productive, thereby exposing the whole climate policy to general criticism.

31 Calculations based on Eurostat data , Eurostat. © European Union, 1995-2015: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_110a&lang=en

32 EEA GHG Data Viewer: http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer

33 EEA (2014), Trends and projections in Europe 2014

34 Calculations based on Eurostat data, Eurostat. © European Union, 1995-2014: http://appsso.eurostat.ec.europa.eu/nui/show.o?dataset=nrg_113a&lang=en

1. Electricity markets have been most affected

First and foremost, EU policies have resulted in a dramatic change in the rules governing the electricity industry, so that EU consumers and producers have had to come to terms with completely new market mechanisms.

a) Power market distortion

In the context of sluggish demand, the development of renewables driven by policy support and incentives, rather than by supply and demand adequacy and market signals, has resulted in significant **overcapacities** in the power generation segment.

Renewables capacity has been growing independently of the market's need for new generation capacity. Even now, it is anticipated that the increase in renewable capacity will outpace electricity demand growth under most scenarios going forward: for example, non-hydro renewable installed capacity will increase by 60% over 11 years (379 GW in 2014 to 608 GW in 2025), or a CAGR of 4.4% per annum. Electricity demand is expected to grow by little more than 1% per annum over the same period (ENTSOE-E Adequacy Report, 2014). Restoring generation adequacy will therefore only be achieved through the closure of existing capacities, i.e. shutting down a mix of old, inefficient plants as well as newer high-performing power plants.

- ***Generous feed-in tariffs have distorted the market***
  Because renewable systems are not yet technically or economically mature, support schemes for renewables have been based on feed-in tariffs, i.e. a guaranteed price level determined by public authorities which makes renewable energy producers immune to market signals. These tariffs can be compared to the wholesale electricity prices in these countries (see Figure 17): in 2014, they were around 3.2-4.0 EUR cents/kWh in Germany, 2.5-4.4 in France and 4.5 and 6.0 in the UK.

Table 2. 2014 feed-in tariffs (in c€/kWh) in Germany, France and the UK

	Onshore wind	Offshore wind	Solar	Geothermal	Biomass (CHP[35])
Germany	4.9-8.9	3.9-19.4	8.7-12.8	25.2	5.8-13.6
France	2.8-8.2	3-13	7.17-27.94	20 + bonus	4.5 + bonus
UK	3.7-17.78	177	6.38-14.38	13.4	

- ***"Priority dispatch" principle for renewables***
  The Transmission System Operators' (TSO) obligation to dispatch renewables ahead of any other source of electricity in the merit order, have made renewable sources of electricity immune from market mechanisms, or any market mechanism at all. In addition, they create an extra challenge for the grid operators in achieving grid balancing and financing a vast number of new connections to the grid.

- ***Public sector support for domestic renewable generation capacity may have deterred investments in new cross-border interconnectors which would have been a more efficient solution for ensuring security of supply***
  Additional investments in transmission grids of EUR 68 billion are projected from 2020 to 2030. They will help keep progress on track for the 2030 and 2050 objectives: they enable the construction of around 109 GW of additional transmission capacity, including offshore wind connections[36] – a 50% increase from the planned network in 2020 and a near doubling of today's existing capacity. Most of the additional interconnections are projected across borders (between southern UK and Ireland (13 GW), between south-western France and north-eastern Spain (9 GW)), however large transmission upgrades are also required within countries (north-western to western Germany (10 GW) and north to southern UK (8 GW))[37]. In October 2014, the European Council called for an urgent implementation of all the measures to meet the target of achieving interconnection of at least 10% of their installed electricity production capacity for all Member States by 2020[38]. Upgrading the interconnection capacity at EU level is perhaps what should have been started with, before thinking about increasing capacities[39].

35 CHP stands for Combined Heat and Power

36 Power Perspectives 2030: On the road to a decarbonized power sector; available on: http://www.roadmap2050.eu/project/power-perspective-2030

37 EU Roadmap 2050, Power Perspectives

38 Communication from the European Council (EUCO 169/14), 24 October 2014; available on: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf

39 In 2006, the EC launched the TEN-E programme, in application of previous EU decisions 1996 and 2003. This programme deals with the interconnection, interoperability and development of trans-European networks for transporting electricity and gas. It has listed a number of projects of European interest which are essential for the effective operation of the internal energy market. But the TEN-E programme action was only limited to a budget of around EUR 20 million per year, mainly intended for financing feasibility studies. (http://europa.eu/legislation_summaries/other/l24096_en.htm)

b) Electricity markets facing both over-supply and blackouts

Overcapacity coupled with a risk of capacity shortage.

In early September 2014, both the French and UK TSOs highlighted increasing challenges around security of supply[40,41] putting forward the decision to mothball capacity in the face of a slowdown in demand and new renewables developments, combined with the anticipated closure of plants for regulatory or environmental reasons.

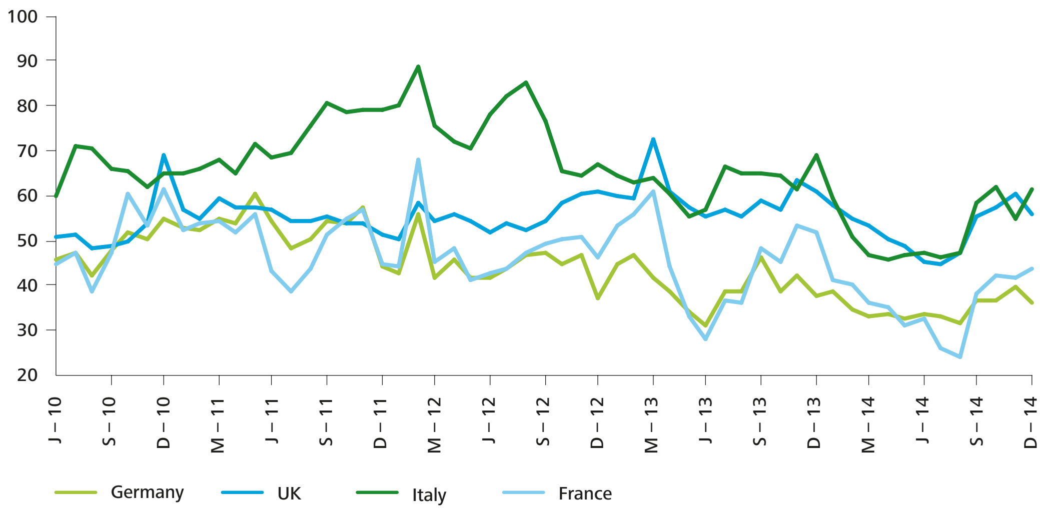
French TSO, RTE, anticipates that the effect of the Industrial Emissions Directive[42] (IED) legislation entering into force in 2016 will be that 3.8 GW of fuel oil-fired power capacity will presumably close. This is in addition to a reduction of 1.3 GW in Combined Cycle Gas Turbine (CCGT) capacity which had to be mothballed for economic reasons. In Germany, another 4.3 GW of coal-fired plants are not compliant with the IED and need to be shut down. In the UK, National Grid has pointed to a sharp reduction in the security margin due to the mothballing or closure of existing plants pursuant to the Large Combustion Plant Directive[43] (LCPD) legislation. National Grid assumes that around 5 GW of conventional plants will shut down permanently for winters 2016 and 2017 (due to emission standards and plant reaching the end of their lifetime), and an additional 1GW of gas-fired plant will be mothballed in the same period. In total, over the last three years, economics have forced European **utilities to mothball 51 GW of modern gas-fired generation assets**, equivalent to the capacity of Belgium, the Czech Republic and Portugal[44].

Belgium is already short of capacity, primarily as a result of the unavailability of the Doel 3 and Tihange 2 nuclear plants. Shutdown of Doel 1 and 2 in the short term was planned, but is likely to be postponed.

In all cases, **new renewable energy capacity has failed to make up for the gap resulting from the shutdown of fossil fuel capacity, whether for economic, operational or environmental reasons**.

2. Subsidised REN did not make producers profitable, quite the contrary…

Figure 17. Wholesale electricity prices: Baseload Spot Day Ahead (€/MWh) in four countries[45]



In an economically depressed context of sluggish growth and demand, such as we have seen on the German, Italian, Spanish and French markets, **the influx of renewable electricity**, i.e. zero marginal cost electricity sources, **has caused the wholesale price of electricity to drop sharply to levels which made traditional, centralised thermal power plants uncompetitive**.

Renewable sources have produced large amounts of subsidised electricity therefore at a sunk cost for the producer. This has had the effect of squeezing the higher cost gas-fired generation plants out of the market, letting the coal-fired generators produce the marginal MWh and ultimately set the price of the electric system.

40 National Grid, 2013 Electricity Ten Year Statement

41 RTE, Bilan Prévisionnel de l'équilibre offre-demande d'électricité en France, 2014

42 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

43 Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants

44 Source: Le Monde, 2014: http://www.lemonde.fr/economie/article/2014/02/27/gerard-mestrallet-nous-allons-recruter-15-000-personnes-par-an_4374169_3234.html

45 Bloomberg

These wholesale prices sometimes do not even cover the variable costs of gas-fired, and even coal-fired, power generators.

The low price of wholesale electricity led utilities to mothball new gas-fired capacities which although newly built, efficient, flexible and high-performing were simply no longer needed. This has deterred investment in the electricity sector with the exception of the subsidised renewable generation industry, ultimately putting the mid to long-term security of electricity supply in jeopardy.

Figure 18. UK clean dark and spark spreads (£/MWh)[46]

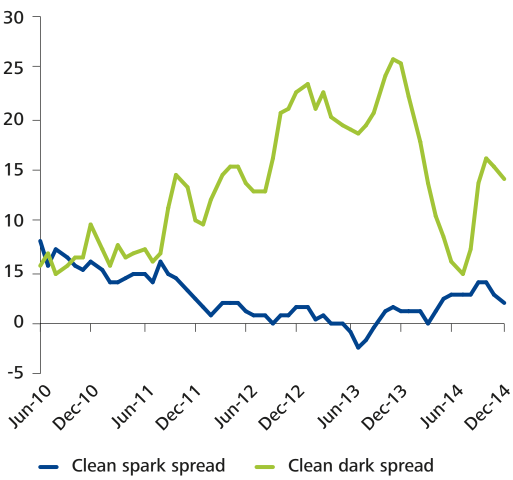
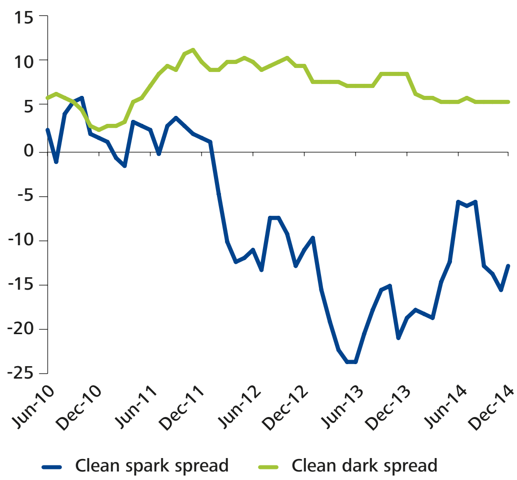


Figure 19. German clean dark and spark spreads (€/MWh)[47]



As the UK and Germany's Clean Dark and Clean Spark Spreads[48] demonstrate, the combination of low wholesale electricity prices and low carbon prices, low coal prices and high contracted gas prices has made it difficult to make a profit from gas-fired generation. Most gas-fired power generation units are generating losses. Coal-fired plants – a number of which are polluting and inefficient – are supplying electricity for both mid-merit and baseload. Their being largely profitable is a paradox in the context of an EU policy that wants to go green and underpins the problem with the ETS system.

3. …and it did not make consumers better off either…

Ironically, the end-customer has not benefited from the decline in wholesale power prices. On the contrary retail electricity prices have increased significantly in most markets, pushed up by the cost of financing renewable capacity.

a) REN support policies have been costly

The costs of renewable development are supported by the public sector via several schemes which are often hard to compare: The SDE+ (Sustainable Energy Incentive) in the Netherlands comes straight from the state budget (and is passed on through the tariff), whilst France, the UK or Germany tender 20 year-contracts based on a guaranteed price through feed-in tariffs or feed-in premium.

Estimates of support for renewables show that a high level of public sector support is necessary to balance the cost of renewables: in Germany, the renewable energy sector is currently subsidised with approximately EUR 19.4 billion per year (EUR 240 per inhabitant in 2014[49]); in Belgium, public sector support to Combined Heat and Power (CHP) and RES amounted to around EUR 1.5 billion in 2013[50]; and in France, the global cost for the support of renewables in power production is estimated to be around EUR 40.5 billion for the 2012-2020 period[51].

b) Wholesale and retail prices moving in opposite directions

End-user prices for electricity paid by companies and households have increased over the last decade in real terms. The reasons for this are high and increasing taxes and levies on the final electricity price, the cost of networks and fuel. In most countries, taxes including the financial charge of supporting renewables, and the network cost component in the retail price of electricity, now represent more than two thirds of the price paid by final consumers.

46 Bloomberg

47 Bloomberg

48 The UK Clean Dark Spread, is the indicator of the theoretical profitability of UK coal-fired power plants operating at 35% efficiency, allowing for the cost of coal and emissions and incorporating the cost of the UK government's Carbon Price Support (CPS) levy. Conversely, the UK Clean Spark Spread, is the indicator of the theoretical profitability of a gas-fired power plants in the UK. The German Clean Dark Spread is the indicator of the theoretical profitability of a coal-fired power plants operating at 35% efficiency in Germany, allowing for the cost of coal and EUA (EU Allowance Unit under the ETS) emissions.

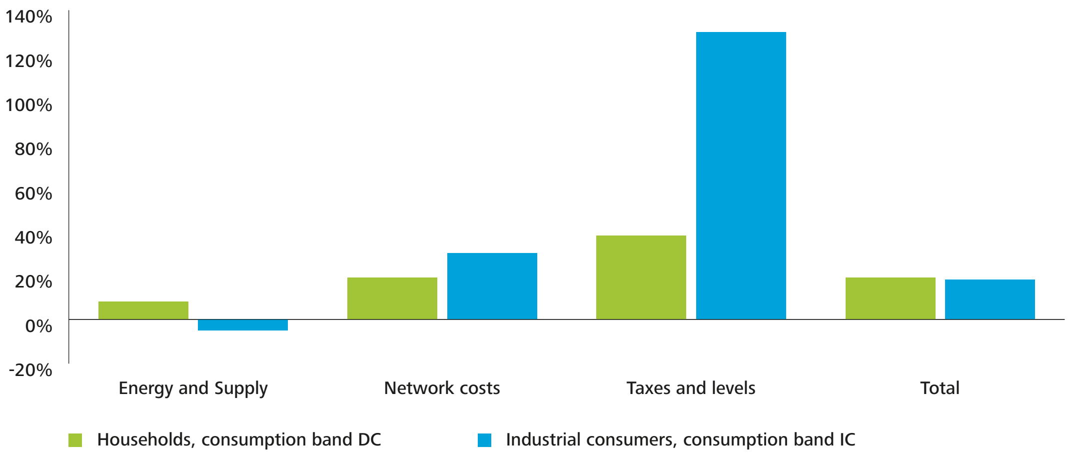
49 http://www.wiwo.de/politik/deutschland/trotz-reform-verbraucher-werden-2015-eine-milliarde-euro-mehr-eeg-umlage-bezahlen/9414526.html

50 See calculation in Belgium country profile

51 Cour des comptes (2013) – La politique de développement des énergies renouvelables – juillet 2013

The wholesale electricity price went down by as much as 35-45% between 2008 and 2012 as a result of abundant renewable electricity supplies reaching the market, however few European consumers have benefitted from the global commodity price decrease, **as the average weighted tax on electricity across Europe has increased by 127%, while network charges have gone up by 30% for industrial users and 18% for residential consumers over the period 2008 – 2012**.

Figure 20. EU-28 weighted average retail electricity prices, 2008-2012 (percentage change by component),[52, 53]



Germany stands out as a good example of a market where the taxes and levies to support renewable energies have called EU energy policies into question. The EEG-Levy to finance renewable generation can go as high as EUR 60/MWh, compared to EUR 40/MWh for the sole cost component of energy[54]. Considering the components of household electricity prices in Germany, it is interesting to note that, fifteen years after the liberalization of the power markets, the energy component proper, which reflects the wholesale market price and is driven by the supply and demand balance, accounts for less than 24% of the costs today (according to figures from the EEX), and will continue to decline in percentage terms, whilst the levies or taxes for financing the green economy and the public sector exceed both the derivatives market price for the front year and the spot market price. This figure compares an EU average of 40% for the energy component and 30% each for the network charge and the tax portion[55].

Moreover, part of the costs of public policies (in favor of renewable energy, combined heat and power, social access to energy, etc.) have not completely been passed on to final users, thus generating huge deficits: in Spain, the electricity tariff deficit – the share of investment that still needs to supported by end-users and is still expected to increase the retail price of electricity – was € 30 billion by 2014, equivalent to € 100/MWh over one year; in France, the tariff deficit of the CSPE (public support to renewable development and to social tariffs) amounted to € 5.8 billion at the end of 2014[56]. These tariff deficits will drive further tariff increases in the future.

52 © European Union, http://eur-lex.europa.eu, 1998-2015, “Energy prices and costs report”, Commission staff working document [SWD(2014) 20 final], part 1/4, available at: http://eur-lex.europa.eu/resource.html?uri=cellar:ba385885-8433-11e3-9b7d-01aa75ed71a1.0001.01/DOC_1&format=PDF

53 Prices include all taxes in the case of households. Prices exclude VAT and other recoverable taxes in the case of industry, as well as industry exemptions (data not available).

54 EPEX Spot

55 EPEX SPOT – Powernext

56 EDF

What has gone wrong?

1. Have we ticked each box of the main energy policy roadmap: sustainability, affordability competitiveness and security of supply?

- Sustainability?
  - **The EU has considerably reduced its energy intensity.** The European economy has experienced a real decoupling of economic growth and energy consumption (with its GDP increasing by 40% from 2000 to 2012, while its gross inland energy consumption has gone down by some 2.5%) (Figure 21).
  - **The EU has reduced its carbon intensity, both in relation to population and to GDP.** EU-28 GHG emissions per inhabitant have decreased by 24% between 1990 and 2010 and EU-28 GHG emissions per euro of GDP have decreased by 37% between 200 and 2012.

Figure 21. EU-28 energy intensity 2000-2012[57]

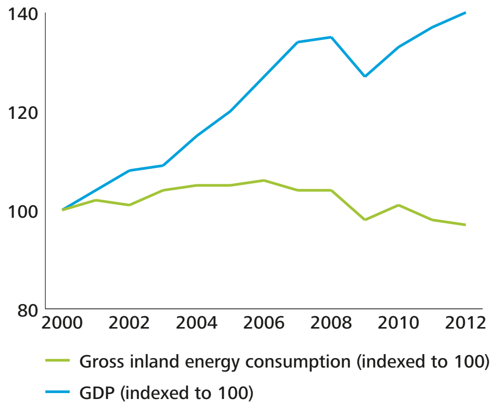
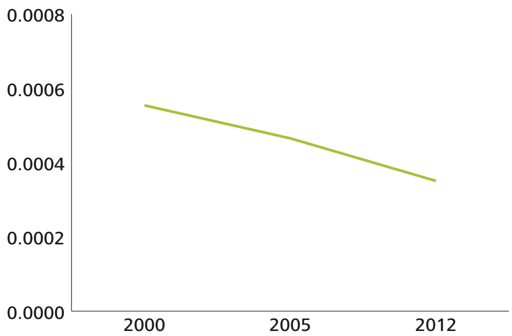


Figure 22. EU-28 GHG emissions per inhabitant 1990-2010 (tCO_2eq/inhabitant)[58]

Figure 23. EU-28 GHG emissions per euro of GDP 2000-2012 (tCO_2eq/€)[59]

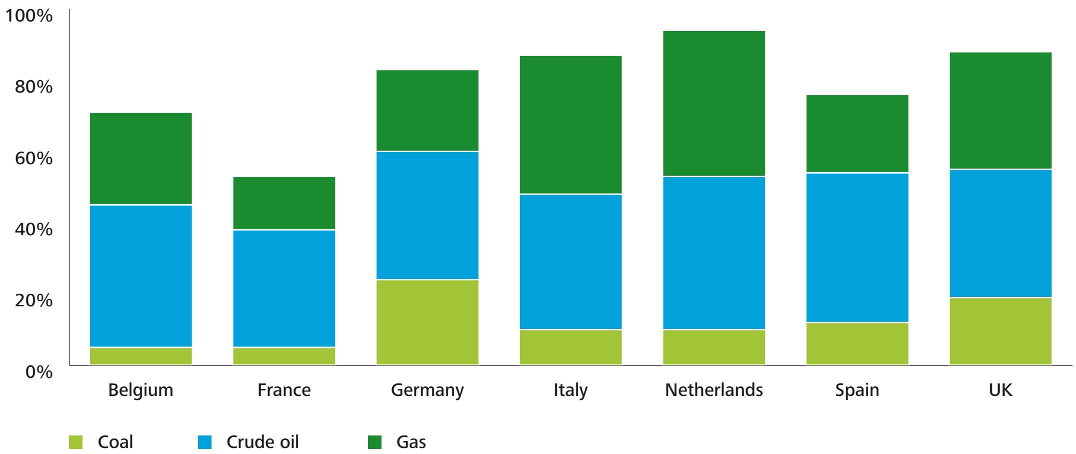


57 Calculations based on Eurostat data, Eurostat. © European Union, 1995-2015: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc320&plugin=1 and http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

58 Calculations based on Eurostat data; Eurostat. © European Union, 1995-2015: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_air_gge&lang=en; http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_pjan&lang=en; http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_gdp_c&lang=en;

59 Calculations based on Eurostat data, Eurostat. © European Union, 1995-2015: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc210&plugin=1

Figure 24. Share of fossil fuels in gross inland energy consumption of seven countries[60]



A number of EU Member States have a ratio of fossil fuel to total energy consumption which is close to, or even in excess of, 90%, including Italy, the Netherlands and the UK. At the end of 2012, the ratio of fossil fuel to total primary energy was 74% compared with 83% in 1990[61]. Oil is still the leading carbon-based source of energy, with a 32% share, followed by gas (23%). Coal however stands at 18% of the EU-28 energy mix, dramatically down from 28% in 1990.

- Affordability and competitiveness?

Prices to final customers have risen.

Looking at the various tax regimes across the EU, it is interesting to note that taxes on electricity have risen by 31% on average between 2008 and 2012 for households; and, at a time when political decision makers are calling for an industrial renaissance in Europe, **taxes on electricity have risen by 109% on average between 2008 and 2012 for industrial users**[62]. However, government policies are also keen on limiting the tax hit on industries in order to protect Europe's ailing competitiveness[63].

Figure 25. Evolution of European average household price components (in €/MWh) between 2008 and 2012

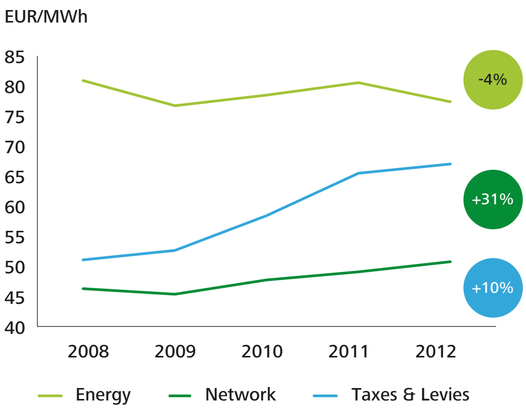
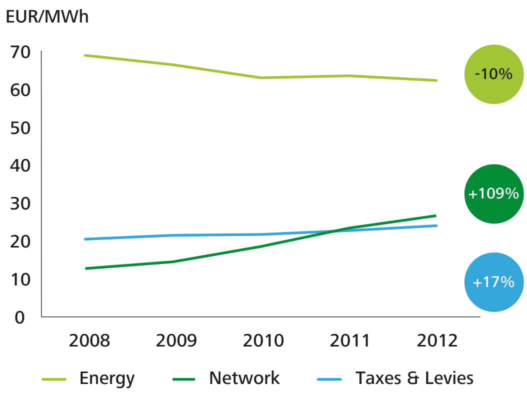


Figure 26. Evolution of European average industrial price components (in €/MWh) between 2008 and 2012



60 Calculations based on Eurostat data, Eurostat. © European Union, 1995-2015, http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc320&plugin=1

61 © OECD/IEA 2014 Energy Policies of IEA Countries, IEA Publishing. Licence: http://www.iea.org/t&c/

62 Eurelectric (2014), Analysis of European Power Price Increase Drivers, A Eurelectric study, May 2014; http://www.eurelectric.org/media/131606/prices_study_final-2014-2500-0001-01-e.pdf

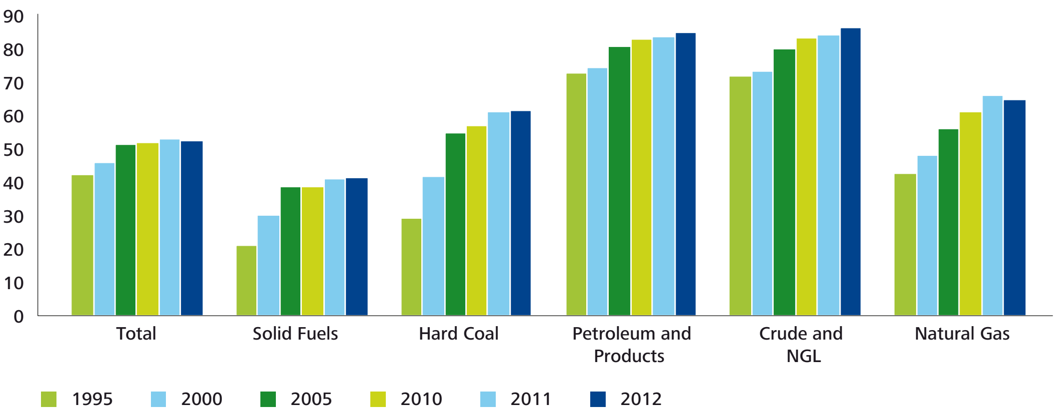
63 © European Union, 1995-2015. European Commission (2014), "Energy prices and costs report", Commission staff working document [SWD(2014) 20 final], available at: http://www.cep.eu/Analysen/COM_2014_21_Energiepreise/Staff_Working_Document_SWD_2014__20.pdf

- Security of supply?

The EU's energy dependence on foreign sources of supply has also increased. In 2012, energy import dependence stood at 53%, 1 percentage point more than in 2005 and 10 more than twenty years ago, despite strong renewables development and energy efficiency measures. Dependence on natural gas imports has increased as the resource base of the North Sea has depleted and reached 66% in 2012. Coal dependence also increased significantly (62% for hard coal in 2012), and oil import dependency remains very high: 95% in 2012.

The lesson of the Ukraine crises is that the EU should press on with its decarbonisation strategy, with a view to developing indigenous renewable energy and improving energy efficiency. This strategy has the key benefit of reducing the degree to which Europe depends on fossil fuels – oil, gas and coal – that it currently imports from Russia for the most part, and from the Middle East and North Africa for much of the balance. These figures have actually gone up, not down, although the 3 x 20 policy was also meant to reduce energy dependence. The countries most vulnerable to any cut-off of Russian energy exports are the Eastern European countries which are, at the same time, the EU's most energy-intensive Member States with the least renewable objectives.

Figure 27. EU-28 energy import dependence by fuel, 1995-2012 (% (toe/toe))[64]



The security of energy supply in an increasingly dependent EU also relies upon a diversification of energy suppliers and routes, in addition to a a diversified energy mix.

EU policies were well intentioned but went in a direction which took the market where one did not want it to go.

2. The carbon market did not help

An over-supplied carbon market failed to send the right price signals.

The long-standing low carbon price on the European ETS market has failed to establish the real value of the climate liability. It also failed to give investors the price signal necessary to consider investment in technologies, including CCS (carbon capture and storage) for example, which would have ultimately led to a large reduction in physical emissions.

The reasons for such a dysfunctional carbon market are to be found in the over-allocation of carbon credits under the ETS. This was itself fuelled by the extra impact of investment vehicles established by the Kyoto Protocol and known as CERs (Certified Emissions Reductions) and ERUs (Emission Reduction Units) implementing Joint Implementation or Clean Development Mechanisms investments in or outside the Annex B countries of the Kyoto Protocol. This surplus of EUAs under the EU ETS is in fact the pure reflection of a dysfunctional Kyoto Protocol, namely the over-allocation of national carbon credits (known as AAUs) above the actual GHG emissions of the countries in the 2012 amended Annex B list under the Kyoto Protocol[65].

This surplus today represents up to 7 billion tons of CO_2 credits[66] (around two thirds of one year of CO_2 emissions), two billion of which are held by the Ukraine alone, with the EU-28 holding the balance, i.e. just under 5 billion tons of CO_2 credits. This total surplus, when carried over in the years ahead, could represent an annual 10% of base-year emissions for all countries participating in the second Kyoto commitment period 2013-2020.

64 Eurostat data in EU Energy in figures. Statistical pocketbook 2014. © European Union, 2014http://ec.europa.eu/energy/sites/ener/files/documents/2014_pocketbook.pdf

65 There are however restrictions as to the yearly volumes of CERs or ERUs that can be converted into EUAs. From 2008, EU ETS installations have also been allowed to use Kyoto offset credits (CERs or ERUs) up to a limit of 13.5% of their allocation on average (source: Key Figures on Climate, 2014 Edition, CDC Climat, French Ministère de l'Écologie, du Développement Durable et de l'Énergie)

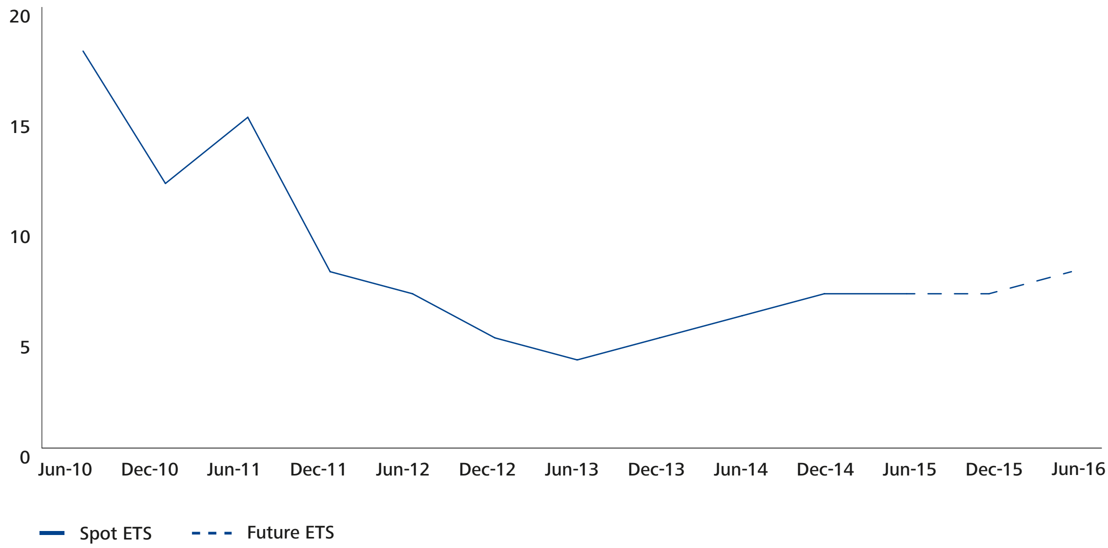
66 Romain Morel and Igor Shishlov (2012), "Ex-post evaluation of the Kyoto Protocol: Four key lessons for the 2015 Paris agreement", CDC Climat research: http://www.cdcclimat.com/IMG/pdf/14-05_climate_report_no44_-_analysis_of_the_kp-2.pdf

In spite of the EC's decision to back-load most of the surplus within the Reserve Margin Mechanism starting in 2021, the carbon price signal could stay low across the EU for the foreseeable future and fail to support the financing of the transition to a low carbon economy.

With a significant surplus of carbon credits from the outset, it might have been foreseen that the EU ETS market would imperfectly reflect the CO_2 liability. **This initial over-allocation was made even more damaging when the economic crisis caused a downturn in industrial activity.**

With a low carbon price as a result, the ETS was doomed to remain a weak incentive to reducing carbon emissions.

Figure 28. Price of the CO_2 allowances on the ETS (€/ton)



During the very early years of carbon trading, most analysts and brokers were forecasting an average CO_2 price of EUR 20/t for 2008-2010, EUR 30/t in 2012 rising to EUR 35/t for 2013-2015 because of strong liquidity on the ETS market. The "fuel-switching" carbon price today, i.e. the price of carbon which would make burning gas indifferent to burning coal for power generation, is in the EUR 35-45/ton of CO_2 range, a long way away from the current carbon market price of EUR 6 7/ton. And certainly an even longer way away from financing any renewable generation facility or any carbon-abatement project, not to mention the Carbon Capture and Storage (CCS) projects which are reported to break even at EUR 80/ton of carbon at today's prices.

In a way, it could be considered that the initial general objective of the ETS, i.e. reaching a given level of GHG emissions at the lowest possible cost, was a success, but whether the ETS mechanism actually proves to be responsible for the decrease in EU carbon emissions is highly questionable.

3. The EU 3 x 20 policies were set up in a different world: the paradigm shift

a) The EU energy context has unfolded very differently from what was anticipated at the outset

Before passing any judgment on the relevance or the irrelevance of the EU climate and energy package and what it has achieved, it is necessary to look back to the years when the policies were initially designed. **One has to remember that EU policies were developed against a set of assumptions whereby energy demand was going to be robust, the priority was to avoid further development of carbon-intensive technologies, and incentives were necessary to support the development of renewable technologies in order to make them competitive in the not so distant future.**

For instance, in 2002, the IEA's World Energy Outlook assumed that electricity demand in the EU would grow by 1% per annum over the 2000–2020 period (with 5% yearly growth for both gas-fired and renewable electricity) and globally by 0.8% for the period 2000-2030, as opposed to just 0.5% yearly growth currently envisaged by the IEA until 2040[67].

67 © OECD/IEA 2014 World Energy Outlook, IEA Publishing. Licence: http://www.iea.org/t&c/

b) Some technical potential for improvement has been less developed than initially planned

When the EU's '20-20-20' targets were endorsed by the European Council in 2007, there was obviously **much uncertainty about what technology would deliver in the years ahead. Many more technology breakthroughs than really happened were expected in various areas such as second generation biofuels, CCS, electric cars, etc. Unfortunately, progress has proved to be slower than planned in these sectors and caused the burden to shift from certain economic sectors to others.**

From the 1990s to around 2007, **biofuels** were considered to be a fully sustainable source of energy which was able to reduce GHG emissions and to increase renewable energy's share in transport. For instance in 2006, France set more ambitious targets than the other European Member States and decided to set a target of a 10% share of biofuels in transport in 2015, five years ahead of the European target. But a world food crisis occurred in 2007-2008. Biofuels were subject to criticism for being responsible for huge increases in world food prices, thus jeopardising the poorer populations' access to food.

As a consequence, the European Union stopped promoting first generation biofuels (biofuels produced from the edible parts of plants) and tried to encourage a second generation of biofuels produced from the non-edible parts. Unfortunately, the industrial development of the latter is difficult and very few commercial facilities have been built as of now. This makes the future of biofuels in Europe highly uncertain, and has meant no political consensus could be reached to date. The revision of the renewable energy Directive, which the European Commission announced in mid-2012, has been stalled for two years. No progress is in sight today. The proposed revision included a suggested 5% cap on the amount of food crop-derived biofuels (first generation), which implied that the rest of the target should be reached through second generation biofuels. Unfortunately for these plans, these advanced biofuels are not yet widely available on an industrial scale.

These rather disappointing developments in the biofuels sector were repeated in other areas, including construction (where the implementation of best practices in energy efficiency has been much lower than planned. This was especially true during the economic crisis, which had a strong impact on the construction of new buildings). The same happened in green cogeneration, etc.

This is why most governments, regulators and public attention turned to renewable technologies for electricity. Thus, less important development in some fields has been compensated for by greater action in others. So, part of the burden has shifted from sector to sector.

c) The economic crisis accelerated and completed this paradigm shift

In addition to withdrawing public sector support from green policies, the economic crisis was responsible for **slowing down the renewal of the European car fleet or the upgrading of old buildings**. Much of the progress expected from the construction of new, energy-efficient buildings also did not take place, especially in southern Europe.

In the aftermath of the financial crisis, public budgets had to be severely cut and **public sector support for investments in renewables and in energy efficiency were reduced.** Between 2010 and 2012, Spain, in particular, issued several regulations lowering the level of support to renewables in order to reduce the annual electricity tariff deficit. The target of a zero deficit was not completely reached. Moreover, these measures created a lot of uncertainty in the electricity generation sector.

4. EU energy policy: still a patchwork of national policies

a) Energy policies have largely remained at Member State level

Whilst energy policy is a shared competence under the EU Treaties, much of the electricity regulation has been designed at national level, and investments have been little coordinated at EU level so far.

The need for "Generation Adequacy", a proxy for capacity supply and demand, has been addressed at the Member State level and has often reflected sovereign objectives rather than a market analysis based on regional supply and demand equilibria.

As a result, Member States have often considered new public intervention in isolation, such as support schemes for investments in new electricity generation capacity or capacity payment schemes to make up for intermittent sources. Some of these measures have led to inefficient plants being artificially kept in operation through public support, or unnecessary new generation capacity being built. Today, there is as yet no EU supra-entity in charge of monitoring unruly capacity development, particularly of renewable energy, or excessive capital expenditure being channelled to creating unnecessary capacities.

b) No coordination on energy mix

The EU is still divided over its energy mix and more specifically over its fuels for power generation, with the German electricity generation capacity mix consisting of roughly 50% fossil energy, 12% nuclear and 38% renewables, France being 52% nuclear, Italy over 68% fossil fuel-based, the UK with a 73% fossil-fuel generation mix and Poland over 85% coal-based etc.

Figure 29. 2012 Gross inland energy consumption in seven countries (Mtoe)[68]

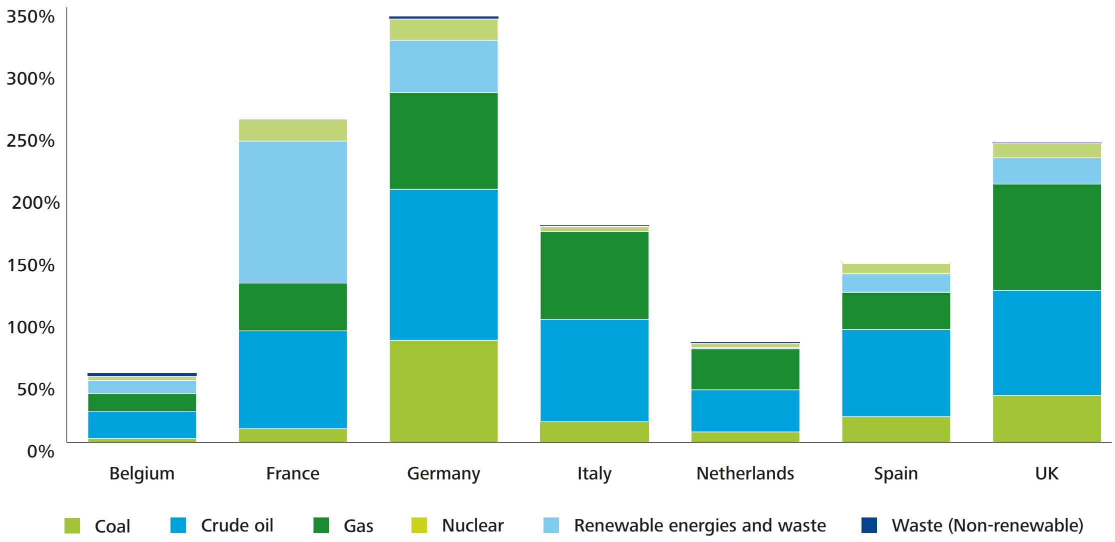
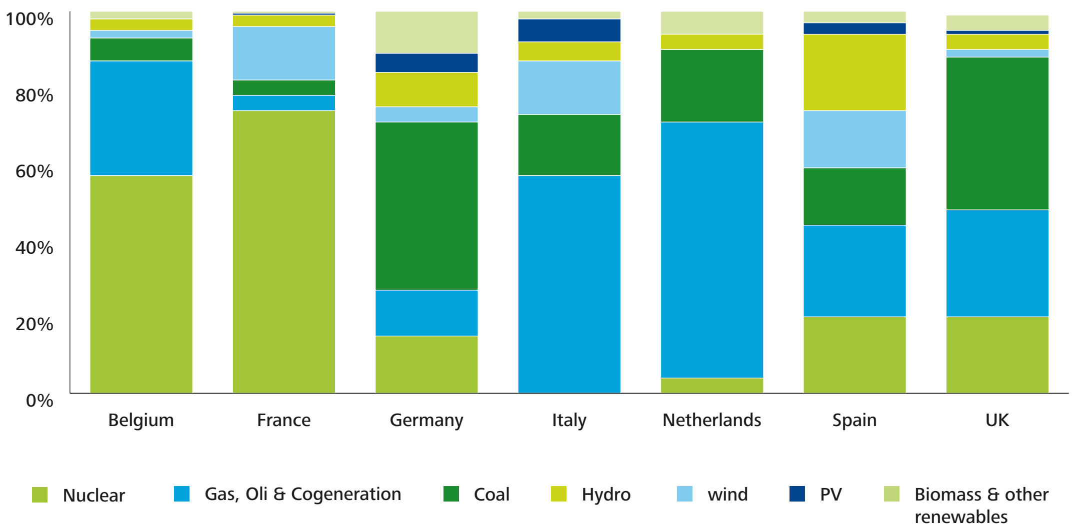


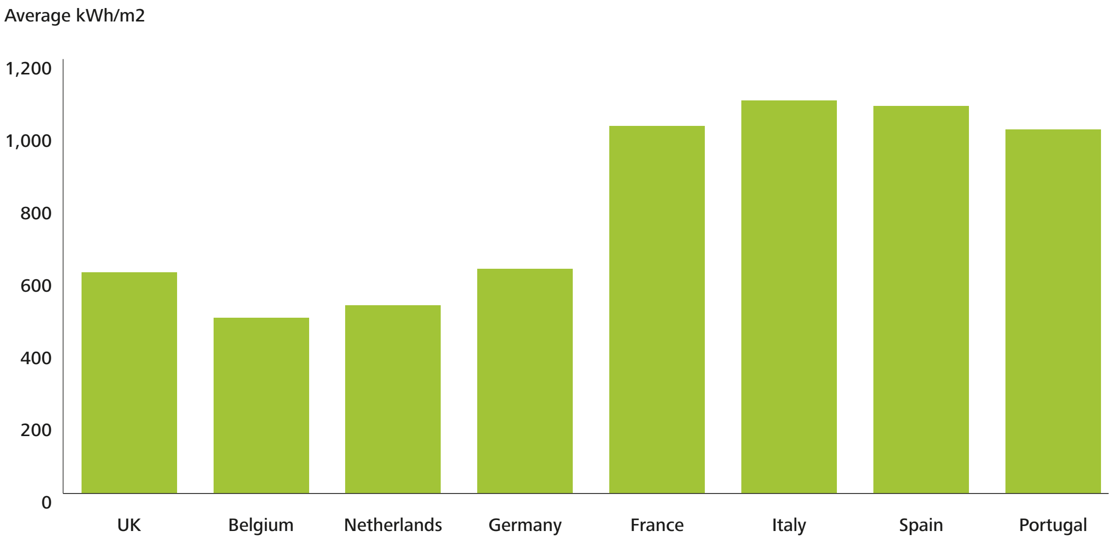
Figure 30. 2012 Power production mix in seven countries (percentages of generation)[69]



68 Calculations based on Eurostat data, 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

69 Elia, Rapport Annuel 2013; RTE Bilan Electrique Français 2013; RWE, BMWi ; Terna Group, Dati Statistici sull'energia elettrica in Italia, 2013 ; IEA, Energy Policies of IE Countries, 2014 ; RED, El Sistema Eléctrico Español, 2013 ; EC, EU Country Factsheet, 2012

Figure 31. Yearly sum of global irradiation at horizontal plane (2001-2008 average kWh/m2)[70]



There are various reasons for these differences in the energy mix:

- **Some relate to the climate or geographic nature of the EU Member States,** e.g. the hydropower potential is much higher in Scandinavian or Alpine countries. The solar potential is higher in Southern Europe. The average irradiation is much higher in Italy and Spain than in the UK, the Netherlands or Belgium (Figure 31).

- **Other differences are political, especially with respect to nuclear.** Italy has no nuclear plants and its opposition to nuclear power was restated through a popular referendum in June 2011 at a time when the largest Italian utility was considering nuclear reactors outside of Italy. Germany and Belgium have decided on a nuclear power phase out (by 2022 in Germany and by 2025 in Belgium). France, the country with the highest share of nuclear power, has decided to cap its nuclear generation capacity (i.e. any new plant has to be compensated by the closure of an old one) and to decrease the share of nuclear power from 75% to 50% of the electricity mix by 2025. On the other hand, the Dutch Government is in favor of constructing new nuclear power plants, even if no firm investment decision has been taken yet. And the UK is currently building a first-of-a-kind nuclear capacity to benefit from a contract for difference mechanism.

EU Member States are strongly divided over which source of energy they prefer. Poland argues that 'coal should be rehabilitated in the EU as a contributor to energy independence'[71], a move that would certainly constitute a major change in EU policy. The UK, for its part, insists that 'the development of coal reserves should only be encouraged in the context of carbon capture and storage'[70], and the EU should 'avoid the temptation to reverse existing policies or undertake new ones that would be contrary to its overall energy and climate policies'. Germany never consulted its big nuclear neighbor when it decided to close down its nuclear reactors. Poland has been actively trying to unleash its shale gas potential in the context of high dependence on Russian gas, whilst France has adopted a legal ban on hydraulic fracturing and has no concerns about long-term gas import contracts.

70 PVGIS © European Communities, 2001-2008, Šúri, M, Huld, T. A., Dunlop E. D., Ossenbrink, H. A., 2007. Potential of solar electricity generation in the European Union Member States and candidate countries. Solar energy, 81, 1295-1305.: http://re.jrc.ec.europa.eu/pvgis/solres/solreseurope.htm

71 Quoted by David Buchan (2013) in "Why Europe Energy and Climate policies are coming apart?" (Oxford Institute of Energy Studies), available online at: http://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/07/SP-28.pdf

c) The energy and climate policies have moved the EU away from the original objective of creating a single, integrated energy market

Huge price differentials at retail and industrial levels distort competition between Member States and hamper the development of a proper integrated energy market. In a price review published in early 2014 by the European Commission[72], it appears that a typical household in Denmark pays EUR 0.30/kWh for its electricity, of which EUR 0.10/kWh are taxes, whilst a typical household in France pays some EUR 0.15/kWh for the same. Of this just over EUR 0.03/kWh are taxes. A mid-size industrial company with two similar production facilities in Finland and in Italy will receive an electricity bill of EUR 0.75/kWh in Finland and EUR 0.20/kWh in Italy. VAT on electricity further ranges from 6% in Luxembourg to 27% in Hungary.

Energy prices are a clear differentiator amongst Europeans whilst at the same time, EPEX SPOT, the European electricity spot market operator, working with most EU TSOs, has successfully achieved a European market coupling system which stretches from Italy to Finland and Norway, and from Portugal to the Baltics. This generates a real-time spot electricity price which is expected to become the only electricity reference price in the EU-28 in the near future. With an almost unique market price, bottlenecks on interconnections, taxes and grid costs make retail prices from one country to another vastly different.

5. Conclusion

Recent EU energy history is full of irony:

- The policy intention was first and foremost to move away from a hydrocarbon-based economy to a more sustainable and greener industry centred on the price of carbon, but it was unable to foresee the collapse of the carbon market, which was a central plank of implementation.

- The EU thought that the development of renewable energy sources would reduce its dependence on imported, foreign fossil energy supplies: this development has not been important enough to avoid the increase of the EU's dependence on foreign sources of energy supply. The policy has tied the European economy to high-cost and intermittent sources of energy, while not enough effort has been made to see how fossil fuel imports could be efficiently reduced.

- The EU has moved from a consistent energy and climate policy addressing sustainability, security of supply and affordability through a set of three objectives to inconsistent policy implementation and practice where sustainability undermines affordability and security.

- The EU has worked hard on liberalizing EU energy markets and "unbundling" European utilities to introduce more market mechanisms into the European economy. Yet the price of electricity in the EU has never been so uncompetitive when compared with other large economies, and the share of regulated components in the electricity price has now reached 75% in Germany, for instance.

In just ten or twelve years, it seems that European policy has taken EU-28 somewhere it had no intention of going when it started.

The European Union is one of the only great economic powers in the world that is adopting a new economic model, which is less carbon-intensive and more renewable-intensive.

In the last few years, in the aftermath of the economic crisis, the focus of energy and climate and energy policies has been evolving. These policies have to be justified to a greater extent not only on climate and renewable grounds, but for their positive impacts in terms of growth enhancement and job creation.

72 © European Union, http://eur-lex.europa.eu, 1998-2015,, "Energy prices and costs report", Commission staff working document [SWD(2014) 20 final], available at: http://www.cep.eu/Analysen/COM_2014_21_Energiepreise/Staff_Working_Document_SWD_2014__20.pdf

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

1. EU energy policy beyond 2020 – what is to change?

The major policy changes envisaged for the post-2020 era in the policy framework for 2030 include a renewable energy target which will be at EU level only, and not be differentiated by Member State, and a greenhouse gas reduction obligation which will be set at 43% versus 1990 emissions for the ETS sector, and at 30% for the non-ETS sector. There will be differentiated obligations at national level for the non-ETS sector.

The EU has also added urgently needed measures in order to ensure that the existing minimum target of electricity interconnector capacity being equal to 10% of production capacity be achieved by 2020, and has set a target of 15% by 2030.

Furthermore, a decision at EU level on establishing a Market Stability Reserve after 2021 will absorb the EUA surplus.

This comes on top of the previously published EU Energy Roadmap 2050 which established the ambition of decarbonizing the EU economy by 80% in 2050 compared to 1990 emissions levels. The EU Energy Roadmap further includes five decarbonization scenarios to achieve this emissions reduction, all assuming a primary energy demand reduction of 33-40% versus 2005 at EU-28 level.

Looking forward, beyond 2020 and until 2050, many questions remain: **to what extent will the 2030 package make it possible to overcome the difficulties encountered so far?** To what extent can these new targets be reached without endangering further security of supply and the affordability of energy? And, how are we going to make the most of the currently untapped industrial potential of Europe: biofuel development, energy efficiency in buildings, efficient cars, smart grids and decentralised energy systems etc.

2. EU energy policy beyond 2020 – What are the solutions?

Table 3. Troubleshooting synthesis

	Issues	EC Proposal[73]	Challenges
Renewables	Their development has been driven by state support schemes independent of any adequacy mechanism	They should be developed as and when needed in accordance with generation adequacy requirements at EU and national levels and based on a bidding process	Efficient technologies still in their infancy and require support (e g marine…) may suffer significant delays
	Support schemes based on guaranteed prices are inappropriate and have kept market participants immune from market signals	They should be based on guaranteed volumes agreed to in advance by market participants under a power purchase agreement	For market participants to commit to guaranteed volumes via a bidding process is likely to result in a higher risk premium and higher capital costs
	Incentives today based on feed-in-tariff	Should come on top of market price through some form of Contract for Difference, not in lieu of market price	As the market price goes down, the incentive goes up for the Treasury
		Should come on top of market price PLUS carbon price through some form of ETS-related Contract for Difference, rather than ignoring the CO_2 price	As the carbon credit price goes down, the incentive goes up for the Treasury
GHG ETS	Over-allocation of carbon credits will keep growing until 2020 and weaken the carbon price signal	Reform the ETS market with a view to transferring the CO_2 credit surplus to a Market Stability Reserve after 2020 in order to regulate the carbon price	Adoption of a Market Stability Reserve in 2021 is too far out.
GHG – Non-ETS	Non-ETS sector accounts for around half or more than half of the GHG physical emissions and only accounts for 10% of the effort sharing	A clear, single and binding approach should be established with unique binding targets for all Member States in order to achieve domestic objectives on greenhouse gas emissions in the non-ETS sector	
Energy Efficiency	Member States disagree on targets. Western Europe well ahead of Eastern Europe	Energy Efficiency Directive should be, or could be, the single key target which would allow all technologies to compete	Achievements difficult to measure based on single EE objective. Many sectors concerned

73 © European Union, 1995-2015. These proposals are taken from the following documents by the European Commission:

- Commission staff working document impact assessment: A policy framework for climate and energy in the period from 2020 up to 2030, 22 01 2014
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A policy framework for climate and energy in the period from 2020 to 2030
- Green Paper on energy and climate policy, March 2013

Table 3. Troubleshooting synthesis (continued)

	Issues	EC Proposal[73]	Challenges
Public Policies	Risk of under capacity: capacity development and new power plant construction	Should be supported by long-term contracts between generators and off-takers (including consortia of companies), subject to those contracts complying with competition law provisions: long-term contracts will provide both generators and companies with the predictability and price outlook that is needed to support their financing, including contracting hedges against peak prices, better planning and more efficient operations	Long-term contracts take volumes out of the liquid, day-ahead market. But, the example of the oil market demonstrates a market may still be active, liquid and efficient when a predominantly OTC market uses a spot price which is established by only a small share of the physical volumes. The NYMEX spot contract accounts for only 5% of the physical volumes
	Lagging integrated market: dilemma of how to speed up integration	Review market rules, including network access rules (network codes), as well as intraday access rules for electricity suppliers, putting all competitors from different Member States on the same footing: when Member States develop intraday, balancing and ancillary services markets, all players, including end-users, should be able to participate in those markets. This will stimulate demand response	Complexity of intraday market and pricing mechanism Few incentives for small end-users to become market participants in the intraday market
	An "Insufficient level of generation adequacy" remains	The EC wants to align and streamline the rules with respect to increasing reserve capacity margins, in particular through capacity payment mechanisms, in order to ensure generation adequacy. Public support schemes will therefore be offered for investments in new electricity generation capacity or for remunerating existing plants to remain operational. At the same time, the EC establishes as a principle that no investment in generation from fossil fuel plants will be rewarded unless it can be shown that "a less harmful alternative to achieve generation adequacy does not exist".	The proposal will be conditional upon the Commission's assessment that the capacity remuneration mechanisms do not result in over-compensation. Alternatively, Member States will have to demonstrate that generation adequacy cannot be addressed through alternative measures to new generation capacity, such as demand-side management response measures or new energy infrastructure. The merit of the proposal is that all contribution to generation adequacy will be taken into account, new capacity development, demand-response systems, interconnections...
	Switching rates tend to be low in Europe in part in consequence of imperfect price signals. Pricing signals from the wholesale market are low and fail to make final energy-consumers price-sensitive. Too many complex, sticky retail prices and non-market based price regulations.	Develop demand-response measures through a fully rolled out high speed open information and communication technology infrastructure	Need for a fully rolled out high speed open information and communication technology infrastructure
	Support to Renewables is a Member State competence.	Support to Renewables should be a joint EU and Member State decision. In particular, Support to intermittent energy should not be available where the interconnection, grid infrastructure or existing flexible capacities are low.	This will challenge the principle of Member States' sovereignty over energy matters.

Table 3. Troubleshooting synthesis (continued)

	Issues	EC Proposal[74]	Challenges
State Aid[73]	Granting State aid is in principle incompatible with the internal market and the Treaty on the Functioning of the EU. The EU Treaty provides however for exemptions. In 2014, the European Commission issued propositions to review the State Aid system, including the so-called "compatibility criteria" with a view to achieving the 2020 renewable energy targets while minimising the distortive effects of support schemes.		
	"State aid rules for support schemes to electricity from renewable energy sources (RES-e) do not prevent cost-inefficiencies and undue market distortions."	Support schemes to promote electricity from renewable energy sources will be market-based mechanisms that address market failures, ensure cost effectiveness and avoid overcompensation or market distortion. In particular: 1. RES-e installations will have to sell their electricity production on the market, and will receive a "subsidy" indexed to market prices, as is already the case in a few MS (Feed-In premiums). 2. RES-e producers will be further subject to the same balancing responsibilities as other electricity generators: they will be responsible for their deviations from the scheduled generation plan.	A market-based framework with a view to restoring investor confidence and keeping capital costs down will need to start with eliminating the distortions created by the existence of the two different support schemes, Feed-In Tariff versus Feed-In Premiums. Then more market integration will have to be achieved through more cross border opening. The RES-e producers will definitely face a higher risk on their return on investment which may itself lead to an increased cost of capital. Increased competition across technologies may also lead to giving old proven technologies a market advantage which may hamper the deployment of immature RES-e technologies.
	Financing the support to electricity from renewable energy sources may lead to higher retail energy prices, for industrial consumers, which may increase pressure on Member States to exempt certain undertakings from the costs of financing renewable energy.	Financing the support to electricity from renewable energy sources may lead to higher retail energy prices, for industrial consumers, which may increase pressure on Member States to exempt certain undertakings from the costs of financing renewable energy.[75]	The EC is definitely working hard to minimise the risk of relocation of energy-intensive manufacturers outside of the EU in order to avoid a "RES financing", after the "carbon", leakage. However, the measures seem to be increasingly complex, including various sets of definitions and criteria. The outcome might be that the residential customers, who represent a rather large, inelastic demand with little market power end up bearing the bulk of the RES-e financing efforts.

The 2030 Framework aims to address four current failures of the 3 x 20 policy actions:

1. The EU long-term climate objective of reducing greenhouse gas emissions by 80-95% in 2050 versus 1990 will not be met based on current trends.

2. In view of the EU's growing energy dependence, additional proposals will be needed under the 2030 framework in relation to security of energy supply, in particular in the areas of energy efficiency, demand response potential and a further diversification of the energy mix.

3. The EU needs to send investors the right signal to restore confidence and reduce regulatory risk. For a long time, the EU has relied on the two main policies of liberalizing the market with a view to creating "energy only" cross-border trade, and moving to a green economy by subsidising renewables. The outcome is a surplus of subsidised electricity and a price slump. Remunerating capacities could help fix the problem and send a better signal to investors.

4. The objective of creating a unified European energy market still needs to be implemented. The EU needs to achieve energy cost reduction and competitiveness.

74 © European Union, 1995-2015. Relevant sources include:
- European Commission (2014), Communication from the Commission Guidelines on State aid for environmental protection and energy for 2014-2020
- European Commission (2015), Energy Union Package, A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, 25 February 2015
- European Commission (2015, Energy Union Factsheet, 25 February 2015

75 Aid to an electricity-intensive sector is deemed necessary when sectors are facing a trade intensity of 10% at EU level and when the sector electricity-intensity reaches 10% at EU level. In addition, sectors that face a lower trade exposure but have a much higher electricity-intensity of at least 25% would also benefit from the relief. Equally, sectors having a slightly lower electricity-intensity and facing a very high trade exposure of at least 80% would also be partly or totally exempted from RES-e financing aid.

3. The challenges ahead

a) The internal energy market is supposed to have been "completed" by now

With the development of capacity markets across Europe, have the EU-28 actually missed another opportunity to progress the internal, integrated energy market?

So far, EU electricity liberalization has resulted in "energy-only" markets. These have proved to be the best way to dispatch electricity efficiently and ensure assets are optimized. However, **energy-only markets have failed to deliver a price signal to incentivize investment. This is especially true in countries with large shares of renewables with zero marginal costs**, such as Germany, or where regular price spikes are disruptive for consumers.

The EU is now moving from an energy-only market to a capacity-plus-energy market. A capacity market works by offering all providers of capacity (new and existing power stations, electricity storage, and voluntary demand reductions) a value for capacity reserve contributing to security of supply.

Several capacity payment schemes are being implemented in a few Member States (centralized, decentralized, strategic reserve, etc.). **The development of capacity mechanisms across Europe**, which is a move away from the energy-only market, **is designed to ensure that sufficient reliable capacity is in place to meet demand, either during peak times or in the face of intermittent energy supply sources. The EU needs to define consistent criteria for capacity mechanisms at European level.** This should include single definition for generation adequacy, which would cover existing capacity and new capacity development, demand-response systems, storage capacity, interconnections, consumer load-shedding capability, etc. This entails the creation of capacity coordination systems at regional level. All of this calls for a radical review of the existing EU market design but is a pre-requisite for achieving an integrated energy market and ensuring security of supply.

The capacity market is critical for solving the energy "trilemma", i.e. to deliver delivering green, reliable electricity for the future at the lowest possible cost. The need for reliable electricity generation capacity at all times, especially when moving to a low carbon economy with significant intermittent energy sources, is a unique opportunity to develop a single EU energy market. However, it looks as if national models are going to be developed in various countries. Different mechanisms are going to generate different capacity prices and various capacity price spreads. **The EU-28 actually needed only one capacity market, but at Union level. This may not happen.**

Building a stronger internal energy market implies also further development of cross-border connections and more coordination amongst national Transmission System Operators (TSOs).

b) REN targets versus affordability: how can we reach REN targets without pushing energy prices up for consumers?

According to the IEA, the EU incentives to renewables was around USD 57 billion in 2012, which represent around 60% of worldwide incentives to renewables (which reached USD 101 billion in 2012, 11% more than in 2011)[76]. The bulk of this went to solar PV. These **total incentives,** if it were to be evenly paid by all electricity consumers, as opposed to only a fraction of the market today, **would represent a price increase in excess of USD 20 for each MWh consumed in the EU**.

In its Impact Assessment Report[77] the European Commission pointed out that were the emission reduction efforts to continue beyond 2020, and be largely achieved through the development of renewable energy sources, an increase in real terms in the average electricity price of some 30% above 2011 levels would be needed to support investment in new generation capacity, energy efficiency measures and grid extension. This does not take into account any increase in international fossil fuel prices. **This does not bode well for the affordability of EU electricity.**

At industrial retail level, the price is already twice as high as in the US and 20% more expensive than in China today according to the European Commission itself. This is despite the fact that the wholesale price has come down consistently in Europe as a result of depressed demand and overcapacities in electricity generation.

The EU needs to find alternative ways of financing smart grids, energy efficiency and renewable while integrating those fully into a competitive market, without passing the burden on to household and SME electricity bills.

76 © OECD/IEA 2013 World Energy Outlook, IEA Publishing. Licence: http://www.iea.org/t&c/

77 © European Union, http://eur-lex.europa.eu, 1998-2015, "Impact Assessment – A policy framework for climate and energy in the period from 2020 up to 2030", Commission staff working document [SWD(2014) 15 final], available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN

In order to keep EU electricity affordable for consumers, a cap needs to be put on subsidizing renewable capacities, either by limiting capacity development or the level of incentives (as is already the case in Germany, Spain and the UK). **"Subsidy auctioning"** could be a good way to balance state intervention and market mechanisms. This is where renewable developers bid for the lowest possible incentive level. This mechanism **has the advantage of capping the increase in electricity bills for households, as well as incentivizing the investor to promote the most competitive technology**.

A question then still remains: should the EU stick to this mechanism whereby smart grids, energy efficiency investments and renewables development are (almost entirely) paid for by a surcharge on household and SME electricity bills, while the largest energy users are largely relieved of these financial charges in many countries?

Alternatives include:

- **A pure tax incentive mechanism,** where investors could recover their investment through a tax cut: the advantage of the tax incentive is to limit the damage done by renewables to the competitiveness of electricity prices.
- **A system of Energy Investment Allowances (EIA),** such as that in place in the Netherlands. It incentivizes renewables development and energy-efficient technologies (including renewables) by allowing deduction of part of the investment costs from taxable profits. The advantage is that investors select their technology based on their perception of the adequacy level or supply and demand equilibrium, rather than opting for the technology that attracts a subsidy. Another advantage is that it avoids increasing the price of retail electricity through the EEG (in Germany) or the public service obligation of the tariff, e.g. the CSPE (in France).
- **A UK-style carbon price floor,** which has the merit of raising consumers' awareness of the cost of energy and financing the energy transition at the same time.

c) GHG: are we going to fix the ETS market and have a market mechanism that produces the right price of carbon?

The EU's long-term GHG emissions reduction goals look like a mere extension of the previous goal by another 20% cut to be achieved over a 10-year period beyond 2020. It might be considered slightly optimistic on the part of EU lawmakers to believe that **EU Member States will be able to reduce their emissions collectively by another 20% by ten years from now, given it took them almost 30 years to reduce carbon levels to under 20%, and this was against a backdrop of severe economic contraction**.

In 2014, the IEA stated that a EUR 55/ton of CO_2 equivalent was necessary for the EU to achieve its renewable energy target of 27% of final consumption. **More interestingly, the EC has calculated that EUR 53/ton CO_2 would suffice to achieve all 2030 objectives. This means that a high price for carbon could be a more efficient policy tool than costly renewables.** It also means that this is the carbon price level needed today to help move away from coal to gas, nuclear and/or carbon-free technologies.

Given the present situation of the ETS and the very low price of CO_2 allowances, there is widespread recognition that the ETS market is due for an overhaul, starting with eliminating the credit surplus. The proposed reform includes "backloading" EUAs, the creation of a market stability reserve to be used as a "credit buffer" to regulate the price after 2020, and a CO_2 reduction increase from 1.74% annually to 2.2% from 2021 onwards.

But none of the reforms above will be effective before 2021. This will obviously be too late to have a carbon price constituting a driver for low carbon technologies by 2020. In the years ahead, investor confidence in EU energy projects will remain low. So, presumably, will the carbon price. This also means that European power plants will burn a great deal of coal, since it is available on the market on a vast scale at a competitive price – unless legislation forces coal out of the market.

In the longer-term, the 2030 ambitious GHG emissions targets (-43% between 2005 and 2030 in the ETS sector) are likely to push the carbon price upward at last.

d) Carbon, renewables, energy efficiency: do we need so many objectives?

In the 2030 package, **the energy efficiency target seems to have been taken out of the set of three binding criteria** and replaced by a few indicative objectives. In terms of **2030 renewables objectives, the 27% target is now to be "binding at the EU level"**, and it is explicitly stated that it is **"not [to] be translated into nationally binding targets"** in contrast to the present system. But how will it be delivered? How will Europe make sure the objective is met, other than through protracted, endless government-to-government negotiations and horse-trading? Or, does it mean that the renewables target has now become non-binding altogether?

The GHG emission reduction potential of non-ETS sectors (which include transport, buildings, agriculture and waste) **seems to have been underutilized until now.** In 2013, the non-ETS sector contributed around 60% of European GHG emissions[78], whereas its GHG emission reduction targets were less ambitious than those for the ETS sector (the targeted reduction between 2005 and 2020 is 10% in the non-ETS sector and 2021% in the ETS sector). It can be wondered how the EU-28 can encourage, in a most cost-effective way, the GHG emission reductions in the sectors with high GHG emission reduction potential, such as transportation, buildings, land and forestry.

However, the task of reducing CO_2 across the non-ETS sectors does not look easy as the sector covers a vast number of small, scattered emitters. For the period 2013-2020, these are subject to binding greenhouse gas emission targets for Member States set by the Effort Sharing Decision (ESD)[79]. After 2020, they will probably remain subject to national targets, which will be de-correlated from the ETS objectives. In other words, it will not be possible for a country to swap ETS allowances for non-ETS emissions. Cracking down on heavy vehicle pollution in cities will not provide anyone with credit for relaxing the carbon regulation on their power system. In other words, it will not be possible to swap non-ETS achievements against ETS objectives. That could have actually helped to reduce physical emissions.

The 3 x 20 targets are complex, especially those relating to energy efficiency, and may have created more inconsistencies than real synergies between the different targets. The post-2020 targets do not seem clearer and it will probably not be easy to monitor progress in reaching them.

In fact, what is the point in imposing such a large, complex host of differentiated and EU objectives? **Why not stick to a single emissions reduction target rather than multiple targets which vary at EU and national levels? Why not stick to a single, highly visible and measurable carbon emissions target covering ETS and non-ETS sectors, and let countries and markets select the technology which they think makes more sense or shows a better cost-benefit ratio?**

e) To what extent can technology be part of the solution?

One of the biggest challenges ahead may be the role that developments in technology and behavior will be able to play to alleviate the burden required to meet the ambitious targets for 2030 and 2050. As indicated above, expectations were high in this regard when the initial targets were set.

It was expected that within a few years, most vehicles would be running on second generation biofuels, hydrogen or electricity; it would be easy to store electricity produced from RES thanks to storage technologies; there would be massive underground storage of CO_2 from power plants, thus paving the way to the age of abundant clean coal.

We all know that things did not happen this way.

We have witnessed a few breakthroughs: solar photovoltaic yields are increasing significantly, while the cost is decreasing steadily, thus making it more competitive day-by-day – so competitive in fact that that it has more or less killed all the competition from more ground-breaking alternative solar technologies, such as Concentrated Solar Power (CSP) or organic PV.

78 EEA (2014), Trends and projections in Europe 2014

79 Decision No. 406/2009/EC of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas reduction commitment up to 2020.

But there were few other successes in sight before this decade despite the political ambitions and the millions of Euro spent on R&D: several large-scale CCS projects were undertaken in the 2000s but the technology stalled shortly after because of its high costs and its relatively low social acceptability. Wind power has developed but without any significant technological improvement. Second and even third generation biofuels were said to be on the brink of being ready for the market in the early 2000s (via either thermochemical or biological pathways) but after a few bankruptcies (Choren et al.), the situation has not changed much, and we are still waiting for industrial development of these new technologies. Electric cars are still scarce, etc.

That said, **over the last few years, things may have begun to change.** Several factors are at work: the major development of the Silicon Valley giants and the profound impact this has had both on some technological developments and on our day-to-day behaviors; the economic crisis and the consequent search for more resource-efficient ways of life; R&D efforts undertaken over a few decades bearing fruit at last… Whatever the reason, a careful observer can spot significant developments, even if it will be a few years yet before they reach their full potential:

- Toyota paved the way to new modes of motorization with its successful, but expensive, Prius Hybrid a few years ago. Over the last two to three years, mainstream car manufacturers have begun to sell **affordable electric vehicles** (e.g. Renault and its Zoe).

- The spread of connected objects and the search for resource efficiency have made the development of new **vehicle-sharing modes** easier, either through centralized models (e.g. Autolib) or on a more personal basis (e.g. Bla Bla Car).

- Metering energy consumption with precision has long been very costly, meaning that it was only available to very large consumers. Simpler meters have paved the way to the **massive development of smart meters and smart grids**; smartphones enable easy long distance energy control and command. A better demand/response match is probably in sight.

- The technologies required for demand-side response (such as smart distribution networks, smart meters and appliances, and electricity storages) and demand-response services (dynamic pricing, interruptible load or dynamic-load capping contracts for industry, commercial businesses and households, participation in balancing markets, service aggregation and demand optimisation for households) are blooming and may mean that **the enormous potential of the demand-side response can be exploited on an EU scale at last** (currently, peak demand could be reduced by 60 GW, approximately 10 % of EU's peak demand)[80].

The future is not so bright for all the long awaited innovations. Some technologies may be relatively technically mature but not yet competitive in current market conditions (e.g. CCS, power-to-gas and new technologies related to energy efficiency in buildings). And some very promising technologies are still further from commercial scale, such as next generation biomass-to-energy processes or power storage. But between now and 2030, technological developments may surprise us.

On February 24, 2015, the European Commission set out its strategy to achieve "a resilient Energy Union with a forward-looking climate change policy"[81]. This shows positive signals to tackle the challenges outlined in this study. Concrete measures still need to be defined and implemented in the next few years.

According to official ex ante evaluations by the EC, the benefits of saving energy and resources as the single path to achieving a carbon-free society would by far exceed the cost of the investment requirements. Given the very high costs involved, it would be worthwhile to reassess this ex ante evaluation regularly, once the costs and benefits can be evaluated *a posteriori* – and to adapt policies if necessary before they lead us once more into unexpected and unwanted territory.

80 Source: http://ec.europa.eu © European Union, 1995-2015, European Commission (2013) Communication from the Commission Delivering the internal electricity market and making the most of public intervention [C(2013) 7243 final], available at: http://ec.europa.eu/energy/sites/ener/files/documents/com_2013_public_intervention_en.pdf

81 http://ec.europa.eu/priorities/energy-union/index_en.htm

List of acronyms

BAU: Business as usual

CAGR: Compound annual growth rate

CER: Certified Emissions Reductions

CCGT: Combined Cycle Gas Turbine

CCS: Carbon Capture and Storage

CHP: Combined Heat and Power

CPS: Carbon Price Support

CSP: Concentrated Solar Power

CSPE: Contribution au service public de l'électricité (France)

EC: European Commission

EE: Energy Efficiency

EEA: European Environment Agency

EED: Energy Efficiency Directive (Directive 2012/27/EU)

EEG: Erneuerbare-Energien-Gesetz (Germany)

EII: Energy-Intensive Industries

ERU: Emission Reduction Units

ESD: Effort Sharing Decision

ETS: Emissions Trading System

EU: European Union

EU-28: European Union, 28 Member States

EUA: EU Allowance Unit (under the ETS)

FEC: Final Energy Consumption[82]

FQD: Fuel Quality Directive (Directive 2009/30/EC)

GHG: Greenhouse Gas

IEA: International Energy Agency

IED: Industrial Emissions Directive (Directive 2010/75/EU)

IPP: Independent Power Producers

LCPD: Large Combustion Plant Directive (Directive 2001/80/EC)

MS: Member State

PEC: Primary Energy Consumption[76]

PV: Photovoltaic

RED: Renewable Energy Directive (Directive 2009/28/EC)

REN: Renewable energy

RES: Renewable energy source

SDE+: Stimulering Duurzame Energieproductie (Netherlands)

toe: Ton of oil equivalent

TSO: Transmission System Operator

UK: United Kingdom

UNFCCC: United Nations Framework Convention on Climate Change

82 Eurostat uses three main indicators to measure energy consumption:

- **Gross inland (energy) consumption** is calculated as follows: primary production + recovered products + total imports + variations of stocks – total exports – bunkers;
- **Primary Energy Consumption** is meant the Gross Inland Consumption excluding all non-energy use of energy carriers (e.g. natural gas used not for combustion but for producing chemicals);
- **Final energy consumption** expresses the sum of the energy supplied to the final consumer's door for all energy uses. It is the sum of final energy consumption in industry, transport, households, services, agriculture, etc. Final energy consumption in industry covers the consumption in all industrial sectors with the exception of the 'Energy sector'

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Appendix

European energy market reform
Country profile: Belgium

Contents

Current situation

Energy consumption and trade balance

In 2012, Belgium's energy consumption amounted to 56 Mtoe; more than 70% came from fossil fuels. Petroleum products (22 Mtoe) represent the first source of energy consumption, followed by natural gas (14 Mtoe). The share of oil products and nuclear in the energy mix remained stable during the last two decades, while natural gas consumption increased significantly, from 8 Mtoe in 1990 to 14 Mtoe in 2012.

Figure 1. Gross inland consumption in 2012 (56 Mtoe)[1]

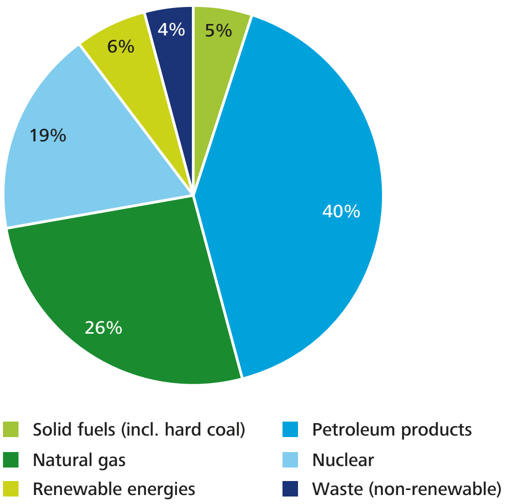
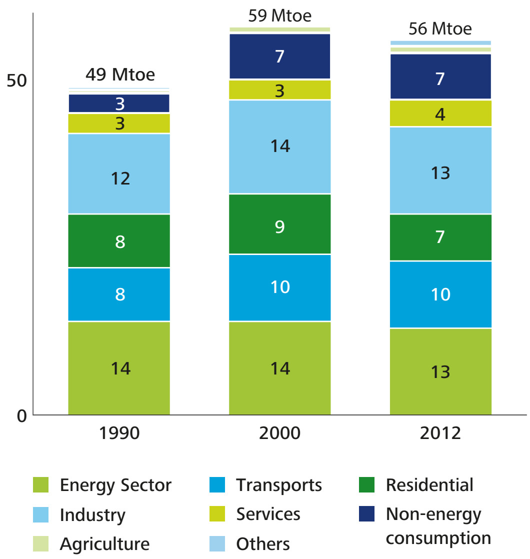


Figure 2. Gross inland consumption by sector (in Mtoe)[1]



The sharp increase in Belgium's energy consumption from 1990 to 2000 (+20%) has slowed down since 2000. Between 2000 and 2010, consumption grew by 3% and started decreasing in 2011 (-8% between 2011 and 2013).

The industrial sector accounted for 24% of energy consumption in 2012, the same share as in 2000. The energy sector was the main driver of overall consumption until 2012; while its contribution declined by 12% between 1990 and 2012, it became the second highest energy consumer (23%) in 2012, after industry. During this period, residential consumption experienced a similar decrease (-10%), while non-energy consumption[2] grew significantly (+153%), pushing up its share of energy consumption to 12%, which is almost on par with the residential sector's 13% share. As a critical hub for chemicals and plastics, Belgium is very attractive to the chemical industry. Its share of chemicals and plastics in the economy is almost twice the EU27 average, and its chemical trade balance increased by nearly 50% between 2002 and 2012.[3]

Key figures:

Population (2013): 11.2 million

GDP (2013): 382,692 bn €

GDP/capita (2013): 34,500 €

GDP/PEC (2012): 7.72 €/kgoe

PEC/capita (2012): 4.39 toe/cap.

Net Energy import: 47 Mtoe

CO_2 eq/capita: 9.46 tCO_2eq/cap

Increasing importance of natural gas in Belgium's energy mix.

Natural gas consumption nearly doubled between 1990 and 2010 before falling by 15% in 2011 and 2012. The fourth source of energy in the mix in 1990, natural gas had become the second source of energy consumption by 2012.

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

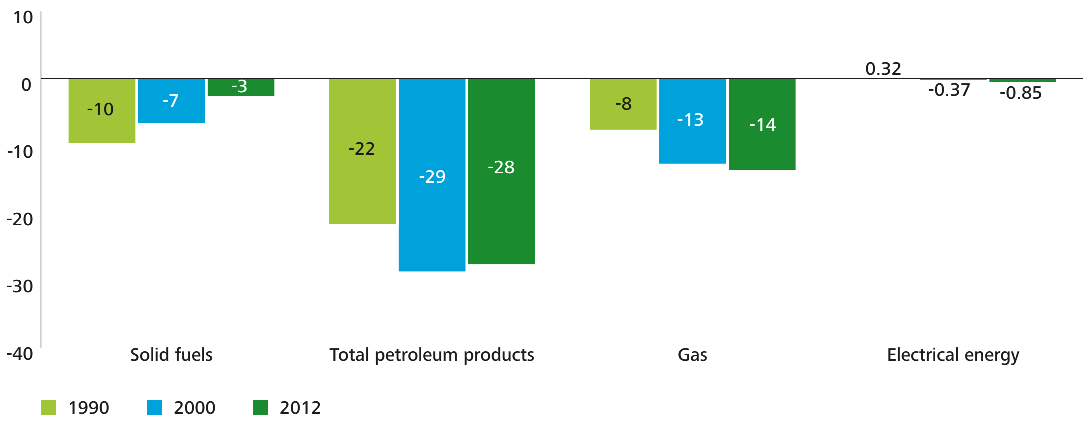
2 Non-energy consumption refers to fuels that are used as raw materials and are not consumed as fuel or transformed into other fuels

3 Essenscia – Belgian Federation for Chemistry and Life Sciences Industries, 2013

Heavily dependent on imported energy, Belgium needs to work on its energy security.

Belgium has recently taken measures to enhance the security of supply in various energy sectors, particularly electricity and gas. In the oil sector, the public stockholding agency, APERTA was created in 2006 to manage the strategic oil stocks that Belgium has difficulties in maintaining obligations (4.4 million tons crude oil-equivalent). Source: http://www.apetra.be/en/about-us.

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



Belgium is heavily dependent on imported energy: oil, gas and coal. For coal, the imbalance has decreased since 1990, whereas for gas, the imbalance has almost doubled due to its growing importance in the energy mix. In recent years, Belgium's energy dependency has slightly decreased (-8% since 2001) and reached 74% in 2012.[4]

However, **Belgium is still among the most energy-dependent EU countries** and ranked at eighth place in terms of energy dependency in 2012.

Nuclear energy provides over 55% of Belgian electricity. The phase-out of nuclear generation planned between 2015 and 2025 will pose a real challenge.

Renewables produced 7% of Belgium's power in 2013.

Power generation

Nuclear and gas are Belgium's main electricity sources, providing 87% of the country's electricity in 2013. Electricity capacity was 21 GW in 2013; 29% (or six GW) came from nuclear power plants that produced 57% of the country's electricity.[5] Gas holds second place in the power mix with an installed capacity of 4.3 GW (21%), contributing 29% of the electricity output, a percentage which fell in 2012 and 2013. Renewable energy represented 34% of the country's power capacity but only 7% of 2012 production; photovoltaic sources generate less than 1% of electricity output, with 13% of electricity capacity.

The phase-out of nuclear generation planned between 2015 and 2025, if pursued, will present a real challenge for Belgium and lead to major changes in the power market.

Figure 4. Electricity capacity, 20.6 GW (2013)

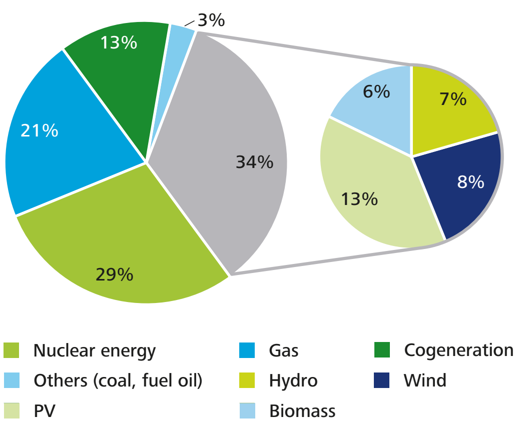
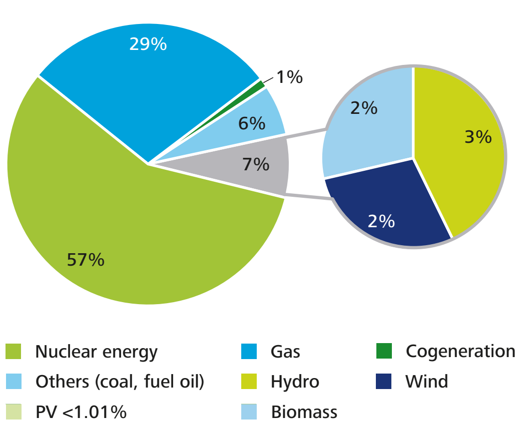


Figure 5. Net electricity production, 71 TWh (2013)

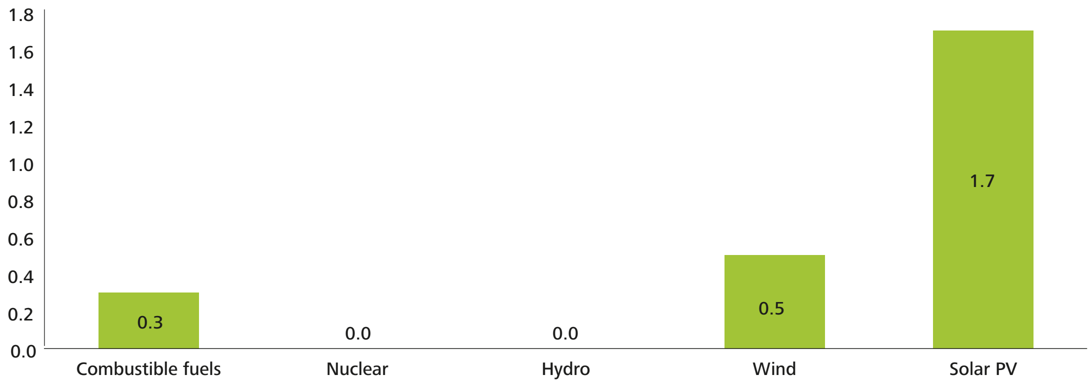


Between 2005 and 2012, Belgium added more than 4 GW of power capacity, mainly from solar and wind technologies (including 2.2 GW between 2010 and 2012).

4 Eurostat. Energy dependency shows the extent to which an economy relies upon imports in order to meet its energy needs. The indicator is calculated as net imports divided by the sum of gross inland energy consumption plus bunkers.

5 ELIA, rapport annuel 2013

Figure 6. Electrical capacity change 2010-2012 (GW)[6]



Between 2010 and 2012, wind capacity grew from 0.9 to 1.4 GW and solar capacity went from 0.9 GW to 2.6 GW. However, generation from renewables is intermittent, dispersed and weather-dependent, leading to grid stability issues such as congestions and imbalances. More flexibility is needed to cope with congestion and benefit from the installed capacity.[7]

In 2007 and 2011, the Belgium Commission for Regulation of Electricity and Gas (CREG), as well as other authorities, concluded that **Belgium faces security issues due to low electricity production capacity in the face of rising demand**. The financial crisis has delayed the need for additional capacity investments; however, the country may struggle to meet demand as early as 2015. In 2012-2013, Belgium's production capacity was compromised due to cold weather, and spare production capacity was limited to 370 MW during peaks. Security of supply is also threatened by the unplanned temporary halt of three nuclear reactors since mid-2014, representing half of installed nuclear capacity. The planned shutdown of the oldest nuclear plants (in Doel and Tihange) in 2015 and additional gas plant closures (Ruien 5 & 6 and Awirs 5) will further reduce electricity capacity and threaten the country's security of supply. Moreover, imports from France are declining, as France also faces security of supply issues. Additional concerns might arise from differences in spark spreads (the gross margin of power plants from selling a unit of electricity) between gas and coal, the latter being more affordable despite generating more emissions.

Power market: market mechanism and main actors

The opening of the Belgian market to competition was completed in January 2007 (July 2003 for Flanders, and January 2007 for Wallonia and the Brussels-Capital region).

Electricity production is concentrated, and dominated by two main incumbents: Electrabel, owned by GDF SUEZ, and SPE-Luminus, majority-owned by EDF. Commercial and residential markets are **considered competitive and dynamic**[8] **with a number of active electricity suppliers and a high and increasing switching rate** across Belgium's three regions since 2011.

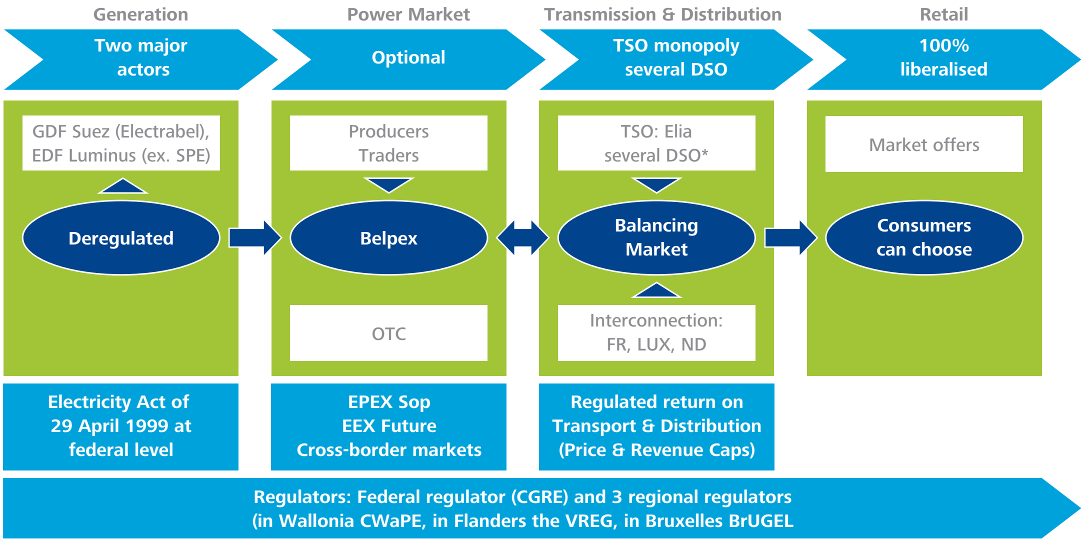
Elia, a public company listed on Euronext, is the only electricity TSO in Belgium. Publi-T, a cooperative company representing Belgian municipalities and inter-municipal companies, owns 45.2% of Elia's shares.

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

7 Sia Partners, Benelux The Belgian Electricity market: overview, analysis of today's issues and suggestions to fix it, 2013

8 © OECD/IEA 2009 Energy Policies of IEA Countries – Belgium 2009 Review, IEA Publishing. Licence: http://www.iea.org/t&c/

Figure 7. Market mechanism



*ORES, Tecteo (Resa), Régie de Wavre, AIESH and AIEG in Wallonia, Sibelge in the Bruxelles Region Eandis and Infrax in Flandre

Distribution system operators (DSOs) are ORES, Tecteo, Régie de Wavre, AIESH and AIEG in Wallonia, Sibelga in the Brussels-Capital region, and Eandis and Infrax in Flanders. Together, they manage the day-to-day operations of the grid. Municipalities own the DSOs' shares.

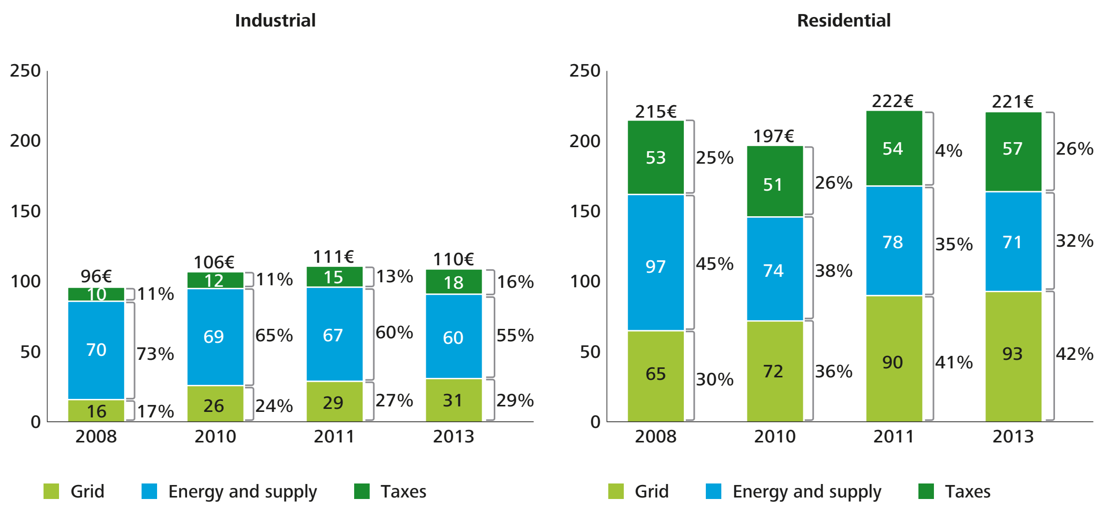
Power prices

Electricity prices are determined in the Belgian electricity spot market (Belpex), which has been coupled to the French and Dutch electricity markets, Powernext and APX, since 2007. The market price is the same in those three countries, only differing when there is insufficient interconnection capacity available on the Belgian-French or the Belgian-Dutch borders.[9] Wholesale market prices are based on Belpex and APX (Belpex has been a 100% subsidiary of APX since 2010). Domestic retail prices are not related to either wholesale price or to actual cost, but are instead indexed to, for example, fuel prices (coal and gas) and the RPI (Retail Price Index). Although retail prices are not regulated, most suppliers use a variation of cost indexation formulae calculated by CREG (the Belgian energy market regulator).[9]

In 2008, the Belgian government announced that nuclear power plant operators would have to pay a "nuclear contribution" of € 250 million. This nuclear contribution was increased to € 550m for 2011 and subsequent years. Nuclear producers are contesting the nuclear contribution and have filed several claims in the courts. To date, court decisions have not supported these claims.

9 © OECD/IEA 2009 Energy Policies of IEA Countries – Belgium 2009 Review, IEA Publishing. Licence: http://www.iea.org/t&c/

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



High residential electricity prices and supply issues.

Belgium's energy prices for average industrial consumers are below the EU-28 average, but consumers pay the fifth highest residential electricity prices in the EU. Insufficient interconnection capacity on the Belgian-French or Belgian-Dutch borders can make it difficult for the country to balance supply and demand.

Retail prices for residential consumers in Belgium are among the top 10 highest prices in Europe. Residential consumers pay the fifth highest retail prices in the EU (221 €/MWh in 2013), 18% above the EU-28 average (169 €/MWh in 2013). Prices for household consumers rose by 13% from 2010 to 2012, after a decrease between 2008 and 2010 (-8%). This increase was due to rising grid costs (+38%), partially offset by declining energy costs (-19%) and taxes (-1%).

In 2012, Belgium's overall policy support costs (PSC) were 29 €/MWh, both for industrial and residential users, which was higher than the European average (21 €/MWh for industrial users and 25 €/MWh for residential ones). These policy support levies are charged on three tariff components: commodity-related RES and CHP support (50%) for energy; system-related RES support (23%) for the network; and public service obligations/social policy support costs (27%) for taxes[11]. As a result, the overall support to CHP and RES amounts to 21 €/MWh (i.e. around € 1.5 billion in 2013). This means that power and grey energy (the energy hidden in a product) market prices do not necessarily reflect the real underlying cost structures and unit costs of renewables as compared to grey energy. Furthermore, not all of the policy support costs paid out to renewable energy producers have led to increased consumer tariffs and taxes, a situation likely to push up power prices in the future, regardless of energy sources. Overall, the effectiveness of the country's PSC and its (green) return on investment has been called into question, and current policies can afford to be improved.

In 2012, retail prices for average industrial users in Belgium totaled 111 €/MWh, below the EU average (125 €/MWh). The prices grew by 15% between 2008 and 2012, as a result of increasing grid costs (+81%) and taxes (+43%). Energy and supply related costs slightly decreased (-4% from 2008 to 2012) for the same period.

However, between 2011 and 2013, large industrial consumers in Flanders and Wallonia paid on average between 12% (for a 1,000 GWh profile in Flanders) **and 45%** (for a 100 GWh profile in Wallonia), **prices that were considerably higher than those charged in neighboring countries such as Germany, France and the Netherlands.** These differences are predominantly due to policy measures in neighboring countries (reductions and exemptions) that favor industrial consumers, such as lower regulated market prices (in France), lower network costs (in Germany) and lower electricity taxes (in the Netherlands and France). Electricity taxes in Flanders are relatively high, and are even more so in Wallonia.[12]

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

11 Eurelectric, Analysis of European Power Price Increase Drivers, May 2014

12 Deloitte (2013), Benchmarking study of electricity prices between Belgium and neighboring countries

Targets for 2020

20-20-20 EU targets for Belgium:

- 18% reduction of primary energy consumption, as compared to a 2020 projection (calculated with the model PRIMES 2007).
- 13% share of renewables.
- 21% and 15% reduction of ETS and non-ETS GHG emissions, respectively, to be implemented at the regional level, requiring close coordination.

In 2009, the National Climate Plan set the main targets and action plans regarding energy and the climate. They were subsequently reviewed and updated in several other plans, and confirmed in the 2014 National Reform Program:

- An indicative energy efficiency target of an 18% reduction in primary energy consumption by 2020 (compared to a baseline projected scenario for 2020 calculated by the European energy model PRIMES 2007).
- A 13% share of gross final energy consumption from renewable energy sources by 2020.
- A 21% reduction of GHG emissions by 2020 compared to 2005 in sectors covered by the EU emission trading system (ETS).
- A 15% reduction of GHG emissions by 2020 compared to 2005 in non-ETS sectors.

Even if the 20-20-20 European targets apply to Belgium, climate and energy policies are mostly implemented at the regional level (Flanders, Wallonia and the Brussels-Capital region), a situation which can sometimes raise coordination issues. The national targets, set up in response to the European 20-20-20 targets, are translated into regional targets for each of Belgium's three regions, under the coordination of several federal agencies (Inter-ministry Conference for the Environment, Coordination Committee of International Environment Policy and National Climate Commission).

Energy efficiency: with a stable final energy consumption in recent years, Belgium needs to implement measures to reach its energy efficiency targets.

Belgium's primary energy consumption has remained almost stable since 2005. It is not clear whether Belgium will be able to reach its 2020 energy efficiency target.

Energy efficiency targets

Belgium's energy efficiency has been improving in recent years, but its energy intensity remains higher than its neighbors'. This relatively higher energy intensity can be partly explained by the particular structure of its economy and industry, which features a proportionally high share of energy-intensive activities, such as chemicals and metallurgy. While GDP in Belgium rose by 49% between 2000 and 2012, its primary energy consumption in 2012 decreased by 5% as compared to the 2000 level. However, this decline is quite recent; final energy consumption grew steadily from 1990 to 2010 (+19%).

Figure 9. Final energy consumption (Mtoe) and 2020 target[13]

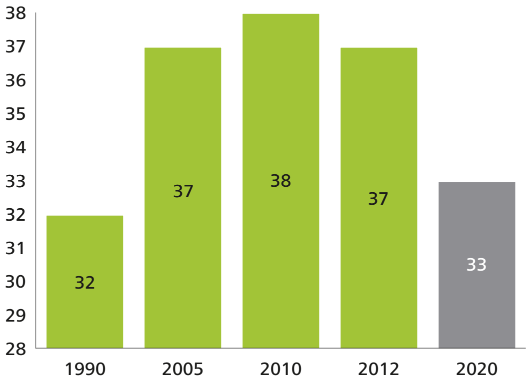
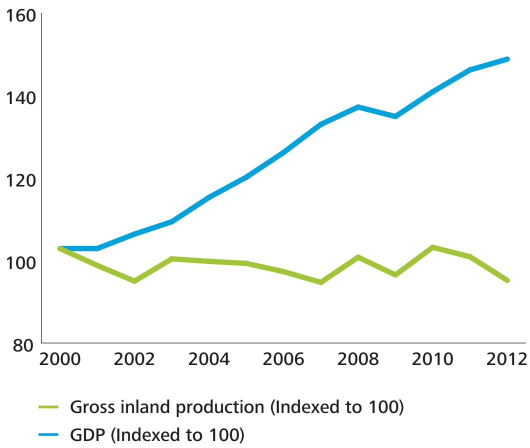


Figure 10. Energy efficiency 2000-2012



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

In April 2014, the Belgian government adopted the 2014 National Energy Efficiency Action Plan (NEEAP).[14] **The overall targeted primary energy savings fostered by existing and planned policies amount to 9.6 Mtoe by 2020** (calculated as the difference between projected gross inland consumption in 2020, without and with energy savings measures). If achieved, these savings would allow Belgium to meet its objectives of an 18% reduction in primary energy consumption in 2020. Some of the measures Belgium has adopted to meet its energy savings targets include:

- Implementation of the ecodesign and ecolabelling Directives (2.73 Mtoe) in the **residential and services sectors** to promote more energy efficient products (for building, heating, boiler, isolation, materials, etc.) and related incentives.

- Public support to **residential consumers to encourage investments in renewables and/or energy savings** (tax credits for the maintenance and replacement of heating boilers, solar water heating, installation of photovoltaic panels or installations to produce geothermal energy, etc.).

- For **transport**, measures to limit the growth of road traffic, develop other means of transport and reduce energy use in the transport sector; energy consumption from transport has not declined in the past 12 years.

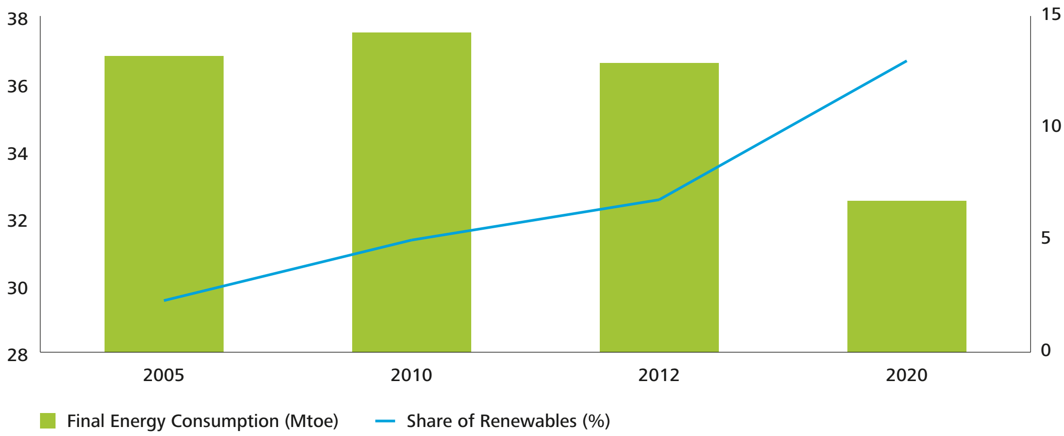
The Belgian NEEAP lacks clear sectorial targets and an overall target for the mid and long terms.[15] In the NEEAP, each region has committed itself to reach a 9% energy saving target by 2020, as part of the Energy Efficiency Directive (EED) framework. The Flemish region expects the highest savings: it is targeting a 13.9% saving by 2016 (compared to the reference scenario). For its part, Wallonia expects to save 7.9%, which will put it short of meeting the EED target. Brussels is likely to reach its 10% energy savings target in 2016.

With final energy consumption remaining stable between 2005 and 2012, it is not clear whether Belgium will be able to reach its 2020 energy efficiency target.

Renewable energy targets

Belgium's renewable energy targets aim at reaching a 13% renewables share of final energy consumption by 2020. In 2012, renewables accounted for 6.8% of final energy consumption, compared to 2.5% in 2005. This means Belgium has achieved nearly half of its target.

Figure 11. Renewable energy share of final energy use (2012)[16]



14 European Commission, http://ec.europa.eu/energy/efficiency/eed/neep_en.htm

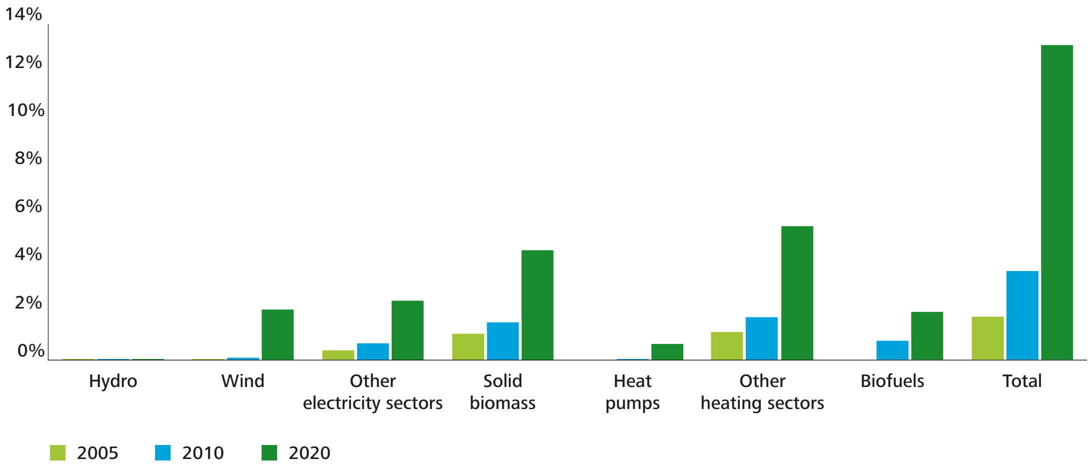
15 Assessment of Energy efficiency action plan and policies in EU Member States, Belgium Country profile Energy Efficiency Watch, http://www.energy-efficiency-watch.org/fileadmin/eew_documents/Documents/EEW2/Belgium.pdf

16 Source: http://ec.europa.eu. © European Union, 1995-2015

Renewable energy: 51% of Belgium's target has yet to be achieved. Belgium could have difficulties reaching its 2020 targets.

Belgium is currently generating 6.8% of its final energy consumption from renewables. New capacities will come mainly from wind and, to a lesser degree, biomass. Difficulty maintaining this momentum could impede the country's ability to reach its energy efficiency targets unless more ambitious measures are implemented in the next few years.

Figure 12. Renewable energy share of final energy use by type, in 2005 and 2010, and target for 2020, in %[17]



Targeted capacity in 2020 is 8,255 MW of renewable capacities for electricity production, 2,588 ktoe for heating and cooling, and 886 ktoe for the transport sector.[18]

To promote renewable use in the power sector, **Belgium implemented a system of green certificates** (allocated to production from renewable sources). These certificates can be traded on a dedicated market. Electricity sellers must present green certificates to meet their requirement. They are required to have a share of their sold electricity produced from renewables; a minimum price is guaranteed by the regulator.

In addition to this green certificate scheme, Belgium has prepared a roadmap that includes financial incentives, as well as regulatory and non-binding measures related to the following strategic areas:

- Offshore wind generation (reserved zone for offshore winds parks, contribution to cabling costs, etc.).
- Heating and cooling (CHP certificates, support mechanism for green heating).
- Promotion of investments in renewable energy (tax reduction for investments on ENR for companies and individuals, etc.).
- Promotion of biofuels (mandatory blending of sustainable biofuels, tax exempt quotas for sustainable biofuels, etc.).[18]

17 EEA: Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States

18 National renewable energy action plan, November 2010: http://www.buildup.eu/sites/default/files/content/national_renewable_energy_action_plan_belgium_en.pdf

The costs of financing renewables in the power sector (mainly through green certificates) are passed on to consumers and are largely responsible for the country's high final electricity prices. **Overall public contributions to the CHP and RES programs amounted to 21 €/MWh,[19] i.e. around € 1.5 billion in 2013**, exceeding the European average. Similarly, the costs of subsidies and incentives to promote investment in solar photovoltaic energy are expected to reach € 750 million per year in 2020.[20] Yet, while these PV subsidies and incentives have increased Belgium's solar power installed capacity, the country's climate prevents these installations from yielding significant production.

Given the high costs of developing renewables, and lagging energy efficiency performance, **Belgium will have difficulties in reaching its 2020 targets**. To change this equation, the country may need to adopt new policies capable of delivering higher (green and cost) efficiencies.

GHG emissions and targets

Figure 13. GHG emissions[21]

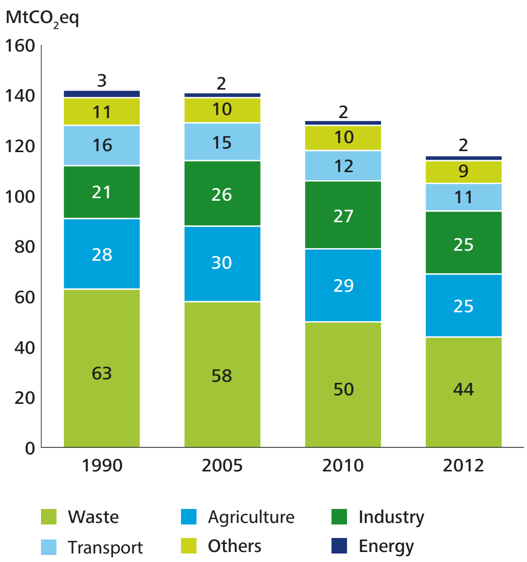
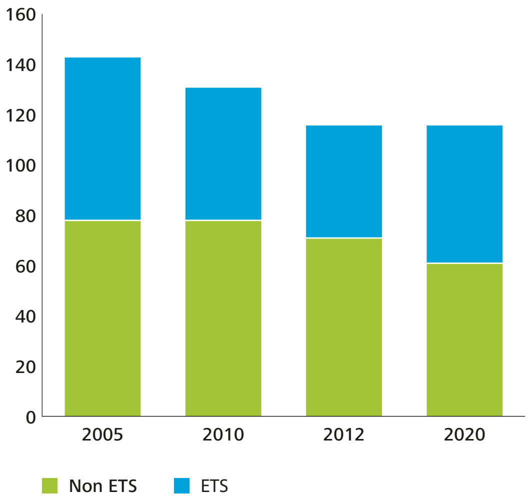


Figure 14. ETS and non-ETS GHG emissions and target[22]



Regarding GHG emissions, the targets for 2020 are a 21% reduction in the ETS sector and a 15% reduction in the non-ETS sector (both compared to 2005 levels), which means a global target of 116 Mt CO_2eq in 2020, just below the 2012 level (117 Mt CO_2eq).

Belgium's GHG emissions have been declining over the last decade, falling 18% below 1990 levels. Yet Belgium has 21% higher per capita emissions than the EU average (10.9 vs. 9.0 tCO_2eq), mainly due to the transport sector, followed by the energy use and supply, manufacturing, industrial, agricultural and waste sectors (2012).[23]

In 2012, **non-ETS GHG emissions** were 6% below the country's 2005 level and 11% above its 2020 target. According to the latest projections, and taking existing measures into account, Belgium is expected to miss its 2020 non-ETS emission target, hitting -4 % in 2020 as compared with 2005,[24] rather than its -15% goal.

In the **ETS sector**, Belgium will need to decarbonize its electricity sector to meet its 2020 target, especially if it hopes to simultaneously improve its security of supply. **GHG emissions are likely to grow in the next few years if the decision to phase out nuclear power between 2015 and 2025 is pursued, as much of the replacement is likely to come from fossil fuels.**

Total GHG emissions in Belgium: the 2020 targets have been already nearly achieved, but emissions might rise.

Belgium's GHG emissions have already decreased, but the nuclear phase-out could counterbalance the process depending on the choice of substitutes. As a result, costs are likely to rise, placing an additional burden on the economy.

19 Deloitte calculations based on Eurelectric data extracted from "Analyses of power price increase drivers, May 2014" 20BCG, 2013

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

22 EEA, 2014

23 http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014; Source: Eurostat. © European Union, 1995-2015, 2012: http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsdcc210&language=en

24 Assessment of climate change policies in the context of the European semester, Belgium report, DG Climate action, ECOLOGIC, Eclareaon, http://ec.europa.eu/clima/policies/g-gas/progress/docs/be_2014_en.pdf

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

Belgium is highly dependent on others.

Belgium is dependent on imports of fossil fuels and will probably need to increase dependency on gas; it is a net importer of electricity and has high electricity prices that can affect the country's competitiveness.

Belgium energy dependency challenges

Since the closure of its last coal mine in 1992, Belgium is 100% dependent on imports for its consumption of fossil fuels, which constitute around 70% of its gross inland energy consumption. With the exception of 2009, Belgium has also been a (growing) **net importer of electricity**. In the wake of its decision to close all of its nuclear capacity between 2015 and 2025, Belgium needs to clarify its long-term energy policy and decide on its future energy mix, taking into account security of supply, competitiveness and environmental objectives. A substantial increase in natural gas imports will keep Belgium strongly reliant on imported fossil fuel. Also, Belgium's energy market is characterized by high electricity prices which, coupled with high labor costs, influences the competitiveness of the country in general and its industry in particular.

Belgium has an ambitious policy to develop a strong share of renewables towards 2050.

The country has put in place a system of green certificates, adopted legislation to prioritize access to the grid for electricity from renewables, and introduced subsidies and incentives for investment in renewable power. However, the costs of these measures are being passed on to final consumers.

More significantly, Belgium's climate is not ideal for the development of photovoltaic energy.

Proactive policy on renewables energy impacting retail prices

Renewables have been developed significantly in Belgium since 2000, reaching a generation capacity of 6.5 GW (corresponding to 34% of total capacity in 2012). Nevertheless, their global production still represents a modest 6% of gross inland consumption. The variable and intermittent nature of renewable energy sources requires electricity systems to be more flexible. Elia, Belgium's transmission system operator, has grid projects ongoing to connect renewables to a larger market to ensure their availability.

Progress in developing renewables has been made at substantial cost. Over the **short-term, this might result in a substantial increase in gas imports and use**. Notably, this would hamper Belgium's ability to meet the climate change targets established for the country by the EU, in particular for CO_2 emissions.

For 2030, Belgium aims to reach 10 GW of installed capacity from renewables. However, the proactive Belgian policy to promote renewables might encounter problems: the initiatives of the country's three regions, in addition to the federal government, have led to a **fragmented market for green certificates**.

Biomass and onshore and offshore wind seem to have the highest development potential among renewable energies due to Belgium's geographic and climatic conditions, as well as its high population density. Also, it is not yet clear whether hydro and geothermal technology can be deployed on a large scale. This limited potential increases the overall costs and challenges associated with developing renewable energy.

Phasing out of nuclear plants could threaten GHG emission targets and raise costs.

The currently planned withdrawal from nuclear, if maintained, involves risks for energy security, industry competitiveness and affordable energy costs to consumers.

The planned nuclear phase-out could increase dependency on gas consumption and increase costs

Belgium is heavily dependent for its electricity on seven nuclear reactors still in operation, which generate about half of its domestic electricity production (40 TWh in 2012, 51% of the total 79 TWh production).[25] However, current policy and regulatory decisions of the Belgian government are expected to gradually curb and bring the nuclear share of electricity production to zero within 11 years. The final timing of the phase-out is as follows: **of the seven Belgian reactors, two were expected to close in 2015, one in 2022, one in 2023 and three in 2025; but the Belgian government recently decided to extend by 10 years the two reactors initially scheduled for closure in 2015**. In addition to the phasing-out decision, the annual federal tax on nuclear power generation, which in 2013 reached € 550 million, created an unfavorable financial and technical environment for the nuclear industry. In 2014, **the plants that had to close for technical reasons represented half of the country's nuclear capacity**. Given Belgium's current low rates of electricity production capacity, such technical incidents could cause shortages of supply if imports cannot fill the gap, especially in the high demand peaks of the winter season. In its efforts to replace nuclear with gas-fuelled plants to ensure baseline electricity production, Belgium may also **increase its dependence on gas import** by up to 80% of future energy supply.[26] That's especially true when you consider that many of Belgium's gas-fired power plants and investment projects are currently under water due to the negative spark spread situation. By forcing the country to increase its gas imports, this situation could have a significant negative impact on Belgium's trade deficit and would be difficult to sustain over the long term, particularly amid concerns about the rising costs – and supply insecurity – for primary resources. **Finally, replacement of nuclear with gas or coal is likely not compatible with the country's CO_2 targets**, which aim for a 15% reduction from its 2005 level by 2020. In fact, a projected additional gas-fired capacity of seven GW by 2030 would increase CO_2 emissions by 60% over the 2013 level (+9 Mt CO_2eq).[27] To compensate, Belgium might have to purchase emission allowances from the ETS, with a further substantial cost-penalty, estimated up to € 2 billion. **In essence, the currently-planned phase-out from nuclear in a relatively short period could raise significant risks for the country's energy security and industrial competitiveness, further push up energy costs to consumers and hinder Belgium's ability to meet its climate change targets**.

25 © OECD/IEA 2012 Energy Statistics, IEA Publishing. Licence: http://www.iea.org/t&c/

26 AMCHAM Belgium, Energy Security, http://www.amcham.be/policy/energy/energy-security

27 Boston Consulting Group, "Shaping a Vision for Belgium's Power Landscape", 2013

Additionally, the Belgian government will have to attract investment to replace existing capacities by introducing strong incentives and articulating a long-term vision on energy policy.

Alternatively, the extension of the operational lifetime of nuclear plants from their current 40 years to 50 or 60 years could help limit price increases and maintain security of supply, but this option would have to be balanced with nuclear technology risks.

Crucial cross-border capacity at risk of shortage

As noted earlier, Belgium is a net importer of electricity, notably from France and the Netherlands. As there is currently little direct cross-border capacity with Germany, a project is in progress (the Alegro project) to connect Belgian and German electricity markets in order to reduce the risk of shortages in case of parallel peak demand in several countries. However, the project will only become operational in 2019. The situation is similar with the UK: interconnectors are missing and investment projects are under way.

Belgium's gas transmission infrastructure is operated by a single company, Fluxys, and consists of 3,800 km of pipelines with five compressor stations and 18 interconnection points. The Fluxys network ensures both the transport of natural gas for internal consumption and the transmission to gas markets in neighboring countries. An important gas hub is situated at Zeebrugge with a terminal for gas from Norway and an interconnector terminal for gas from and to the United Kingdom, in addition to the LNG terminal and regasification plant. Zeebrugge is also one of the major spot markets for gas in Europe.

There is **limited storage capacity for natural gas in Belgium,[28] with a need to find means to ensure the necessary flexibility**. Belgium is served by a crude oil pipeline originating in Rotterdam and arriving at Antwerp. Oil products have access to the Central European Pipeline System, which is a NATO pipeline network. Belgium has over 40 oil storage facilities, which are used both for industry's operating needs and as strategic reserves. Nevertheless, Belgium does not fully comply with the obligation on strategic oil storage capacity established by EU legislation to maintain stocks of crude oil and/or petroleum products; for that reason the European Commission recently launched an infringement procedure against Belgium.

Risk of electricity shortages due to absence of cross-border capacity with Germany.

Belgium is dependent on imports of fossil fuels and will probably need to increase dependency on gas; it is a net importer of electricity and has high electricity prices that can affect the country's competitiveness.

Conclusion

The coming years will be crucial for defining the energy future of Belgium. Belgium has been able to put in place an ambitious, proactive (although rather expensive) policy on renewables and has accepted demanding targets for greenhouse gases emissions (-15% by 2020 compared to 2005) and renewables. Subsidies and incentives for renewables have, however, contributed to comparatively high electricity prices for SME and industrial consumers.

Belgium has a complex internal institutional structure and its energy policy commitments are shared by the federal government and the country's three regions. Although all three regions and the federal government have been active in the promotion of renewables, negative outcomes like the fragmentation of the green certificates market show the need to continue pushing for closer co-ordination between regional and federal levels to increase policy and regulatory efficiency.

Dependency on imports, which has been at 100% for fossil fuels since 1992, has extended to electricity in recent years. It is unclear whether the planned closure of all nuclear plants by 2025 could be absorbed at affordable costs, ensuring security of supply and preserving industry competitiveness and the achievement of climate targets. The costs and carbon emission implications of increasing reliance on gas imports should be carefully assessed. Belgium's emission path necessitates significant improvement in energy efficiencies. In the longer term, the 2050 perspective, the economics and the financial practicability for Belgium of an all-renewables energy system deserves further analysis. Priority should be given to defining a robust long-term strategy for a low-carbon future, providing a stable and enabling framework for investments on one side, while guaranteeing competitive energy costs to all affected consumers on the other.

Increasing dependency on gas imports is expected.

Natural gas consumption is expected to increase substantially to make up for the lost generation capacity of Belgium's nuclear plants, which may ultimately be replaced with gas-fired ones.

28 The main storage capacities are situated in Zeebrugge and Loenhout

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European energy market reform
Country profile: France

Contents

Current situation

Energy consumption and trade balance

In 2012, France's primary energy consumption (PEC)[1] reached 259 Mtoe. More than 40% of gross energy consumed is derived from nuclear power. However, fossil fuels still play an important role: petroleum products make up 31% and natural gas totals 8% of the mix.

Figure 1. Gross inland consumption in 2012 (259 Mtoe)[2]

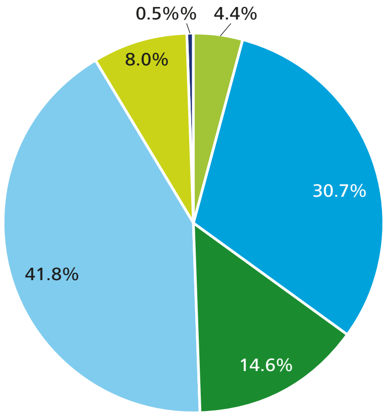
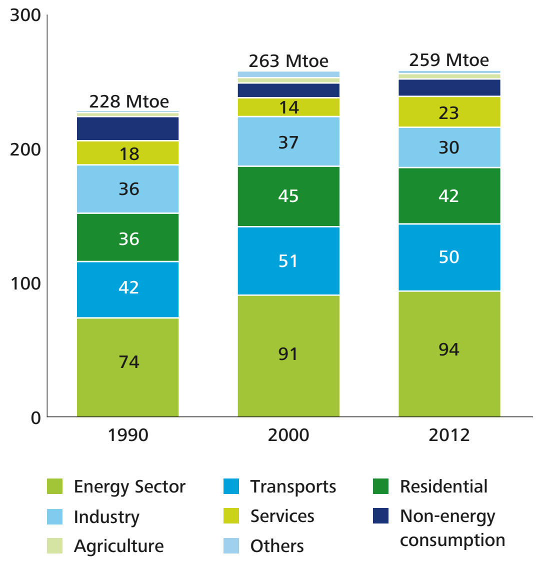


Figure 2. Primary energy consumption by sector (in Mtoe)[3]



Primary energy consumption increased by 15% from 1990 and 2000, and decreased by 2% between 2000 and 2012. This decrease was mainly due to the industrial (energy and non-energy uses) and services sectors.

- The energy sector represented 36% of primary energy consumption in 2012, and has remained stable in volume since 2000.
- The transport sector is the second highest consumer, accounting for 19% of primary energy consumption in 2012, which marked a 19% increase since 1990.
- The residential sector accounted for 16% of primary energy consumption in 2012 (stable between 2000 and 2012).
- The industrial sector accounted for 12% of consumption (19% decrease between 2000 and 2012).

Key figures:

Population (2013):
65.5 m cap.

GDP (2013):
2,059 bn €

GDP/capita (2013):
31,435 €

GDP/PEC (2012):
7.8 €/kgoe

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

While nuclear makes up the highest share (42%) of primary energy consumption, France remains dependent on fossil fuel imports, mainly for transport.

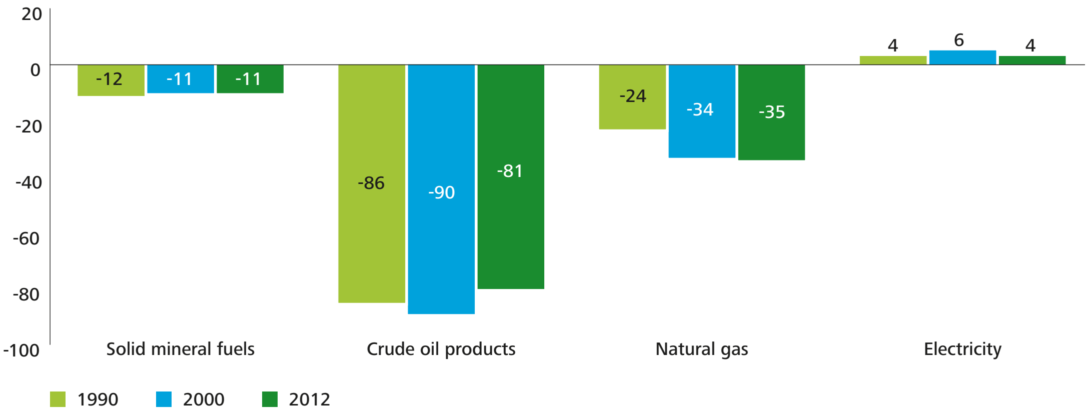
The energy sector represented 36% of primary energy consumption in 2012, a volume that has remained stable since 2000. Fossil fuel imports remain high and the French energy bill reached an historic high of € 69 bn in 2012.

1 The primary energy consumption value presented refer to 'Gross inland energy consumption by fuel type' in Eurostat (Data Table: tsdcc320)

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

3 MEDDE – Chiffres clés de l'énergie, Edition 2013

Figure 3. Energy trade balance (Mtoe)[2]



A high preponderance of nuclear in power production and a very low share of renewables outside hydropower.

The country depends on imports of solid mineral fuels, crude oil products and natural gas. In 2012, the French energy bill reached a record high of € 69 bn (€ 55 bn from oil products and € 13.5 bn from natural gas), accounting for 13% of overall French imports and overtaking the country's trade deficit (€ 67.2 bn in 2012).[4] Oil imports (crude and refined) reached 99.8 Mtoe and natural gas imports amounted to 39.9 Mtoe in 2012.

As far as power is concerned, France is generally a net exporter of large volumes of base-load electricity, but frequently imports peak electricity. In 2013, France exported 79 TWh globally and imported 32 TWh.

Power generation

France has the second largest electricity generation capacity in the EU, and the second "least-carbonized" electricity generation mix after Sweden.

In 2013, nuclear energy accounted for 49% of the generation capacity mix (63 GW), but delivered 73% of the power (402 TWh). Renewable energy sources generated 19% of electricity production, but 74% came from hydro. **Wind and solar** represented an installed capacity of 8.1 GW and 4.3 GW, respectively, and **generated 3% and 1% of overall electricity**.

Nuclear is operated as base-load or mid-merit. Due to its large share in the electricity mix, France has been historically short of peak capacity.

Figure 4. Electricity capacity – 128 GW (2013)[5]

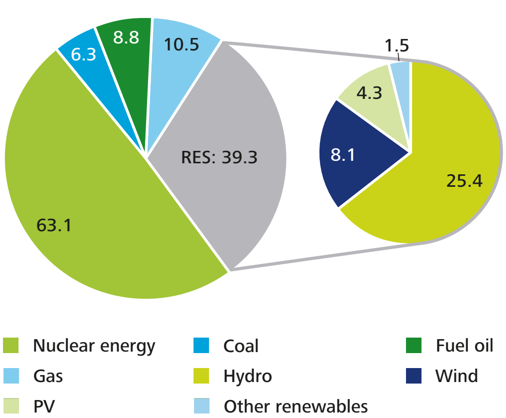
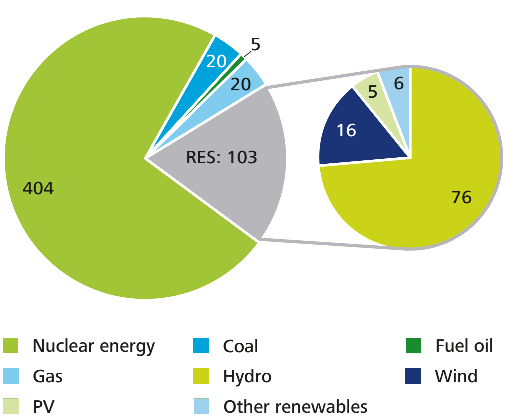


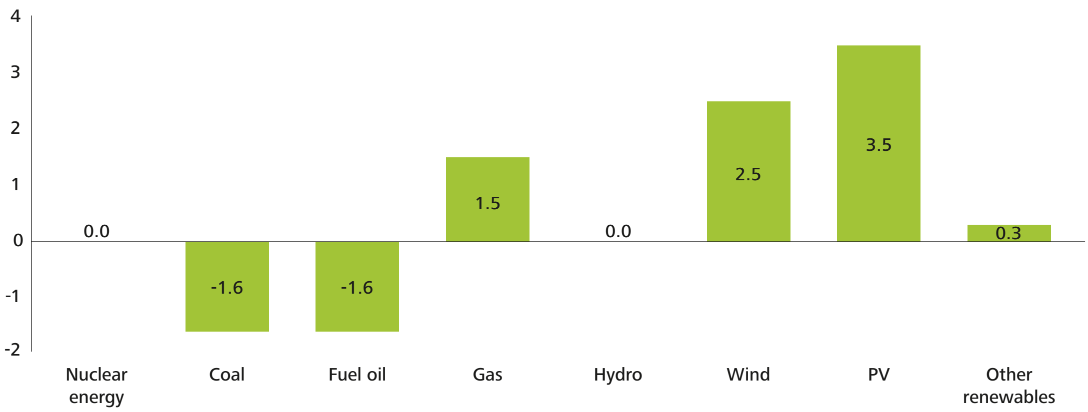
Figure 5. Electricity production – 551 TWh (2013)[5]



4 MEDDE – Panorama énergies-climat, Edition 2013

5 RTE, Bilan électrique français 2013

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

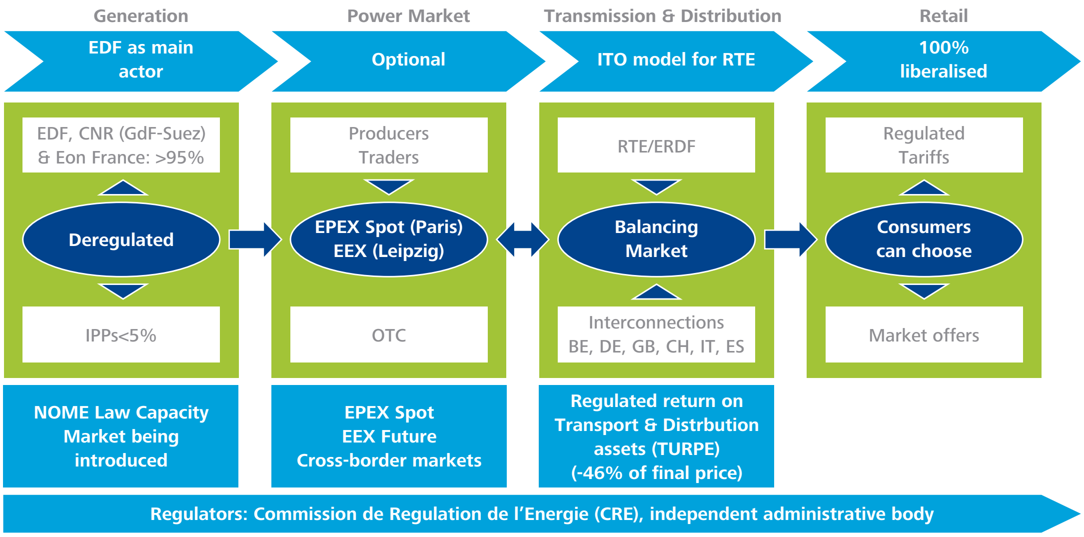


19 GW of new capacity were installed between 2000 and 2013, over two-thirds of which were renewable capacity (mostly onshore wind and solar).

Net capacity has increased by 11% since 2000 and by 3.8% since 2010.

Power market: main actors

Figure 7. Market mechanism



A highly concentrated power market.

The French generation and retail markets are still largely dominated by EDF, the French incumbent utility.

The French power market is highly concentrated. Electricity generation is still largely dominated by EDF, the vertically integrated French incumbent utility that is still controlled by the French state. The French transmission system operator, RTE, and the distribution network operator, ERDF, are 100% owned by EDF.

ERDF manages about 95% of the electricity distribution network in continental France. This network belongs to French municipalities or groups of municipalities that subcontract to ERDF as an operator through a public service delegation. In 2010, the French government approved an energy law (NOME) designed to increase competition in the retail electricity market. By law, EDF has the obligation to make available up to 25% of the nuclear electricity it generates to alternative suppliers on the wholesale market at a regular price, which was set at 42 €/MWh in 2012.

6 RTE, Bilan électrique français 2013 & Bilan électrique français 2010

Rising power prices.

Power prices are not completely deregulated (producers other than EDF pay a regulated access price for nuclear electricity, while residential users and SMEs pay a regulated tariff).

Power prices have increased for both residential and industrial users, primarily as a result of network and tax charge increases. They are likely to rise further in the coming years due to the necessary evolution of the power production mix.

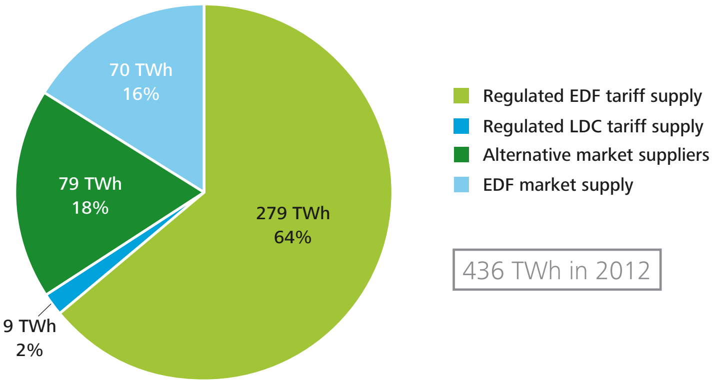
Power prices

French market liberalization began in 1999 as industrial sites became eligible to choose their suppliers. This shift continued in 2004 for SMEs, and was completed in 2007 for residential customers. Residential customers have the choice between contracts at regulated tariffs or contracts at market prices. For SMEs, regulated tariffs will be abandoned from mid-2014 through the end of 2015. This should increase competition among retailers and expand the range of commercial offers and available value-added services.

As at the end of 2012, the incumbent EDF still dominated the market, with a market share of roughly 80%, leaving the remaining share to alternative market suppliers.

In 2012, 64% of electricity was sold at **regulated prices**.

Figure 8. Total retail market split per supplier and contract type in 2012 (TWh;%)



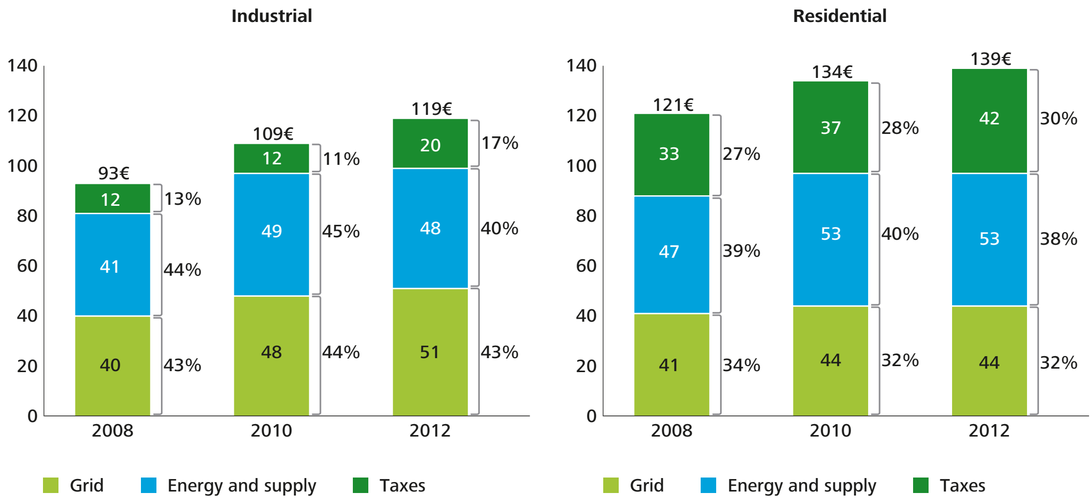
Source: CRE

Retail prices for industrial users totalled 119 €/MWh in 2012, slightly below the European average (125 €/MWh). A 28% price increase between 2008 and 2012 was driven by tax increases (+67%), rising grid costs (+28%), and higher generation and supply costs (+17%).

Residential customer retail prices reached 139 €/MWh in 2012, which is significantly lower than the European average (€ 200 in 2012). The 15% rise since 2008 was mainly driven by an increase in both taxes (+27%) and energy generation and supply components (+13%).

The development of renewable capacity is financed through the CSPE, which is supported by EDF, and not entirely passed on to final consumers.

Figure 9. Retail prices for industrial and residential users (€/MWh)[7]



The energy and supply component of the **price** is largely driven by the fact that nuclear power plants are amortized. Nonetheless, electricity prices are likely to increase in the coming years as investments are made to improve the grid, extend the useful life of nuclear power plants and upgrade their safety standards to post-Fukushima expectations (total cost is estimated to be € 62.5 bn between 2011 and 2025).[8]

7 CRE
8 Cours des Comptes, 2014

Targets for 2020

20-20-20 EU targets for France: what is France committed to?

- **20% energy savings versus 2020 energy demand projections,** i.e. primary energy consumption of 236 Mtoe in 2020 and 131 Mtoe for final energy consumption in 2020
- **23% renewable energies in 2020 final energy consumption**
- **-17% of total GHG emissions in 2020 versus 1990 levels**

  This target was restated later as:

  – -21% for ETS – (emission trading scheme) related GHG emissions in 2020 vs. 2005

  – -14% for non-ETS related GHG emissions in 2020 vs. 2005

Energy and climate policies have been articulated in several laws and regulations over the last few years. In 2007, the "Grenelle de l'environnement" defined a framework for environmental regulation, including a non-binding roadmap to develop renewable energy.

After a consultation phase launched in the aftermath of the "Grenelle de l'environnement," the National Climate Plan was adopted in 2011. It restated the "factor four" commitment (i.e. reducing French GHG emissions by a factor of four between 1990 and 2050), initially announced in 2003. It also set out several policies and measures to promote energy efficiency (energy efficiency in buildings information and eco-labeling), renewable energy (promotion of biofuels and heating from biomass) and reduction of GHG emissions (proposed carbon taxes, which were not ultimately adopted). The main targets regarding power and gas have been reiterated in the country's regular Pluriannual Investment Plans.

In the fall of 2014, all these targets and measures were updated in a new energy transition law (see "Energy transition: definition of the future energy mix" below).

Energy efficiency targets

Figure 10. Final energy consumption (Mtoe)[9]

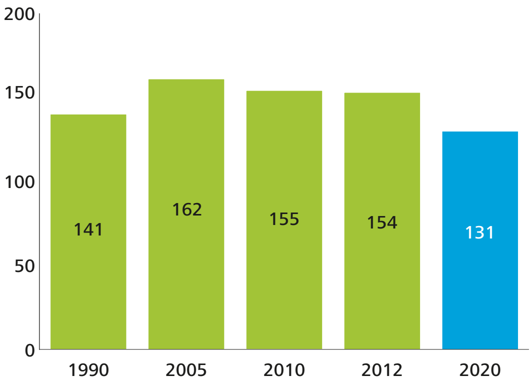
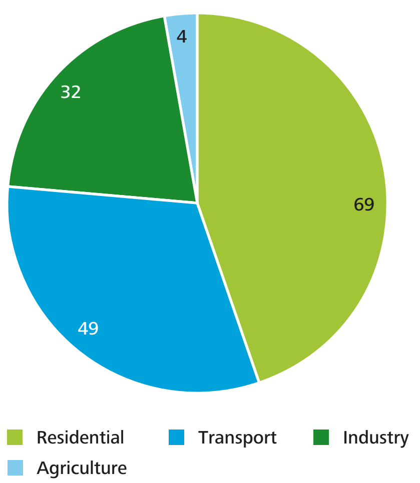


Figure 11. Final energy consumption in 2012, per sector (Mtoe)

Total: 154 Mtoe



France initially committed to a target of 20% energy savings compared to 2020 energy demand projections. According to the country's latest National Energy Efficiency Plan (24/04/2014), this would reduce final energy consumption to 131 Mtoe in 2020 vs. 162 Mtoe in 2005 and 154 Mtoe in 2012.[10] To meet this target, France would need to reduce its final energy demand by 23 Mtoe by 2020, compared to 2012. Yet, between 2005 and 2012, France only realized 26% of its energy efficiency target.

The first priority is to reduce final energy consumption in buildings (44% in 2012 final energy consumption). Since the mid-2000s, final energy consumption in buildings has been relatively stable at around 68-69 Mtoe. Different policy measures have been adopted:

- For existing buildings, the objective is to retrofit 500,000 households each year. To this end, various measures (low interest loans, tax credits, etc.) were implemented. To date, however, France has not come close to hitting its retrofit targets (145,000 retrofits in 2012 and 160,000 in 2013). These measures are expected to reduce final energy consumption by 4.4 Mtoe.
- New buildings have to comply with a limit of 50 kWh/m²/year (from 2011-2013). This measure is expected to reduce final energy consumption by 1.2 Mtoe.

9 MEDDE – Panorama énergies-climat, Edition 2013

10 Source: http://ec.europa.eu. © European Union, 1995-2015

For **transport** (32% in 2012 final energy consumption), the energy efficiency of vehicles is promoted:

- The European regulation on GHG emissions per km for new vehicles and the French system of bonus/malus are powerful drivers to increase the energy efficiency of private cars. Between 2007 and 2011, GHG emissions from new vehicles decreased from 149.3 to 127 gCO_2/km. These measures are expected to reduce final energy consumption by 2.2 Mtoe.

- For heavy duty vehicles, an environmental tax ("écotaxe") was scheduled, but the government finally abandoned it in October 2014 in the wake of heavy protest.

Eco-design measures have also been implemented to increase the **energy efficiency of various products** (e.g. phasing out traditional light bulbs, expected to reduce final energy consumption by 0.8 Mtoe).

Moreover, at a cross-sector level, a **white certificate scheme** ("CEE") was implemented in 2006. It reflects the obligation of energy suppliers (electricity, gas, domestic fuel oil and heating sellers) to promote energy efficiency to their customers (households, local authorities and professionals). This scheme is expected to reduce final energy consumption by more than 9 Mtoe in 2020 (including some double counting with the above mentioned measures).

Yet, in 2012, France still needed to reduce its final energy consumption by 23 Mtoe by 2020. This means that only 26% of its initial 2020 target has been realized so far.

Given this reality, it is difficult to see how France can meet its commitment, other than by issuing additional policy measures for building or driving new momentum in the CHP (combined heat and power) industry, which will still take time to become fully efficient.

Energy efficiency: in 2012, 74% of France's target was yet to be achieved.

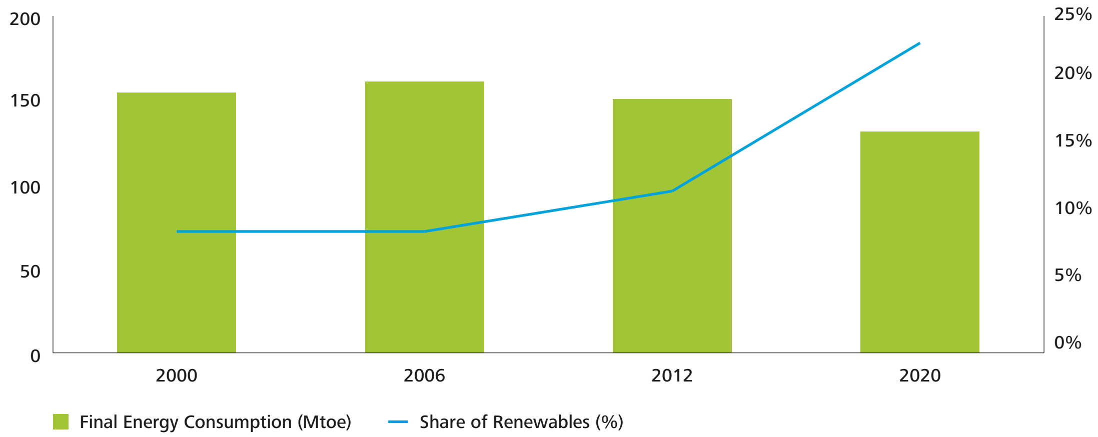
It is difficult to see how France can meet its energy efficiency commitment, other than by issuing additional policy objectives for buildings or resurrecting the cogeneration industry.

Renewable energy targets

France aims to have a 23% share of renewables of final energy consumption in 2020, vs. 9.5% in 2005 and 13.4% in 2012.[11] **Between 2005 and 2012, France only realized 29% of its renewable target**.

If this energy efficiency target (131 Mtoe of final energy consumption in 2020) is reached, 30 Mtoe of final energy consumption should come from renewables in 2020, compared to 19.6 in 2011,[12] This means an additional 11.4 Mtoe will still be needed by 2020.

Figure 12. Renewable energy share of final energy use (2012)[13]

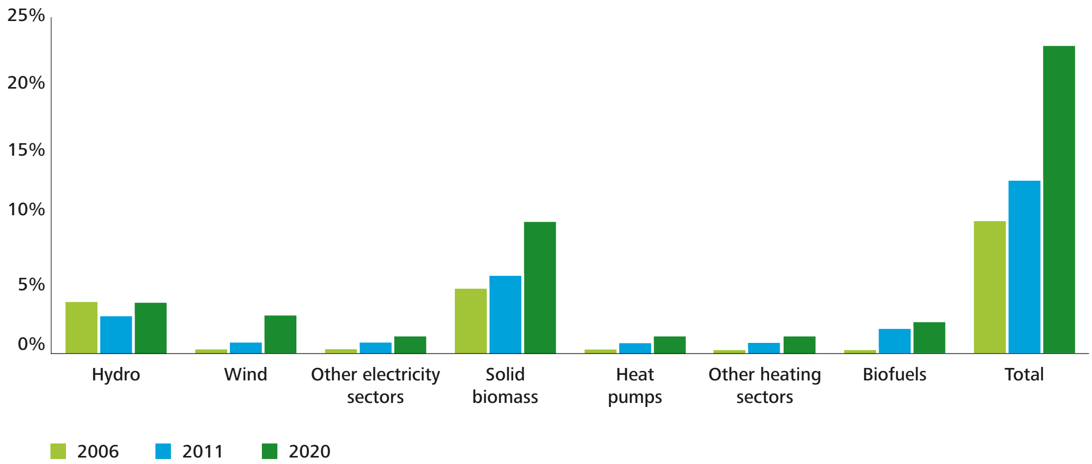


11 Source: Eurostat. © European Union, 1995-2015

12 CGDD 2013

13 Source: http://ec.europa.eu. © European Union, 1995-2015

Figure 13. Renewable energy share of final energy use by type, in 2006 and 2011, and target for 2020, in %[14]



In 2007, the "Grenelle de l'environnement" proposed a non-binding roadmap to develop renewable energy in France:

Table 1. Grenelle roadmap for renewables[15] and situation in 2011 (Mtoe)[16] or 2013 (GW)[17]

	Situation in 2006	Target in 2020	Targeted increase	Situation in 2011 or 2013
Heating	**9.6 Mtoe**	**19.7 Mtoe**	**+ 10 Mtoe**	***11.8 Mtoe***
Wood (domestic heating)	7.4 Mtoe	7.4 Mtoe	–	
Wood and waste (collective, tertiary, industry)	*1.8 Mtoe*	*9 Mtoe*	*+ 7.2 Mtoe*	
Other renewables	0.4 Mtoe	3.2 Mtoe	+ 2.8 Mtoe	
Power	**5.6 Mtoe**	**12.6 Mtoe**	**+ 7 Mtoe**	***5.8 Mtoe***
Hydropower	5.2 Mtoe (25 GW)	5.8 Mtoe (27.5 GW)	+ 0.6 Mtoe	*25.4 GW*
Biomass	0.2 Mtoe (0.35 GW)	1.4 Mtoe (2.3 GW)	+ 1.2 Mtoe	*1.5 GW*
Wind	0.2 Mtoe (1.6 GW)	5 Mtoe (25 GW)	+ 4.8 Mtoe	*8.1 GW*
Photovoltaic	0	0.4 Mtoe (5.4 GW)	+ 0.4 Mtoe	*4.3*
Biofuels	**0.7 Mtoe**	**4 Mtoe**	**+ 3.3 Mtoe**	***2.4 Mtoe***
TOTAL	**~ 16 Mtoe**	**~ 36 Mtoe**	**+ 20 Mtoe**	***19.6 Mtoe***

14 CGDD 2013

15 Grenelle, COP N°10 (2007)

16 CGDD, 2013

17 RTE, Bilan électrique 2013

Since then, targets have slightly changed (overall target of 30 Mtoe by 2020 instead of 36), but this roadmap still provides an interesting view of the main trends and potential targets.

- **Heating** (+10 Mtoe between 2006 and 2020): solid biomass for heating is already the most important renewable energy in terms of energy production, while **heating is the sector in which the largest increase is targeted**. A specific fund ("Fonds Chaleur") was created to develop the generation of heat from renewable energy sources, and biomass in particular. This fund is the main driver of development of wood-energy in France for public housing, local authorities and all businesses (agriculture, industry and tertiary). Between 2009 and 2013, € 1.2 bn was spent to enable the development of approximately 1.1 Mtoe/year of renewable energy (which included 0.9 Mtoe from biomass).[18] Money allocated to this fund is expected to reach € 400 M/year in 2017.

- **Renewables in power production** (+7 Mtoe between 2006 and 2020): hydropower capacity represented 74% of renewable electricity produced in 2012, with capacity remaining rather stable. Targeted increases to meet the country's renewable objectives have been assigned mainly to wind (25.4 GW vs. 1.6 GW in 2020) and solar. Between 2006 and 2013, an additional 12.4 GW capacity from renewables was installed, which represents 37% of the targeted additional capacity to be installed between 2006 and 2020 (33.3 GW).[19]

The support for renewable electricity is mainly based on financial subsidies to generation through a purchase tariff (feed-in tariff) that differs according to sector.

Table 2. 2014 feed-in tariffs (in c€/kWh) and contract duration (years)

	Onshore wind	Offshore wind	Solar	Geothermal	Biomass (CHP)
Feed-in tariffs (cEUR/kWh)	2.8-8.2	3-13	7.17-27.94	20 + bonus	4.5 + bonus
Contract duration (years)	15	20	20	15	20

The biggest challenge ahead is for wind power, where less than 30% of the additional targeted capacity for 2020 has been installed so far (new capacity of 6.5 GW was installed between 2006 and 2013, vs. an initial target of 23.4 GW).

- **Transport sector**: biofuels have seen strong development since the mid-1990s. The production of biofuels is encouraged by a tax whose rate depends on the deviation from the biofuel incorporation target.

  France set a target of a 7% (energy content) biofuel share in transportation fuel in 2010, which was almost achieved in 2012; biofuels represented 5.5% of the total fuels for transport consumption. But, since it is difficult to consume more first generation biofuels,[20] both for technical and political reasons, going further will depend mainly on the timeline of the industrial development of second generation biofuels.[21]

Between 2005 and 2012, France realized only 29% of its renewable energy target. An additional production of 11 Mtoe/year is still needed, which seems difficult to implement in eight years. The most likely way to meet the 23% target will come from:

- a large deployment of biomass for heating (target: +8 Mtoe between 2011 and 2020), provided that there is enough available biomass (until now, access to biomass has been a major hurdle to develop biomass for heating projects); and

- an increased development of wind power (both onshore and offshore) to fulfil the targeted capacity in 2020: around 17 GW of new power capacity is targeted to be installed between 2013 and 2020 (out of the 23.4 GW targeted between 2006 and 2020).

Renewable target: in 2012, 71% of the target had yet to be achieved.

The renewable energy target is very ambitious and seems difficult to reach, especially for heating and power.

The most likely way of meeting it would come from large-scale deployment of biomass for heating (subject to biomass availability) and from increased development of wind power.

18 Ademe

19 It can be noted that in November 2014, the French company Neoen announced the construction of Europe's largest photovoltaic solar park with a total combined output of 300 MW in the Bordeaux area. The park will be operational in October 2015 and is supposed to produce 350 gigawatt-hours yearly to a price of 105 €/MWh for 20 years (Neoen press release (05/11/2014), Reuters)

20 Conventional biofuels made from sugar, starch or vegetable oil

21 Advanced biofuels produced from non-edible biomass, i.e. lignocellulosic biomass or woody crops, agricultural residues or waste

CO_2 targets: France has already met 76% of its 2020 target.

Until now, France has been a low GHG-emitting country, thanks to its high share of nuclear and hydro power.

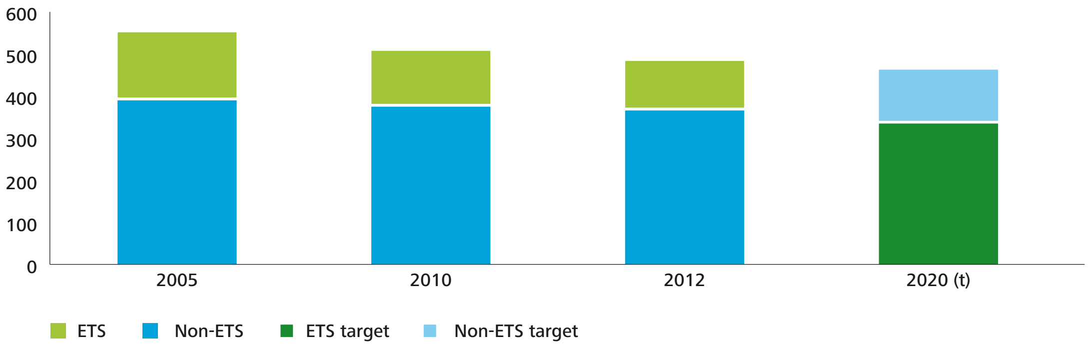
The 2020 GHG emissions target seems reasonably attainable.

Reaching the target for the non-ETS sector depends mostly on the success of the energy efficiency measures applied to buildings, products and private cars, and on the development of renewables.

In 2012, the 2020 target for the ETS sector had already been met.

CO_2 emissions and targets

Figure 14. GHG emissions and targets ($MtCO_2eq$)[22]



- CO_2 target: in the ETS sector, the target is to reduce GHG emissions by 21% between 2005 and 2020 (i.e. by 34 Mt CO_2eq). In 2005, GHG emissions from the ETS sector amounted to 162 Mt CO_2eq. In the non-ETS sector, the target is to reduce GHG emissions by 14% between 2005 and 2020 (i.e. by 55 Mt CO_2eq).[23] In 2005, GHG emissions from the non-ETS sector amounted to 396 Mt CO_2eq.

Total GHG emissions amounted to 558 Mt CO_2eq in 2005 and to 490 Mt CO_2eq in 2012,[22] while targeted total GHG emissions are 469 Mt CO_2eq in 2020. This will require France to reduce its emissions by 89 Mt CO_2eq between 2005 and 2020. **By 2012, however, France had already achieved 76% of its initial target**, leaving only 21 Mt CO_2eq still to be abated before 2020.

- For the **ETS sector**, which essentially represents the power and heat generation industry, emissions had already decreased to 118 Mt CO_2eq[24] in 2012 (i.e. -44 Mt CO_2eq versus a target of -34 Mt CO_2eq in 2020). The 2020 target has already been surpassed, even if it is due more to the decrease of industrial activity in France (structural and cyclical, linked to the 2008 crisis) than it is to deep efforts by the industrial sector to reduce GHG emissions.

- For the **non-ETS sector**, emissions had already decreased to 372 Mt CO_2eq[24] in 2012 (i.e. -24 Mt CO_2eq compared to a reduction target of 55 Mt CO_2eq in 2020). Reaching the target largely depends on the success of the energy efficiency measures applied to buildings (a reduction of more than eight Mt CO_2eq is expected), products (a reduction of more than 4 Mt CO_2eq is expected), private cars (-9 Mt CO_2eq expected) and the development of renewables (more than 6 Mt CO_2eq expected).[25]

With "only" 21 Mt CO_2eq remaining to be abated as of 2012, or 24% of the initial target, France seems well on its way to meeting the EU target, even if a few additional measures may be necessary for the non-ETS sector.

22 EEA, 2014a
23 RMS, 2013
24 EEA, 2014b
25 MEDDE, 2013

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

Energy transition: definition of the future energy mix

For many years, France has been relying on nuclear power and hydropower to reach low carbon intensity, and on hydropower to constitute a high share of renewables.

This situation, however, may no longer be sustainable, since serious political debate surrounds the future of nuclear energy. This likely means that nuclear capacity will decrease slightly by 2030, while hydropower capacity remains more or less stable.

France has implemented several policy measures to reach its targets regarding energy efficiency, renewables and GHG emissions. But these measures may not be ambitious enough to reach the country's targets, and their horizon does not go much further than 2020. **Moreover, France set itself an ambitious target for 2050: to reduce its GHG emissions by a factor four, i.e. emit less than 140 Mt CO_2eq by 2050. Meeting this target without building more nuclear or hydro capacity will be a serious challenge**. As a result, France must find new ways to increase its share of renewables and further decrease its carbon intensity.

In 2013, the French government launched a public debate on energy transition (DNTE), and its lower house of Parliament voted on the new law on October 14, 2014. In February 2015, debate was ongoing in both houses of Parliament. In its present form, this law includes the following provisions:

- Reducing nuclear energy production from 75% to 50% of the electricity mix by 2025.
- Increasing the share of renewables of final energy consumption to 23% in 2020 and to 32% in 2030.
- Reducing primary energy consumption from fossil fuels by 30% by 2030, compared to 2012.
- Reducing GHG emissions by 40% by 2030 and dividing by four GHG emissions by 2050 (both compared to 1990 levels).
- Reducing energy consumption by 50% by 2050 (compared to 2012), with an intermediate goal of 20% in 2030.

Energy efficiency measures for buildings, support for renewables and plans for a new transport infrastructure are also included in the law.

Nuclear power

Many questions with respect to nuclear power are currently being debated in France:

- The French government announced its willingness to **decrease nuclear energy production from 75% to 50% of the electricity mix by 2025**.

  However it remains unclear how this target will be reached and what pathway the country will follow to replace this capacity in less than 10 years, considering the impact these reductions will have on the country's energy competitiveness, security of supply and sustainability.

  Additionally, it is not clear to what extent the French government is entitled to close nuclear power plants for energy policy reasons (rather than for economic or safety ones).

  This decrease from 75% to 50% of electricity production represents around 140 TWh (based on 2013 power production), which is equivalent to five times the power produced from non-hydropower renewables in 2013 or three times the power produced from fossil fuels in 2013.[26] To reduce nuclear power production, while complying with renewable and GHG emission targets, the country will likely need to develop a larger share of renewable energy in power production.

26 Based on figures from RTE (2014), Bilan électrique 2013

Fundamentally, the objective to make up for 140 TWh of lost nuclear power, replaced by a mix of renewable sources, assumes that a renewable capacity of around 70 GW of a mix of solar and wind needs to be financed, developed and commissioned by 2025. A 140 TWh increase is much more significant (at least more than twice higher) than what can be expected from reaching the renewable target for 2020. As such, other measures to support energy efficiency and renewable energy are necessary to compensate for the decrease in nuclear power production by 2025.

Additionally, replacing nuclear power, typically used for base power production, with renewables, which are intrinsically intermittent, raises several questions about how to match spot power demand and supply.

- The **useful life of a nuclear power plant is currently set at 40 years**. This age will be reached between 2020 and 2035 by most of the French nuclear power plants. A decision has to be made about lifetime extensions. Lifetimes are likely to be extended by 10 or 20 years, mainly on economic grounds, since it is less expensive than building a new plant. In fact, according to Percebois and Mandil (2012), the average power cost could rise between 2010 and 2030 from 50 €/MWh to:

  – 50-65 €/MWh if nuclear still represents 70% of the power capacity mix (with the extension of the useful life of existing nuclear power plants);

  – 60-100 €/MWh if EPR (third generation nuclear reactors) nuclear power plants replace existing ones;

  – 80-95 €/MWh if renewable energies are extensively developed.

- Even if the useful life of nuclear power plants is extended, the **question of the replacement of actual nuclear power plants must be addressed by 2040**. Will France build new generation nuclear power plants? Will it rely mostly on energy efficiency and renewable energy (enhanced by all the technological progress realized by this date) to compensate for the progressive closure of its nuclear power plants?

- **Civil and political opposition to nuclear power exists in France** and was recently bolstered by the Fukushima disaster. While this opposition is not as vocal as it is in some other countries (e.g. Germany), it may still have an impact on future political decisions regarding nuclear power production in France in the coming years.

- **Whichever option is chosen, the cost will be significant. The necessary investments for the extension of nuclear plant useful life and those linked to the consequences of the Fukushima disaster are estimated at roughly € 62.5 bn between 2011 and 2025, and at € 30 bn between 2025 and 2033.**[27]

Renewables

Renewable energy may seem to be a good candidate for the required capacity development in the short and mid-terms, but many questions are still pending:

- **Hydropower** is produced by some 400 hydropower plants with a total capacity of 25.5 GW under a concession regime, which is mainly operated by EDF.

  Hydro concessions representing some 5.3 GW expire before 2015. For the first time, concessions will then be submitted to competitive bids. However, terms and conditions are under discussion with the French government.

- **Concerns about the availability and sustainability of biomass are growing**. The biggest barriers for large biomass for heating projects are generally linked to the difficulty of getting access to enough biomass. In fact, although French forests have a rather large potential of wood production, it is often difficult to mobilize. More generally, extending cultivation areas to produce more biomass for energy purposes raises the question of land use changes (LUC): more and more studies argue that using biomass for energy purposes is not as beneficial for the climate as initially thought; it might even increase overall GHG emissions.

27 Cours des Comptes, 2014

- **The financial support for renewable energy is already significant and should rise in the coming years**. In 2013, the Cour des comptes estimated the cost of public support for renewable energy. **The part of the CSPE (renewable financing support charge to be billed to consumers) used to support renewable energy amounted to € 1.4 billion in 2011 and should rise to € 2.2 billion in 2012, € 3 billion in 2013 and approximately € 8 billion in 2020**.[28] This means a global cost for the support of renewables in power production of around € 40.5 billion for the 2012-2020 period (which adds to the € 14.3 billion already allocated between 2006 and 2011). Other expenses also have to be taken into account, such as fiscal measures promoting biofuels, other budgetary subsidies for investment and public support, and public R&D. Moreover the CSPE level is not high enough to pass completely the cost of renewable development (among other components of the CSPE) on to customers. At the end of 2013, the tariff deficit for the CSPE (the major part of it being due to the cost of renewable) amounted to € 5.1 billion,[29] to which one must add € 0.7 billion of deficit for the year 2014.[30]

Fossil fuels and peak power production

Nuclear is mainly used for base-load power production and mid-merit. But new generation reactors, smaller and more flexible, are also on their way. Renewable energies produce electricity in an intermittent way. **So the question is how France will be able to meet its peak demand in the future**. As of today, France is to a certain extent already relying on imports to offset demand. To ensure France has enough power capacity during cold winter days, a decree was signed in January 2015 implementing a national peak power capacity mechanism beginning in the winter of 2016-2017.

Peak power is usually produced from gas or coal. Power production from coal emits much more GHG than that from gas, but is currently less expensive.

Although some countries (mostly the United States for the time being) are developing shale gas to produce more gas and reduce their power production costs, France is very reluctant to exploit its (potential) shale gas resources. Until now, French law has banned geological surveys to estimate these reserves on the grounds that exploiting them could cause serious environmental damage.

Impacts on transmission and supply/demand balances

All these evolutions will have deep impacts on the power transmission and distribution industry.

The **metering, transmission and distribution** of electricity is expected to evolve significantly. Many energy efficiency measures rely on a more efficient way to consume energy, by measuring energy consumption more precisely or by optimizing energy transmission, among other measures. All this depends on the development of smart meters and smart grids. For instance, smart metering will be deployed between now and 2020. Three million power smart meters are expected to be installed between 2014 and 2016, with a remaining 32 million meters implemented from 2017 to 2020.

With the heightened role of independent power producers (IPP), decentralized production and renewable energy, **the power system will move from a highly centralized** (capital, production and network) **to a more decentralized system**. In such a context, smart grids and energy storage will be increasingly useful.

If nuclear capacity remains stable at 50% of power production after 2025, power production capacity from renewables increases and overall electricity demand falls (due to energy efficiency policies, especially in buildings), **there may be a risk of overcapacity of centralized base power production capacity**, except in the case of increased demand for power in transport (due to the development of hybrid and electric vehicles).

Conclusion

France is now at a crossroads. After having relied for several decades on a power production mix dominated by nuclear energy and, to a lesser extent, by hydropower, it is now necessary to find new ways to meet very ambitious energy efficiency and GHG emission reduction targets, when nuclear and hydropower capacities are either capped or on the decline.

The energy transition law, currently under discussion, sets the path for less nuclear and more renewables in the future electricity mix. Should France pursue this path, it will significantly change the country's energy landscape and raise questions about how to cost-effectively transition from a centralized to a decentralized system.

2030 and beyond: in search of a new paradigm.

The whole energy paradigm is changing in France. In recent decades, this paradigm has been based on a power production mix dominated by nuclear energy and, to a lesser extent, by hydropower.

France has not yet defined its future energy mix.

It is now necessary to find new ways to meet very ambitious energy efficiency and GHG emission reduction targets amid stable (or decreasing) nuclear and hydropower capacity.

28 Cour des comptes, 2013

29 EDF, 2014

30 EDF, 2015

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European energy market reform
Country profile: Germany

Contents

Current situation

Energy consumption and trade balance

Germany's gross inland energy consumption[1] stood at 319 Mtoe in 2012 and has experienced a steady downward trend over the last two decades: a decrease of 3.9% from 1990 to 2000, and of -7% from 2000 to 2012. More than 80% of consumption came from fossil fuels. Petroleum products constituted the lion's share of the mix (108 Mtoe), followed by coal (80 Mtoe) and gas (70 Mtoe). Although the role of renewables is steadily increasing, their share remains relatively modest (10%).

Figure 1. Gross inland consumption in 2012 (319 Mtoe)[2]

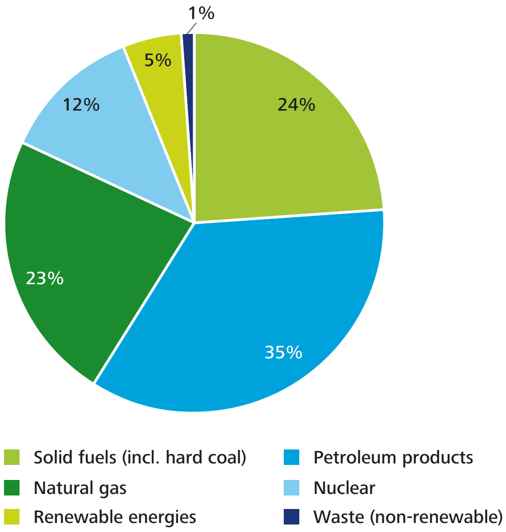
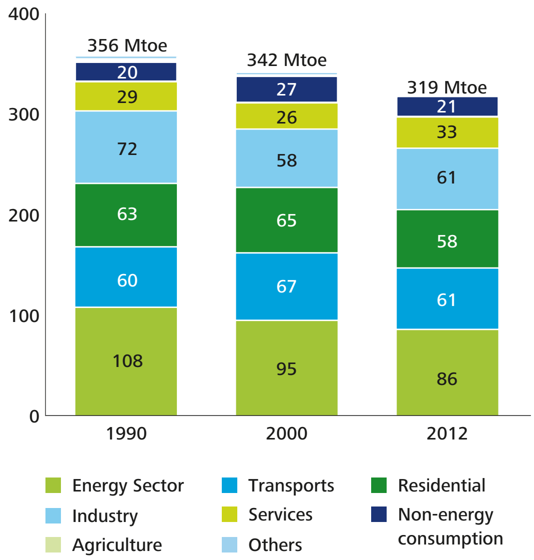


Figure 2. Gross inland consumption by sector (in Mtoe)[3]



The energy sector made up 27% of gross consumption in 2012, equivalent to the year 2000. From 2000 to 2012, the decrease in energy consumption was mainly driven by the energy sector (-9.5%), transport (-8.9%), the residential sector (-11%) and non-energy related fossil fuel consumption (-22%).

Key figures:

Population (2013):
80.5 million

GDP (2013):
2,737 bn €

GDP/capita (2013):
33,997 €

GDP/PEC (2012):
9.2 €/kgoe

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

Fossil fuels make up more than 80% of Germany's gross inland energy consumption.

The energy sector represented 27% of gross energy consumption in 2012; its volume decreased by 9.4% as compared to 2010.

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

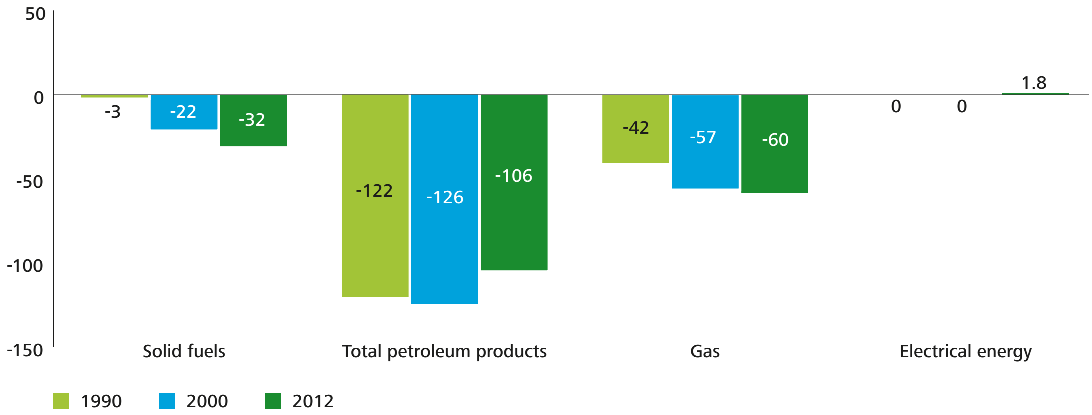
2 Source: Eurostat. © European Union, 1995-2015

Germany depends heavily on fossil fuel imports.

Germany's net imports reached a record high of € 93.5 billion in 2012.

Coal and gas net imports continue to rise steadily, whereas net imports of petroleum products decreased between 2000 and 2012 (-16%).

Figure 3. Energy trade balance (Mtoe)[2]



Over the same period, energy consumption rose by 5% in the industrial sector and by 27% in the services sector.

In 2012, German net imports of oil, gas and coal reached a record high of € 93.5 billion[3] (€ 68 billion for petroleum products, € 23 billion for gas, € 2.5 billion for coal), accounting for 10.2% of total imports[4] for the year. Although Germany is the world's largest miner of lignite, coal imports have been on the rise over the last two decades.

The same holds true for gas, where inland production decreased by 40% between 1990 and 2012 and imports increased by 80%.

44% of the country's electricity production relies on coal, while one third stems from renewables.

Power generation

With over 180 GW of installed capacity, Germany's is the largest electricity market in Europe. Over the last decade, the German energy markets have experienced fundamental changes largely driven by the continuous expansion of renewables and the abrupt decision after the Fukushima accident in 2011 to phase out nuclear power by 2022, which has become one of the cornerstones of Germany's energy market turnaround (*Energiewende*[5]).

Figure 4. Electricity capacity – 183 GW (2013)[6]

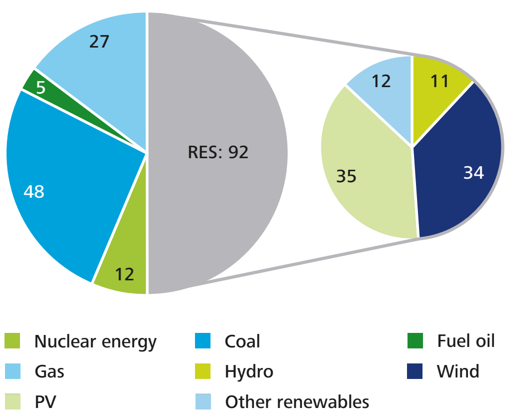
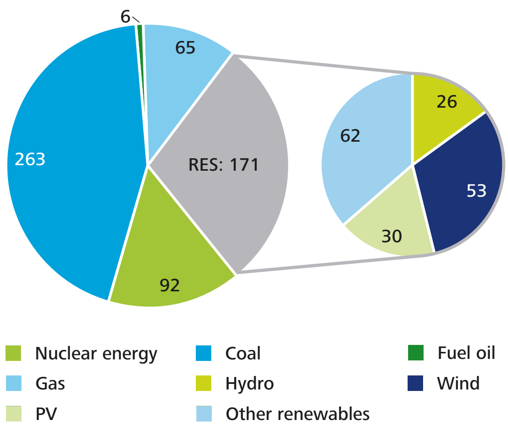


Figure 5. Net electricity production – 596 TWh (2013)[6]



Coal is the main source of fuel for electricity generation, and represented 44% (263 TWh) of generation output in 2013.

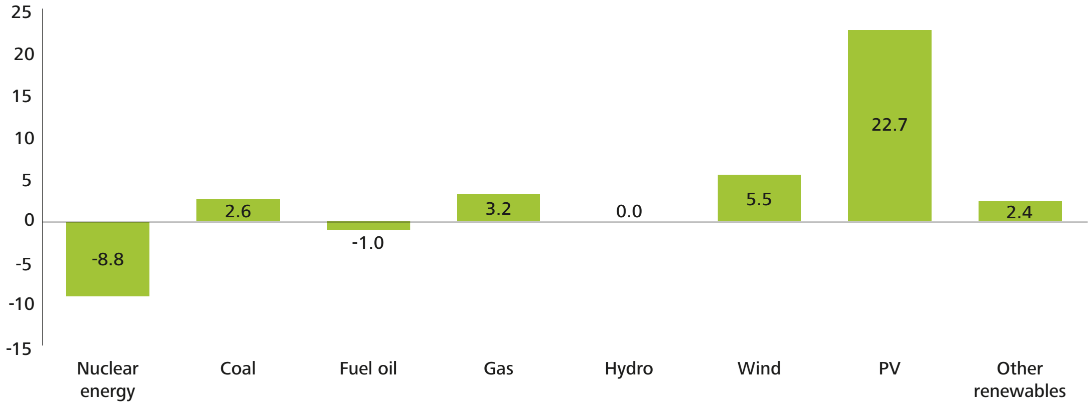
3 www.bafa.de

4 www.destatis.de

5 The *Energiewende* is explained in more detail in the third chapter of this country profile

6 RWE, BMWi

Figure 6. Electricity capacity change from 2009 to 2012 (in GW)[6]

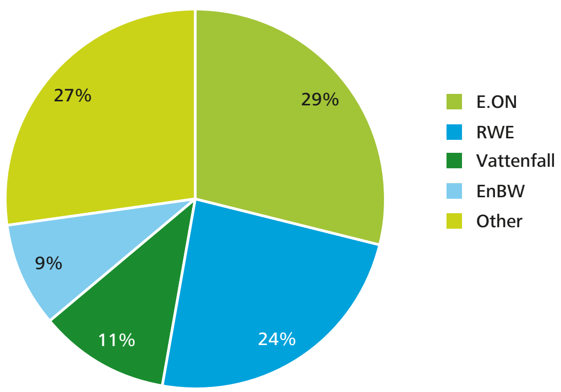


Renewable energy represented 50% of the total generation capacity, and 29% of electricity production. Nuclear still accounted for 7% of installed capacity, generating 15% of the electricity.[6]

From 2009 to 2012, Germany added 26.7 GW of generation capacity, most of which was driven by PV and wind. The immediate shutdown of eight nuclear reactors led to a sharp drop in nuclear capacity. Since peak capacities from renewables need to be balanced, coal and gas capacity increased over the last few years.

Power market: market mechanism and main actors

Figure 7. Market share of electricity generation (2012)[7]



Germany's domestic electricity market was fully liberalized in 1998. **Although there are currently over 800 individual providers, the majority of the country's electricity is still generated by four big energy companies: E.ON, RWE, Vattenfall and EnBW.**

Although shutting down the eight nuclear power plants reduced their generation capacities, **the four companies still produced 73% of electricity in 2012**.[7]

6 RWE, BMWi

7 Monitoring Report 2012 – Developments of the electricity and gas markets in Germany; calculations reproduced with information extracted from annual reports of the companies

Four players dominate the power market and four TSOs operate the grid.

The German power market is liberalized, but dominated by four main players who account for 73% of electricity generation. The grid is operated by four TSOs who historically were owned by the four big energy generators. More than 900 DSOs currently operate in the country.

The German transmission system is the most important hub in the European electricity market. **There are four TSOs** (transmission system operators); **one is still owned by a German energy utility, EnBW**:

- Amprion GmbH operates the largest system in Germany (11,000 km) and was sold in 2011 by RWE to a consortium of financial investors.
- TenneT operates 10,700 km. This grid was sold by E.ON in 2010 to the Dutch TSO.
- Elia (50Hertz Transmission GmbH) operates 9,750 km; the grid was purchased from Vattenfall by the Belgian TSO in 2011.
- TransnetBW GmbH operates 3,300 km and is still owned by EnBW.

Figure 8. Market mechanism

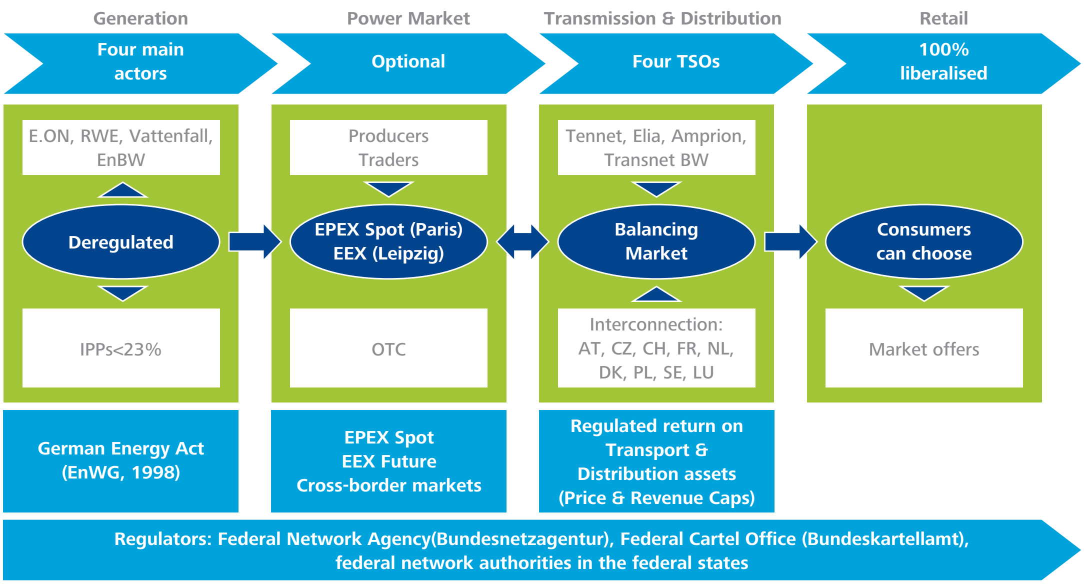


Figure 9. Geographical division of the transmission system by operator

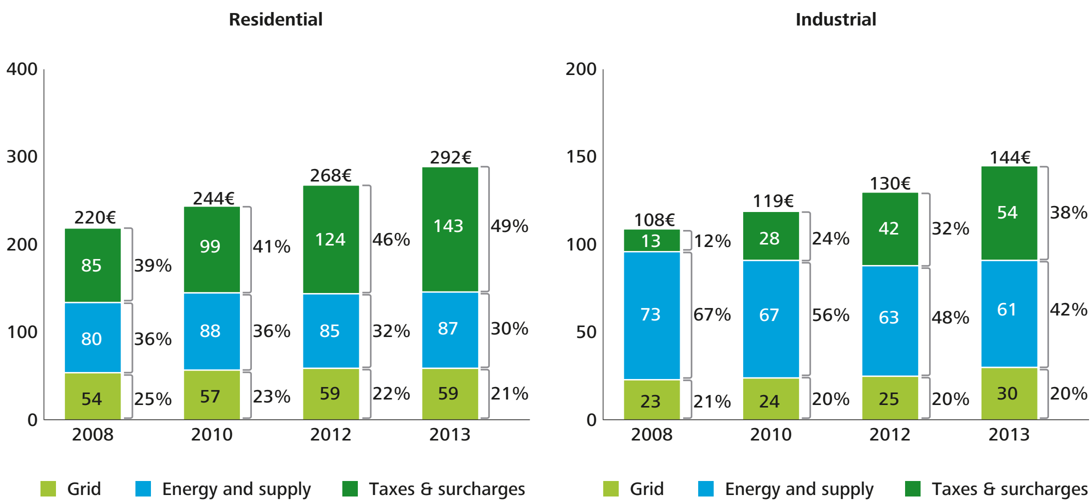
In 2013, more than 900 DSOs (distribution system operators) **were operating in Germany**. The distribution networks are often run by vertically integrated utilities, companies that own generation assets as well as supply and distribution businesses. The country's four dominant companies hold shares in many of these DSOs.

Power prices

Germany has the second highest residential electricity prices in the EU-28 (after Denmark): 45% above the EU-28 average price.

Prices for industrial users are 21% above the EU-28 average, ranking fourth after Cyprus, Malta and Italy, although industrial users pay less than 50% of the residential tariff.

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



Electricity prices rose sharply between 2008 and 2013: +32% for residential users and +33% for industrial users.

While generation and distribution costs remained relatively flat, **the main driver of the significant overall cost increases is linked to taxes and surcharges, which include subsidies to suppport renewable development (the so-called EEG surcharge, see next chapter).**

In 2013, the EEG surcharge made up 36% of the tax burden and 18% of the overall electricity price, compared to only 5% in 2008. It has risen steadily from 11 €/MWh in 2008 to 62 €/MWh in 2014 (CAGR: 33.4%).

High and increasing power prices.

In 2014, the renewable energy sector was subsidized to the tune of approximately € 24 billion. Electricity prices have been rising over the last few years, mainly driven by the significant expansion of renewable capacities. The lion's share of the costs of renewables is borne by household consumers. German electricity prices are the second highest in Europe for residential users and the fourth highest for industrial users.

8 Source: Eurostat. © European Union, 1995-2015 (ten00117 – Residential: 2500 kWh < cons. < 5000 kWh; Industrial: 500 MWh < cons. < 2000 MWh)

Figure 11. EEG-surcharge[9]

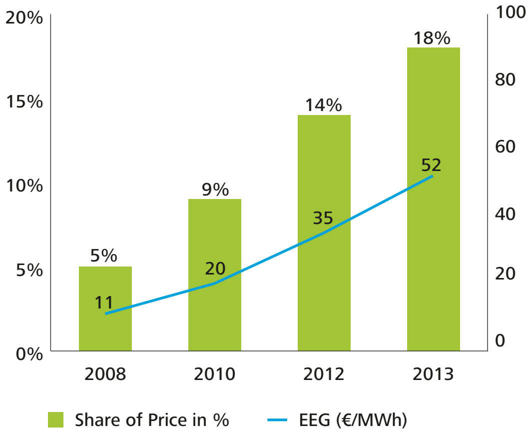
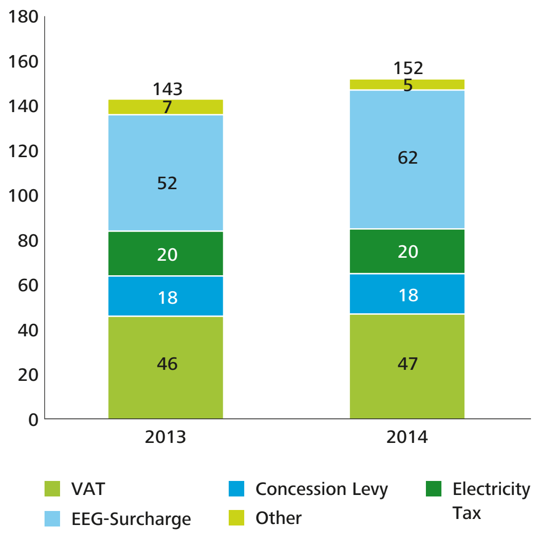


Figure 12. Tax breakdown[9]



Although PV only generated approximately 17% of the renewable electricity in 2013, it accounted for 53% of the EEG costs, almost three times as much as wind (18%) and twice as much as biomass (26%).

9 BDEW

Targets for 2020

In 2010 and 2011, the German government set energy and climate targets for 2020 and 2050 (2010 Energy Concept and 2011 Energy Package):

Table 1. Targets fixed in the Energy Concept[10]

	Targets	2020	2030	2040	2050
Energy efficiency	Reduction of primary energy consumption (base year: 2008)	20%			50%
	Reduction of electricity consumption (base year: 2008)	10%			25%
	Reduction of final energy consumption in the transport sector (base year: 2005)	10%			40%
Renewable energy	Share of renewable energies in electricity consumption	35%	50%	65%	80%
	Share of renewable energies in total final energy consumption	18%	30%	45%	60%
GHG	Reduction in GHG emissions (base year: 1990)	40%	55%	70%	80%-95%

In 2011, after the Fukushima accident, the German government decided on a radical energy turnaround (*Energiewende*), phasing out nuclear power by 2022, although the 2010 Energy Concept initially intended to keep nuclear energy in the mix as a so-called "bridge transition technology."

The Energy Package of 2011 contains six measures that build a framework for the energy turnaround:

- Accelerate the construction of the energy grid (NABEG).
- Redefine energy sector-related laws and ordinances (EnWGÄndG).
- Create an energy and climate fund (EKFG-ÄndG).
- Change the Atomic Energy Act (AtomG).
- Enforce climate-friendly development in cities and communities.
- Change the Atomic Energy Act (AtomG).
- Enforce climate-friendly development in cities and communities.

Energy efficiency targets

Germany's energy intensity has been decreasing over the last 20 years. While its GDP rose by 82% between 1990 and 2012, its primary energy consumption in 2012 had decreased by 5% compared to the 2008 level.

In June 2014, the federal government adopted the third National Energy Efficiency Action Plan (NEEAP), with a primary energy consumption target of 277 Mtoe in 2020 (vs. 315 Mtoe in 2008 and 298 Mtoe in 2012), representing a decrease of 12% compared to 2008.

This target assumes a 1.1% annual GDP increase and an average annual increase of 2.1% in macroeconomic energy productivity from 2008 to 2020.

As of 2012, Germany still needed to decrease its primary energy consumption by 21 Mtoe before 2020. Notably, **between 2008 and 2012, Germany realized 46% of its energy efficiency target, and is consequently on track to reaching its 2020 targets**.

20-20-20 EU targets for Germany: what is Germany committed to in 2020?

- 20% reduction of primary energy consumption compared to 2008 levels.
- 18% renewable energies in 2020 final energy consumption and 35% renewable energies in electricity consumption in 2020.
- 40% reduction of GHG emissions in 2020 versus 1990 levels in total.

Energy efficiency: so far, 54% of Germany's target has yet to be accomplished.

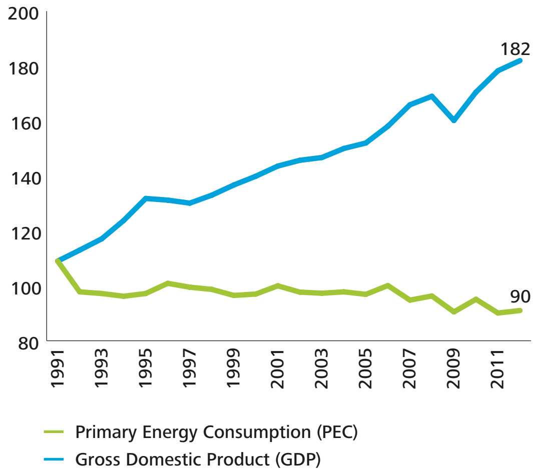
Germany's primary energy consumption has been on a declining trend over the last 20 years. To reach its 2020 targets, it must still reduce consumption by 21 Mtoe (7% of its 2012 consumption).

Germany seems to be on track to reaching its 2020 targets. However, future success will strongly hinge on the effectiveness of its energy efficiency policies, especially in the buildings sector.

10 BMWi

Figure 13. Primary energy consumption (Mtoe) and 2020 target[11]

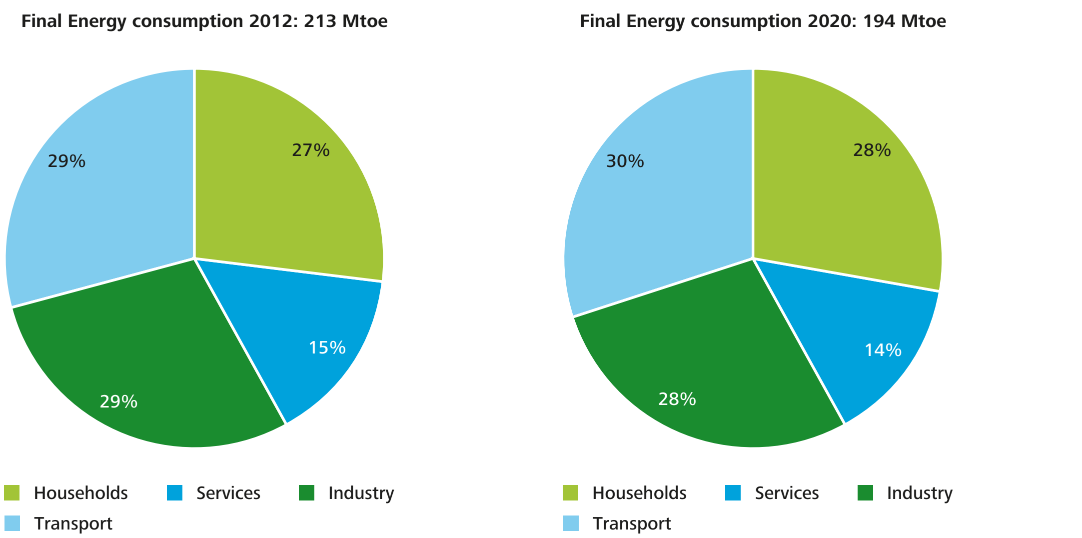
Figure 14. GDP and PEC development[11]



According to the third NEEAP, the target for *final* energy consumption was fixed at 194.3 Mtoe in 2020. The buildings sector is a primary target for overall energy efficiency improvement as it consumes almost 40% of Germany's final energy. In the 2010 Energy Concept, the target was to reduce heat demand by 20% and to have all new buildings become "climate-neutral" by 2020. By 2050, all existing buildings should be climate-neutral. Furthermore, primary energy demand in the building sector should be reduced by 80% by 2050. This will require a doubling of the renovation rate of buildings, from around 1% at the moment to 2% per year, accompanied by significant investments. The recent update of the Energy Saving Ordinance (EnEV 2014) increased the energy efficiency requirements for new and refurbished buildings by 25% from 2016. For its part, the Renewable Heating Act (2011) prescribes the integration of renewables or CMP for new and replaced heating systems.

The KfW, a government-owned development bank, provides loans and grants to refurbish old and new buildings to levels that exceed the minimum energy performance requirements set by the Energy Savings Ordinance (€10.4 bn in 2013). Between 2013 and 2020, the government has committed to increasing these yearly grants by an additional € 300 million.

Figure 15. Final energy consumption in 2012 and 2020 targets, by sector[12]



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

12 http://ec.europa.eu. © European Union, 1995-2015

The transport sector accounts for around 30% of Germany's final energy consumption. Policies related to the energy efficiency target mainly concern the technical improvement of vehicles. In its Energy Concept, the German government set a target to reduce final energy consumption in the transport sector by 10% in 2020, as compared to 2005. However, as of 2012, only 5% of this reduction had been realized, leaving 95% still to be achieved.

Like the transport sector, the industrial sector accounts for almost one-third of the country's final energy consumption. The EU-ETS aims to incentivize energy-intensive industries and the electricity sector to reduce their emissions and consequently enhance overall energy efficiency. The German Development Bank, KfW, introduced an Energy Efficiency Program for SMEs in 2012, providing loans for private companies and self-employed persons to finance energy saving investments (up to € 25 million). SMEs with an annual energy bill of over € 5,000 can also apply for an energy audit provided by KfW. Furthermore, companies can receive investment grants to increase the energy efficiency of their production processes. Another measure geared towards industry is the Surplus Settlement Efficiency System Act (SpaEfV),[13] which defines criteria to qualify for a partial refund of energy and electricity taxes, as well as for partial relief on EEG-surcharges in cases where specific energy efficiency requirements are met.

Renewable energy targets

Germany's renewable energy targets aim at reaching an 18% share in total final energy consumption and a 35% share of electricity consumption by 2020.

An ambitious but costly policy to develop renewables in the power sector:
Development of renewable energy has been subsidized with a price guarantee to renewable energy producers. The following table shows the feed-in tariffs and contract durations in 2014.

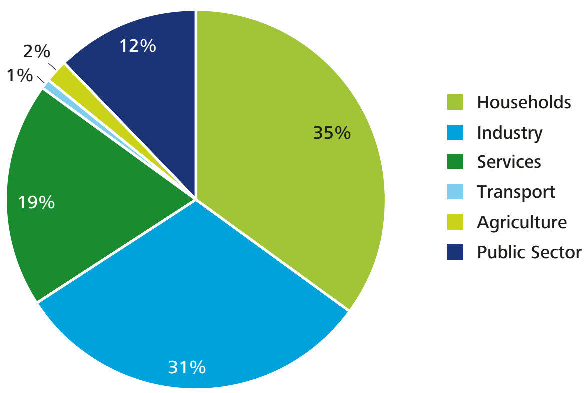
Table 2. 2014 feed-in tariffs (in c€/kWh) and contract durations (years)[14]

	Onshore wind	Offshore wind	Solar	Geothermal	Biomass (CHP)
Feed-in tariffs (c€/kWh)	4.9-8.9	3.9-19.4	8.7-12.8	25.2	5.8-13.6
Contract duration (years)	20	20	20	20	20

The difference between the market price for electricity and the guaranteed price to producers for renewables is passed on to consumers (via the EEG surcharge), whose bills have been rising for years. **Currently, the renewable energy sector is subsidized to the tune of approximately € 19.4 billion per year (€ 240 per resident in 2014[15])**.

In 2014, approximately 3,000 companies, accounting for around 107 TWh, or 18% of total electricity consumption, were fully or partially exempt from paying the EEG surcharge, meaning that a big share of the extra costs of renewables is being shouldered by households.[16]

Figure 16. Financing of the EEG surcharge, by sector[16]



Renewable energy: 66% of the country's target has been achieved so far, although reaching the final target remains uncertain.

Germany currently generates 12% of its final energy consumption and 23% of its electricity from renewables. These shares have been rising continuously in recent years. New capacities will stem mainly from wind and solar.

If current trends prevail, Germany will be well on its way to reaching its 2020 targets. However, recent changes in the EEG may slow down the future development of renewables, hindering the country's ability to reach its targets.

13 Spitzenausgleich-Effizienzsystemverordnung (SpaEfV)

14 EEG 2014, for solar with monthly degression (actual Nov. 2014)

15 http://www.wiwo.de/politik/deutschland/trotz-reform-verbraucher-werden-2015-eine-milliarde-euro-mehr-eeg-umlage-bezahlen/9414526.html

16 BDEW (2014)

Although the majority of Germany's population is generally supportive of the *Energiewende*, rising pricing inequality has eroded popular support over the last four years.

In June 2014, the federal government revised the EEG to limit electricity price hikes. The new law set specific volume targets (so-called expansion corridors) for the annual increase of each renewable energy technology:

- Solar: annual increase of 2.5 GW.
- Onshore wind: annual increase of 2.5 GW.
- Biomass: annual increase of 100 MW.
- Offshore wind: 6.5 GW until 2020 and 15 GW until 2030.

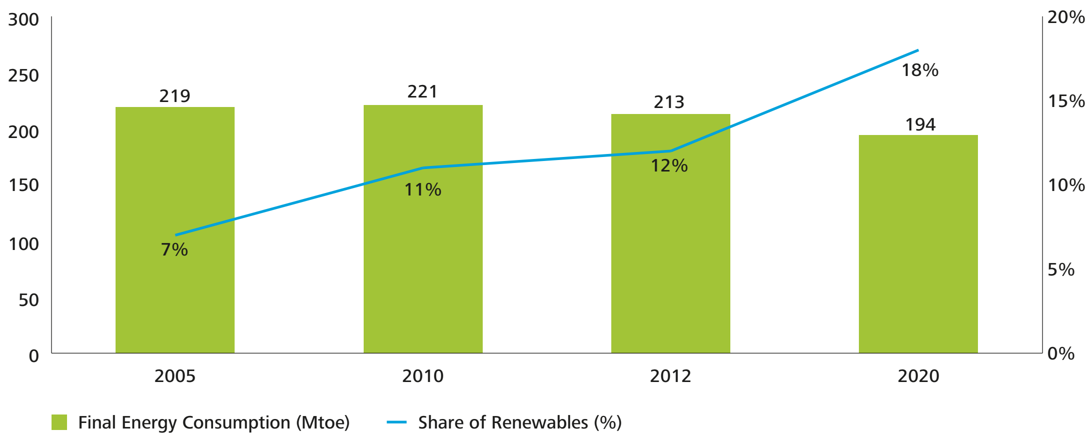
If more new plants are built to support more than the projected capacity, the subsidy rates for additional plants will automatically be reduced (flexible cap).

Additionally, to reduce the high surcharge, these reforms aim to spread the cost to more customers by reducing the number of exempt industrial customers and applying the surcharge to customers that generate their own power.

In October 2014, the German government announced that – for the first time in its history – the EEG surcharge for residential and for non-relieved commercial and industrial customers would fall slightly in 2015, to 61.7 €/MWh, mainly resulting from a surplus of EEG-surcharges from 2013.

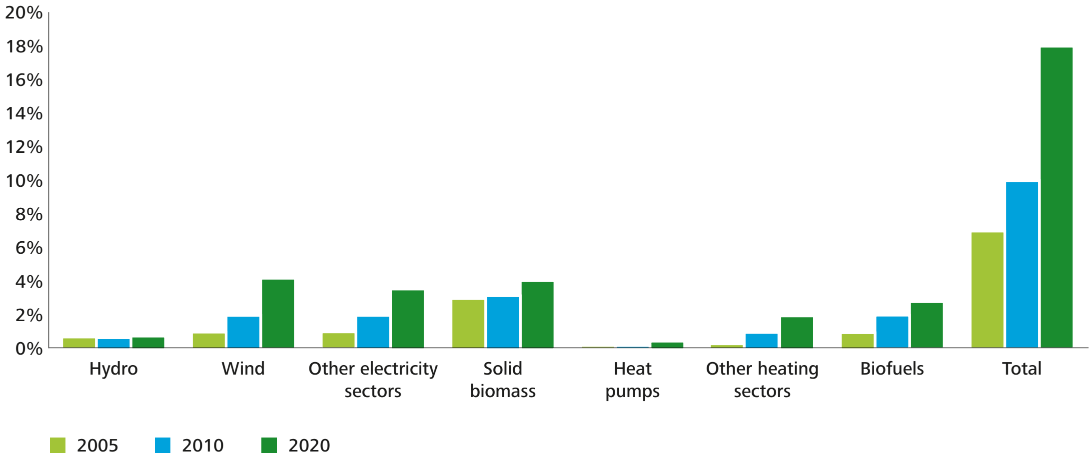
Where is Germany now regarding renewable energy?
Between 2005 and 2012, Germany increased its share of renewables in final energy consumption from 7% to 12%, and its share of renewables in gross electricity consumption from 10% to 23%. This means that 1/3 of the target still remains to be realized before 2020.

Figure 17. Renewable energy share of final energy use (2012)[17]



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

Figure 18. Renewable energy share of final energy use by type, in 2005 and 2010, and target for 2020, in %[18]



The increasing share of renewables was mainly driven by new PV and wind capacities: PV capacities rose from 62 MW in 2000 to 34.7 GW in 2013 (CAGR: 63%), overtaking wind capacities. And wind capacities increased during the same time, from 5.8 GW to 34.4 GW (CAGR: 15%).

As can be inferred from **Figure 18, the main sources of additional renewable energy capacities until 2020 are targeted to come from wind** and other electricity sectors, mainly PV. Germany seems to be on track to reach its renewable energy targets.

However, with the EEG reforms of 2014, which reduced feed-in tariffs and introduced capacity caps, development is likely to slow down. Another impediment to the implementation of new capacities will be the speed with which the new electricity grid can bring energy from the windy north to the energy-hungry south in the face of both administrative barriers and local opposition.

To date, Germany has reached 66% of its renewable energy target. However, given changing policies around renewable power, its ability to reach its 2020 target remains uncertain.

CO_2 emissions and targets

Germany is the largest CO_2 emitter in Europe, accounting for roughly 20% of the overall EU-28 CO_2 emissions in 2012. These emissions have been declining over the last two decades, falling 25% below 1990 levels. However, emissions regained momentum after the country's decision to phase out nuclear power in 2011, and have increased over the last two years due to a higher share of coal (in particular lignite) in the electricity generation mix. **Preliminary numbers suggest that in 2013 emissions further increased to 951 Mt CO_2eq.**[19] These increases can mainly be attributed to the energy sector (+3%), the transport sector (+5%) and the residential sector (+3%).

18 Eurostat. © European Union, 1995-2015

19 http://www.umweltbundesamt.de/

CO_2 emissions: 62% of the target achieved, but emissions are on the rise.

Germany cut its emissions by 25% relative to 1990, but has experienced increased CO_2 emissions since the rapid shut down of eight nuclear plants in 2011. With its high dependence on coal and 11.5 GW of coal plants under construction, it is highly questionable if the remaining 38% of CO_2 reductions can be met by 2020.

Figure 19. GHG emissions and targets[20]

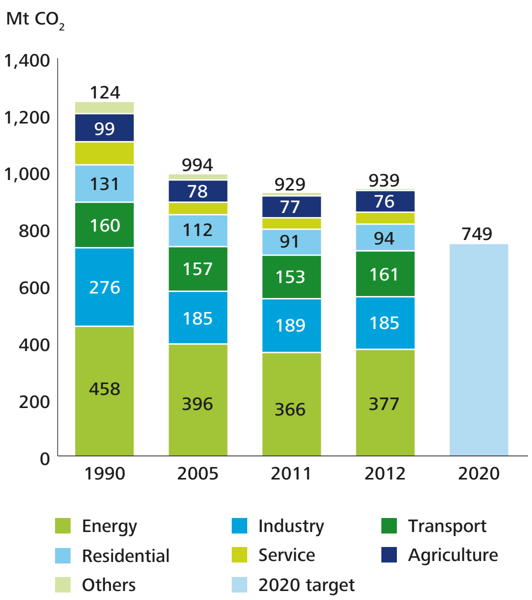
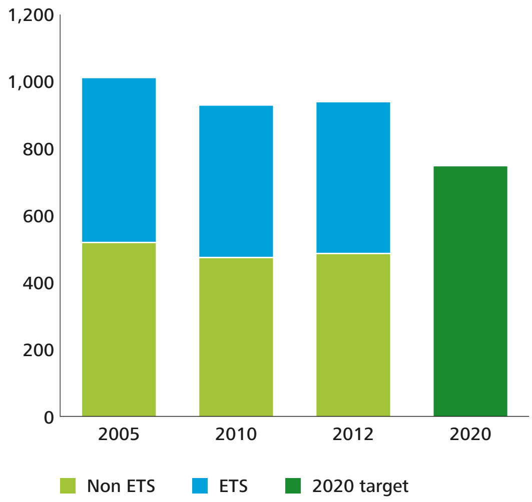
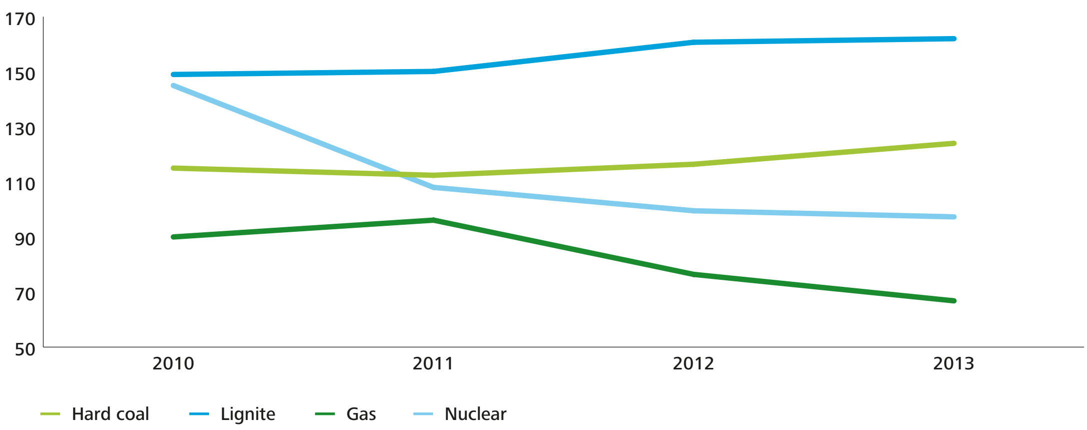


Figure 20. ETS and non-ETS emissions[21]



ETS emissions have been on the rise since 2009, a trend partly attributable to the country's economic recovery. While future CO_2 prices will certainly influence Germany's GHG targets, further significant efforts to reduce both ETS and non-ETS emissions will be required.

Figure 21. Electricity generation from coal, gas and nuclear (in TWh)[10]



Current Ministry of the Environment projections suggest that measures in place should lead to an overall emission reduction of 33% as compared to the 1990 level. **Closing the gap to reach the 40% target would require additional savings of around 85 Mtoe of CO_2eq, meaning that further action is necessary**. Yet, if coal maintains or even increases its considerable share in the German energy mix,[22] the *Energiewende* might impede the country's ability to reach its 2020 targets.

To counteract this development, the government presented its first cornerstones for a 2020 Action Program for Climate Protection[23] in April 2014.

Building on this Action Program, the government plans to develop a national 2050 Climate Protection Plan by 2016. It is, however, unlikely that these measures will be very effective before 2020, which means Germany is unlikely to reach its 2020 CO_2 targets.

20 EEA (2014)

21 VET-Bericht 2013, Treibhausgasemissionen der emissionshandelspflichtigen stationären Anlagen in Deutschland im Jahr 2013, German Emissions Trading Authority (DEHSt) at the Federal Environment Agency

22 WWF (2014): According to a study published by environmental groups including WWF four of the five most polluting coal power plants in Europe are situated in Germany

23 Aktionsprogramm Klimaschutz 2020

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

Energy turnaround (Energiewende)

Germany has set ambitious energy and climate targets for 2050, with interim steps for 2030 and 2040. It was one of the first countries to set up long-term objectives to move toward a low-carbon economy. This endeavor has proven – and will most likely continue to prove – costly to German taxpayers. In February 2013, the then Energy & Environment minister said that the costs of *Energiewende* – reforming and restructuring Germany's energy sector by the end of the 2030s – could reach € 1,000 billion.

These targets, combined with the simultaneous phase-out of nuclear energy by 2022 and the increasing costs to support the development of renewable energy, constitute a major challenge to Germany's ability to guarantee a secure and affordable energy supply. This threatens not only citizens' living standards, but also the competitiveness of Germany's economy.

To the German public, these targets are indicators of the country's ability to complete its energy transition in a timely manner. It remains to be seen whether Germany's policy-makers see the timely achievement of these targets as an end in itself (as a way to avoid political risk and argue in favor of shorter-term expensive fixes) or whether they are serious about adopting a strategy capable of driving down costs and encouraging innovation by fostering exposure to prevailing market forces.

Ambitious targets require ambitious actions – and a more adaptive energy environment.

Germany presented a legal framework to pave the way for its 2020 and 2050 targets. However, it is not clear if this framework will be sufficient.

Nuclear power

Nuclear plants supplied approximately one-quarter of Germany's power before the 2011 Fukushima accident. This disaster changed the German energy strategy in a radical way. The eight oldest reactors (8.8 GW) were permanently shut down in mid-2011 and the government decided to speed up the shuttering of the nine remaining reactors (12.7 GW) by about a decade, to 2022. **In 2013, nuclear generated 97 TWH or 16% of the country's electricity output**.

As an illustration, replacing 97 TWh of nuclear power production would require around 112 GW of new PV, 63 GW of wind or 18 GW of coal power capacities.[24]

Since the nuclear phase-out has broad acceptance among the population and is supported by all the major political parties, it is rather unlikely that another U-turn will occur in the years to come. In September 2011, industry giant Siemens announced its complete withdrawal from the nuclear industry.

This last point demonstrates a critical side effect of the government's decision. Since there is no future role for this type of energy in Germany, specific know-how and technologies will not be developed beyond the current generation. Yet, this know-how will still be needed to decommission the existing power plants. Another major and still unresolved problem is linked to the management of nuclear waste, which is a highly controversial topic in Germany. An operating repository for high-level waste is not expected before 2050.

In essence, the nuclear sector is heading towards a "bad bank" scenario, where the German government may need to take a more active role in organizing and financing the shutdown of the sector – in a manner similar to what happened in the German hard coal mining sector.

12.7 GW of nuclear plants are slated to be gradually replaced between 2015 and 2022, representing 16% of the country's 2013 electricity output.

While replacing nuclear energy seems a stretch but possible, the real challenge lies in shutting down the sector. To achieve this goal, the state will likely need to play a more active role.

Renewables

According to the Energy Concept, renewable energies are the supporting pillar of Germany's future energy supply. The target is for renewables to reach a 60% share of final energy consumption and 80% of electricity production by 2050. Over the past decade, Germany saw a strong expansion of its intermittent energy sources. Wind power has become the most important renewable source of electricity production, with an installed capacity of 34 GW in 2013, followed by solar power, which grew sharply over the last five years (+22.7 GW between 2009 and 2012).

While this development has led to a significant increase of renewables in the German energy mix, it was accompanied by lower (and sometimes even negative) spot prices on the energy exchanges and a crowding-out effect of operating times of conventional power plants (for gas in particular).

In parallel, electricity bills are rising sharply as a result of the cost of the surcharge used to fund renewables. Even if the German government manages to regulate the annual capacity increase, it still remains to be seen how the population's energy bill can be kept at an acceptable level and how it will impact Germany's competitiveness. From 2008 to 2014, the EEG apportionment for residential customers rose from 11 to 62 €/MWh (+460%).

More renewables in the pipeline, but at what cost?

Although development is likely to slow down in the coming years, additional capacities are planned. Yet zero-marginal cost economics will, fundamentally reshape the way energy is procured in the long term.

24 Calculation based on the 2013 TWh/GW ratios; cf. the chapter on power generation

Nevertheless, renewables in the form of onshore and offshore wind, as well as PV, will continue to be the only growing forms of energy in Germany for the foreseeable future. With the system becoming increasingly dominated by renewables, two issues are coming to the fore:

- Storage. The abundance of cheap energy during times of oversupply, combined with the need for grid balancing, will foster innovation in storage solutions such as direct battery storage, indirect power-to-heat and power-to-hydrogen applications.

- Financing. Given the zero-marginal cost of renewables, the relevance of wholesale market prices to refinance renewables investments will likely be called into questioned. Instead, other forms of asset monetization, such as long-term PPAs, may be used to finance capital costs, leaving only residual balancing energy to be traded.

11.7 GW of new coal, threatening GHG emission targets.

With low CO_2 prices and a relatively high gas price in Europe, coal could remain attractive for several years, threatening Germany's long-term GHG emission targets.

Fossil fuels and peak power production

Germany relies heavily on fossil fuels and is a long-time leader in lignite mining. In 2013, coal power plants generated around 45% of Germany's electricity production. Twelve new coal power plants were under construction or planned (11.7 GW)[25] as of May 2013. This new building activity is the result of the last investment cycle up to 2009 that was triggered by then-high clean/dark spreads in the industry. While the new builds were originally supposed to replace inefficient coal plants, they may now step in to fill the nuclear gap that will exist after final shut-downs. Not surprisingly, this compromises Germany's ability to meet the ambitious climate and energy goals it set in 2010.

The speed of the *Energiewende* has significantly changed the economics for conventional power plants. While, in 2013, electricity production from lignite reached its highest level since 1990 – providing further base-load power due to the nuclear phase-out and low CO_2 prices – gas-fired power production has been declining for the last three years due to closure or mothballing of no longer profitable gas-fired plants. In the mid-term, the mix of conventional power production depends on two factors. First, if CO_2 prices remain at their low level, the use of coal is likely to continue. Second, if gas prices remain at their relatively high levels, CCGTs will not increase their operating hours.

A coal-to-gas shift may result from a combination of these two factors. For example, CO_2 prices could arguably rise as a result of EU-ETS reform, while gas prices fall due to global LNG oversupply. However, that scenario remains highly unlikely. Instead, Germany's ongoing dependence on imports from geopolitically-uncertain areas (in 2012, 38% of German gas imports came from Russia[26]) and its lack of plans to engage in fracking, will likely see coal playing a fundamental role in the country's electricity mix for years to come, at least as a transition fuel. As carbon capture and storage (CCS) technology is not yet commercially viable,[27] this means coal emissions will remain a major challenge in Germany.

3,500 km of new grid needed

the north to the rest of the country will require substantial investments, estimated between € 21-26 billion. The success of the *Energiewende* will highly depend on the speed and cost-effectiveness of the grid expansion.

Infrastructure

Germany's power grid is characterized by home-grown production structures that keep power generation relatively close to consumption sites. In the future, electricity production will increase significantly in the northern part of Germany, in particular at the sea and in coastal regions (wind). In addition, much of the country's decentralized generation, such as PV and biomass, will be fed into the grid. Interconnections with neighboring countries are also expected to increase. To address these future challenges, a 10-year grid development plan was developed in 2013, prioritizing the construction of four "energy highways" and other supporting lines. Particularly important will be the construction of north-south energy highways that can bring energy from wind power plants in the north to the south.

The total investment needed for this development is estimated between € 21-26 billion.

25 BDEW (2013)

26 BMWi (2013)

27 In May 2014 Vattenfall announced that they would totally give up CCS research after 10 years because of "challenging market conditions"

Conclusion

With its historic *Energiewende* project, Germany set long-term energy and climate goals and defined intermediate targets. These targets were set before the Fukushima accident in 2011 and therefore before Germany's decision to phase out nuclear by 2022. Nevertheless, the government decided not to adjust its objectives, but to find alternative solutions instead, particularly by further developing renewable energies and promoting energy efficiency. As a result, wind and especially PV capacities have skyrocketed during the last decade, mainly driven by the high feed-in-tariffs set out in the first versions of the EEG. The new EEG 2014 puts a flexible cap on new renewable capacities, allowing the government to better control its future development and to slow down the rapid rise of electricity prices.

Today, Germany has some of the lowest wholesale electricity prices in Europe and some of the highest retail prices, due to its energy policies.

The success or failure of the *Energiewende* will depend on different factors, which each represent a major challenge:

First, to retain public support for the project, the government has to **stabilize electricity prices** and find a solution to the unequal distribution of the burden related to the EEG apportionment.

Second, a fast and cost-effective solution for grid extension needs to be found and implemented.

Third, **Germany has to define the future role of gas (and coal) in its energy mix and work seriously on its CO_2 emissions if it wants to reach its long-term reduction targets and keep its green image**.

Fourth, **the development of cost-effective storage solutions** will be critical to balance intermittent renewable supplies and use the frequent abundance of renewables at zero marginal cost. This should be a focus of political attention, without trying to pre-determine the winning technology.

Fifth, with zero marginal cost renewables increasingly dominating the market, the country must revisit its **fundamental market design and consider different solutions that enable electricity suppliers to realize a return on their investment over the long term while balancing market supply and demand over the short term**.

28 www.
netzentwicklungsplan.de

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Deloitte.

European energy market reform
Country profile: Italy

Contents

Current situation

Energy consumption and trade balance

In 2012, Italy's gross inland energy consumption amounted to 163 Mtoe. **Thirty-eight percent of primary energy consumed is derived from gas (61 Mtoe) and another 38% comes from crude oil, which holds second place in the energy mix (59 Mtoe)**, followed by coal, which represents 10% of consumption (16 Mtoe).[1]

Figure 1. Gross inland energy consumption in 2012 (163 Mtoe)[2]

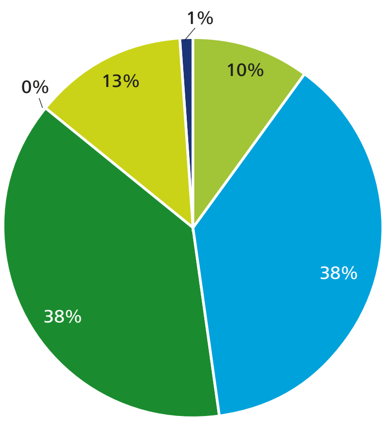
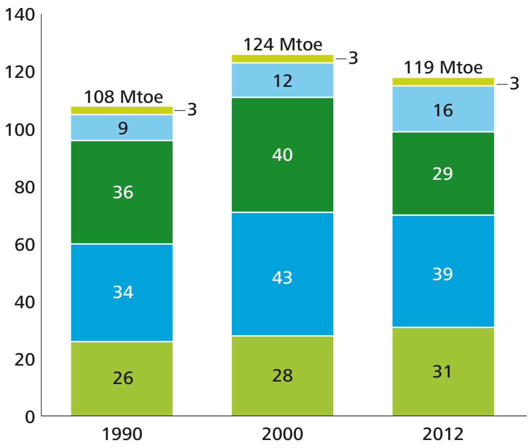


Figure 2. Final energy consumption by sector (in Mtoe)[2]



Italians consume less energy than average Europeans (2.5 toe, including 4,800 kWh of electricity per capita, compared to 3.2 toe and 5,580 kWh for the EU in 2013).[3] This is due to several factors, such as relatively high power prices and the legacy of the economic crisis, which saw electricity demand in the industrial sector fall by 21% between 2008 and 2013. In 2012-2013, overall electricity demand reached its record low since the market was first liberalized at the beginning of the century.[4]

In 2012, the transportation, residential and industrial sectors' share of final energy consumption was 33%, 26% and 25% respectively. Industry and agriculture were the only two sectors showing a decrease in their final energy consumption from 1990 to 2012 (-20% and -10% respectively). **Since 2000, there has been a downward trend for all sectors**, excluding services, where final energy consumption increased by 37%.

Key figures:

Population (2013):
59.7m cap.

GDP (2013):
1,560 bn €

GDP/capita (2013):
26,138 €

GDP/PEC (2012):
9.6 €/kgoe

PEC/capita (2013):
2.5 toe/cap.

Fossil fuels make up 86% of Italy's primary energy consumption, with 38% in crude oil and 38% in gas.

Transport and the residential sector represent almost 60% of overall final energy consumption, and have both been increasing since 1990.

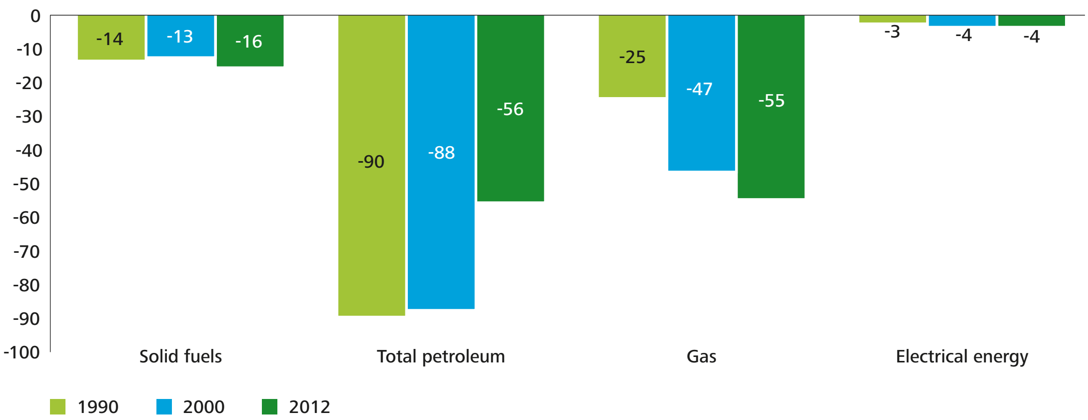
1 It can be noted that, although it is not shown in figure 1, Italy does consume nuclear energy. However, this consumption is 'hidden' as part of total electricity imports taken into account in the calculation of primary energy consumption and thus is not shown in Eurostat data

2 Source: Eurostat. © European Union, 1995-2015, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc320&plugin=1; http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdpc320

3 ENERDATA – Italy energy report, August 2014 update, https://estore.enerdata.net/energy-market/italy-energy-report-and-data.html

4 REF-E (2014) – Il mercato elettrico italiano: stato dell'arte e prospettive. Presentation by Virginia Carnazza

Figure 3. Energy trade balance (Mtoe)



Italy has a high preponderance of thermal power production (74%), while non-hydro renewables generated 13% in 2012.

In 2012, Italy's global energy imports reached 165 Mtoe and exports reached 31 Mtoe.

Italy's energy reserves are scarce: limited oil resources (202 Mt in 2013) and dwindling gas reserves (from 199 bcm in 2000 to 56 bcm in 2013). **The country depends on imports of fossil fuels**.

Oil imports (crude and refined) amounted to 56 Mtoe in 2012 and **have decreased by 38%** since 1990, while **natural gas imports** (55 Mtoe in 2012) **have increased by 119%**. In the 1990s and early 2000s, rising demand for energy, and growing economic and geopolitical uncertainties related to the use of oil, **forced Italian energy producers to intensify their efforts to diversify their energy sources**. Oil as fuel in thermal power plants has been partially replaced by natural gas, as the latter is considered less volatile in terms of price, more accessible and typically comes from less politically unstable areas.

Italy is a net importer of electricity. Roughly 87% of demand is satisfied by a national production of 285 billion kWh (1.3% less than in 2011). The remaining 13% comes from France and Switzerland electricity imports, which benefit from low prices driven by excess power during off-peak periods.

Power generation

Power generation capacity was 128 GW in 2012.[5] **More than 70% of Italy's electricity was generated by thermal plants in 2012**, 14% by hydropower and 13% by other renewables sources.[5]

Figure 4. Electricity production capacity – 128 GW (2012)[5]

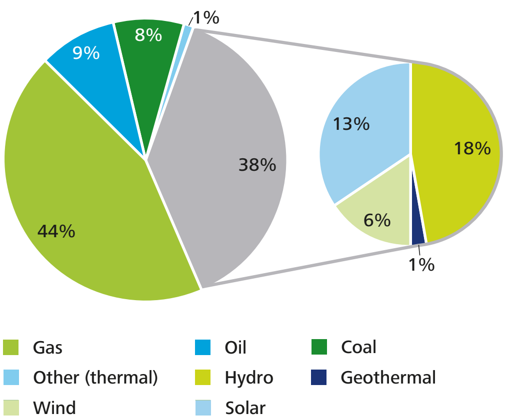
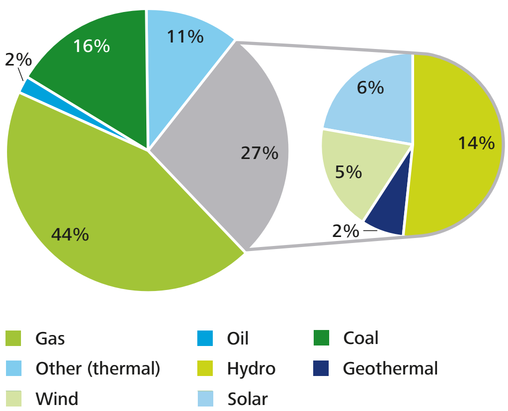


Figure 5. Gross electricity production – 299 GWh (2012)[6]

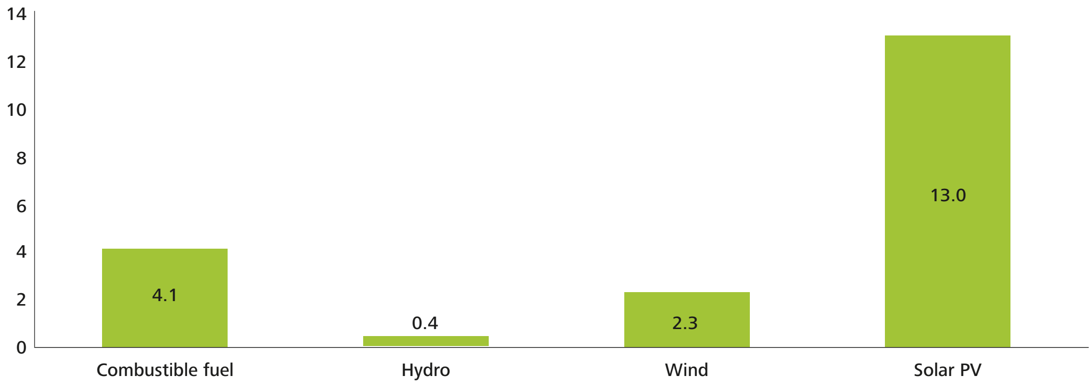


After gas, coal is the second most frequently-used fuel in the Italian electricity generation mix,[7] although reliance on coal has been diminishing in recent years. Italy still has 13 coal-fired power plants, which are increasingly the targets of environmental activism, public attention and media pressure.

5 Terna Group, Confronti Internazionali 2013 (2012 data), http://www.terna.it/LinkClick.aspx?fileticket=3UMfptQkg0k%3d&tabid=418&mid=2501, page 147

6 Terna Group, Direzione Dispacciamento Nazionale. Dati statistici sull'energia elettrica in Italia – 2013, Nota di sintesi ("produzione" pag 100, 112) http://www.terna.it/default/Home/SISTEMA_ELETTRICO/statistiche/dati_statistici.aspx

Figure 6. Electrical capacity change 2010-2012 (GW)[7]

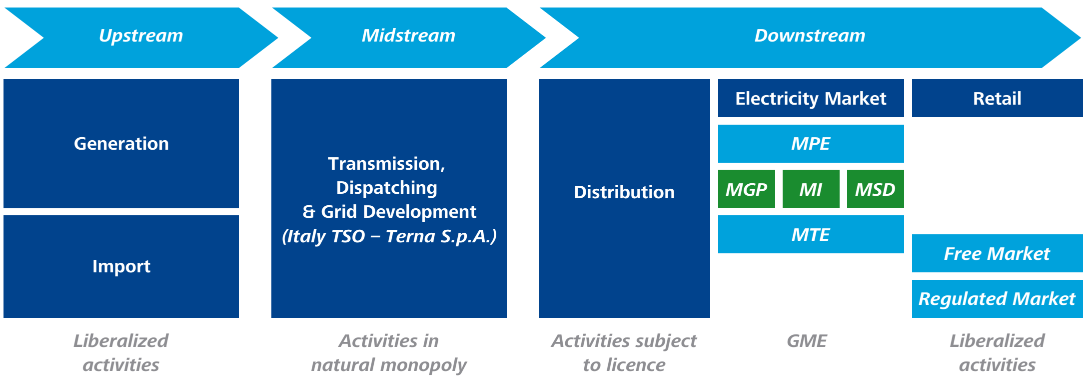


Non-hydropower renewable energy production capacity increased very sharply between 2008 and 2013. Wind and biomass power generation capacities multiplied by two during this period, with an accelerated growth in 2012 (+140% and +155%, respectively, versus 2011). The positive trend is expected to continue.

In 2011, photovoltaic (PV) installed capacity boomed as a result of the generous prices offered under the Conto Energia and Salva Alcoa law, although it slowed down in 2013 after certain incentives to solar farms on agricultural land were eliminated (this took place on July 6, 2013, 30 calendar days after reaching the indicative cumulative cost of incentives of € 6.7 billion per year). That said, PV growth is expected to continue unabated until 2020 (+50%). Geothermal power capacity growth has been weak (+9%) and will probably be slow until 2020 (+22%). Hydropower capacity has remained fairly stable (+4%) and should remain so until 2020 (+3%).[4]

Power market: main actors

Figure 7. Market mechanism/actors[8]



Since the 1990s, regulations have been based on two main pillars: limiting the power generation of former monopolist Enel, and unbundling generation, transmission and retail companies, which led to the introduction of a free market for the sale of electricity to customers. Retail market liberalization started in 1999 with the passing of the so-called "Bersani Decree".[9]

Today, the Italian power market is fairly dispersed. Electricity generation is still dominated by Enel (25.4% of 2012 Italian power production), followed by Eni (9.5%), Edison (7.2%), E.On (4.4%) and other producers to a lesser degree.[10]

The Italian electricity transmission network is almost entirely owned and operated by Terna, a state-owned company. The power distribution market is also very concentrated, with Enel operating 86% of the network despite the existence of more than 133 local operators,[11] mainly municipal.

7 Source: Eurostat. © European Union, 1995-2015 (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_113a&lang=en)

8 GME = Gestore dei Mercati Energetici S.p.A.; GSE = Gestore dei Services Energetici S.p.A.

9 Legislative Decree March 16, 1999, no. 79

10 AEEGSI Autorità per l'energia elettrica, il gas e il sistema idrico (August 2013). Contributo dei principali operatori alla produzione nazionale lorda, http://www.autorita.energia.it/it/dati/eem30.htm

11 AEEGSI Autorità per l'energia elettrica, il gas e il sistema idrico (2013). Relazione annuale sullo stato ei servizi e sull'attività svolta

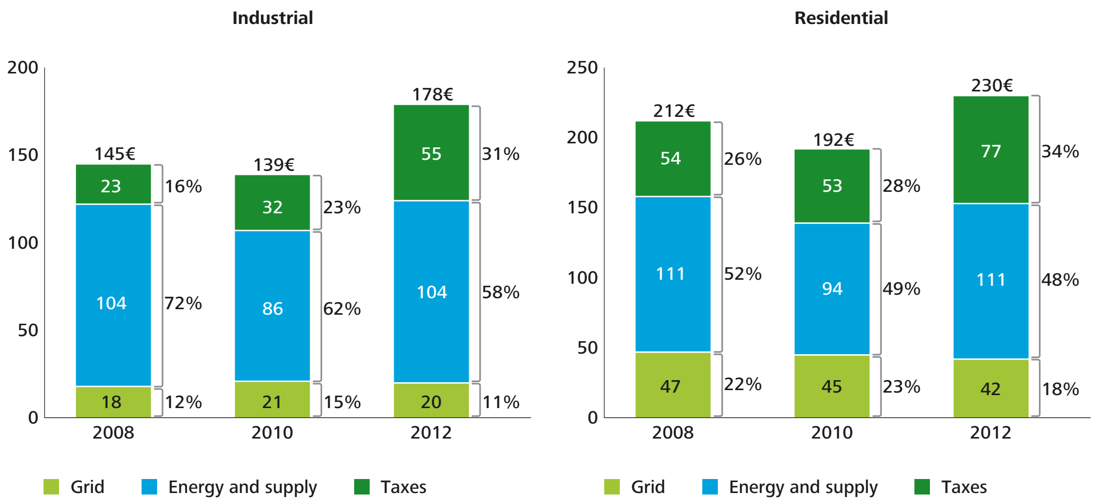
Power prices

On the spot power market, Italy is one of only two European countries (with the UK) where prices on the power exchange have not shown some higher degree of convergence over the 2011-2014 period. Electricity usually trades at a premium compared to most continental peers due to high dependence on natural gas.

High and rising power prices.

Already high, power prices have further increased for both residential and industrial users, primarily as a result of taxes to cover renewable and network charges. They are likely to increase further in the coming years due to the necessary evolution of the power production mix.

Figure 8. Retail prices for industrial[12] and residential[13] users (€/MWh)



The electricity bill rose sharply between 2010 and 2012, before leveling off in 2013.

In 2012, **retail prices for industrial users** (500 MWh–2,000 MWh band) reached 178 €/MWh and were 64% above the European average (109 €/MWh). For industrial users, the 23% price increase between 2008 and 2012 was driven by tax increases (+58%) and grid costs to a lesser extent (+8%).

In 2014, there still exists a regulated tariff for households and SMEs. In February 2015, the Italian government proposed to suppress this regulated tariff by 2018.[14] In 2012, **residential customer retail prices** reached 230 €/MWh for the 2.5 MWh–5 MWh consumption band, which is 34% higher than the European average (171 €/MWh in 2012). The 8% rise since 2008 is the result of an increase in taxes (+42%) and a decrease in grid costs (-10%). Electricity prices for domestic customers are progressive, i.e. increase with consumption.

The general tendency of electricity prices to rise for final consumers is mainly driven by grid costs and increasing taxes to support renewables development, as well as additional measures to promote energy efficiency. Furthermore, the energy component of consumer electricity bills is influenced by the peculiar Italian electricity mix, which is based mostly on gas. The electricity bill for all final consumers increased in the last few years, but not uniformly, with wide differences between consumers depending on the amount of their consumption. No provisions are in place to reduce charges to electricity-intensive consumers, unlike in most other countries. The price dynamic for industrial users also raises competitive issues for the economy: as an example, a mid-size industrial company with two similar producing facilities in Finland and in Italy will receive an electricity bill of 75 €/MWh from Finland and of more than 200 €/MWh from Italy.

12 Source: Eurostat. © European Union, 1995-2015 500–2,000 MWh band

13 Source: Eurostat. © European Union, 1995-2015 2.5–5.0 MWh band

14 Reuters, February 20, 2015

Targets for 2020

The **National Energy Strategy** (Strategia Energetica Nazionale – **SEN**), adopted in March 2013 (as approved by Ministerial Decree of MISE on March 8, 2013), defined four main objectives to improve the competitiveness and sustainability of the Italian energy sector by 2020:

- Reducing energy costs by aligning prices to European average prices.
- Meeting and going beyond European targets set out in the 2020 European Climate-energy package and Italy's National Action Plan of June 2010 (NAP).
- Improving supply security, with a reduction in foreign dependency from 84% to 67% of total energy needs.
- Boosting growth and employment by mobilizing investments of €170-180 billion by 2020, either in traditional sectors or in the 'green economy'.[15]

20-20-20 EU targets for Italy: what is Italy committed to?

- **Reducing GHG emissions by 18% compared with 2005.**
- **15.5 Mtoe of energy savings in annual final energy consumption between 2011 and 2020.**
- **Achieving a 17% share of renewable energy in final gross consumption.**

Energy efficiency targets

Energy efficiency is paramount to achieving all four SEN energy policy objectives.

Italy has several types of energy efficiency targets:[16]

- An indicative target expressed in absolute terms: final energy consumption of 126 Mtoe in 2020.
- A binding target expressed in relative terms: minimum energy savings of 15.5 Mtoe by 2020.

Figure 9. Final energy consumption (Mtoe)[2]

In the SEN 2020 scenario, **final energy consumption is expected to be 126 Mtoe.**[17]

Between 2005 and 2012, the year with the lowest consumption since 2000, Italy achieved 182% of its final energy consumption target – that is, the target has been exceeded.

In line with the targets defined by the SEN, the Legislative Decree no. 102/2014, implementing the Energy Efficiency Directive 2012/27/EU, established the national energy saving target in a reduction of primary energy consumption equal to 20 Mtoe by 2020.

However, if the expected economic recovery occurs, energy consumption could increase between now and 2020. Relative targets are therefore important to take into account as well, in order to offset this potential increase in final energy consumption due to economic recovery by 2020.

15 Ministry of Economic Development, Department of Energy (April 2013) – Annual Report on Energy Efficiency: Results achieved as of 2011 and targets for 2020

16 These targets are put forward in several official documents: the SEN (March 2013) sets global targets for 2011-2020; the Energy Efficiency National Action Plan (Piano d'Azione Italiano per l'Efficienza Energetica – PAEE) of July 2014 (PAEE 2014), updating that of July 2011 (PAEE 2011), clarifies the distribution by sector of global 2020 SEN targets and specifies the progress already made

17 REF-E (2013) – Energia: Rapporto sul mercato e la regolamentazione

In fact, while final energy consumption in 2012 was already below the 2020 target, Italy may have difficulty reaching its energy saving targets. **As far as energy saving targets are concerned, Italy is only at the beginning of its efforts**. The expected savings in 2020 and the savings already achieved in 2012 (vs. 2011) are shown in the table below:

Table 1. Expected savings for final energy consumption (FEC) for 2011-2020 by sector and by measure (in Mtoe/year)

Between 2011 and 2012, Italy realized 15% of its 2020 targeted final energy savings. If this trend can be sustained until 2020, the targets are likely to be reached.

Nevertheless, most of the targeted energy savings are still to be reached.

	2013 Annual Report					PAEE 2014		
	Expected FEC savings in 2020							
Sector	Regulatory standards	Thermal account	55% tax relief	White certificates	TOTAL	Expected FEC savings in 2020 (revised)	Achieved savings in 2012 (vs. 2011)	2020 objective met (%)
Residential	1.60	0.90	1.00	0.30	3.80	3.67	0.96	26%
Tertiary	0.20	1.60	–	0.20	2.00	1.23	0.05	4%
Industry	–	–	–	4.20	4.20	5.10	1.09	21%
Transport	5.40	–	–	0.10	5.50	5.50	0.22	4%
Total per measure (Mtoe/year)	**7.20**	**2.50**	**1.00**	**4.80**	**15.50**	**15.50**	**2.33**	**15.0%**

In 2012, savings were in line with the targets in both the industrial and residential sectors, while the tertiary and transport sectors were lagging. Nevertheless, **this trend could decline by 2020 if the country's economy recovers**.

The PAEE 2014 sets out rather concrete measures for action and hints at how savings were achieved in 2011-2012. The main measures include:

- **Strengthening the rules on minimum energy performance, especially for transport, construction and all products coming under the Ecodesign directive.**

  – The highest savings (5.5 Mtoe) are expected for **transport**, where a significant reduction in energy consumption is expected due to regulations[18] prescribing the sale of vehicles with reduced GHG emissions (95 gCO_2eq/km in 2020).[19] In 2012, only 0.2 Mtoe was achieved (vs. 2011).

  – In the **residential and tertiary** sectors, the Directive on the energy performance of buildings[20] helped save 2.3 Mtoe/y between 2005 and 2012 through replacement of thermal installations, particularly in residential buildings.[21] 1.8 Mtoe of energy savings are expected through the implementation of regulatory standards in these sectors.

- Developing a compulsory energy efficiency scheme based on "**white certificates**."[22] Between 2005 and 2012, 3.0 Mtoe were saved through this mechanism. 4.8 Mtoe of additional energy savings are expected between 2012 and 2020 in all sectors.

18 Regulation 443/2009/EC

19 Ministero dello Sviluppo Italiano – Strategia Energetica Nazionale: per un'energia più competitiva e sostenibile (March 2013)

20 Directive 2002/91/EC (EPBD), transcribed into the 192/05 decree

21 ENEA (Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile) (July 2014) – Piano d'Azione italiano per l'Efficienza Energetica 2014

22 White certificates ("Energy Efficiency Certificates") are tradable instruments giving proof of the achievement of end-use energy savings through energy efficiency improvement initiatives and projects for companies. The mechanism of white certificates was introduced in Italy by Ministerial Decree July 20, 2004. It was amended by Ministerial Decree December 28, 2012

• Stabilizing the instrument in operation since 2007 for a 55% **tax relief** on expenditures to upgrade the energy efficiency of buildings. Between 2005 and 2012, 0.77 Mtoe were saved through this mechanism. One million of tons of oil equivalent of additional energy savings are expected between 2012 and 2020.

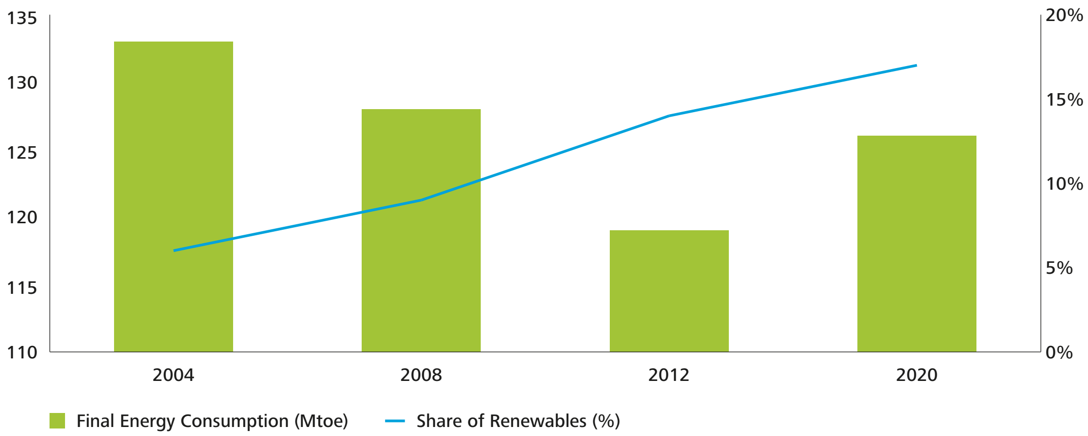
• Introducing support tools such as the **thermal energy account**,[23] and the Energy Performance Contract (EPC). The thermal energy account is an incentive for small projects designed to increase buildings' energy efficiency and generate thermal energy from renewable sources. The incentive is indexed to the project's expected capacity to produce thermal energy.[24] The Energy Performance Contract is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions.[25] 2.5 Mtoe of additional energy savings are expected by 2020.

Renewable energy targets

According to the 2009/28/EC Directive,[26] 17% of Italy's final energy consumption in 2020 should come from renewable sources, vs. 5.9% in 2005 and 13.5% in 2012. Between 2005 and 2012, Italy realized 68% of its renewable target (expressed in Mtoe).[27]

If the SEN energy efficiency target (126 Mtoe of final energy consumption in 2020) is reached, 21.4 Mtoe of final energy consumption should come from renewables in 2020, compared to 17 Mtoe in 2012, 11 Mtoe in 2008 and 8 Mtoe in 2004. This means an additional 5.3 Mtoe will still be needed by 2020.[2] Given current trends, this target seems reachable.

Figure 10. Renewable energy share of final energy use (2012)[28]



23 'Conto Termico', following the Ministerial Decree of December 28, 2012 as published on January 2, 2013. Recently, on last November 11, 2014, Law no. 164 has lastly regulated the incentives for "thermal energy account" (Heating and cooling)

24 GSE website http://www.gse.it/

25 http://ec.europa.eu. © European Union, 1995-2015 http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting

26 This Directive was implemented in Italy with the Legislative Decree March 3, 2011 no. 28, regarding the promotion of energy by renewable sources. Such Decree provides for the specific authorization procedure to realize renewable energy plants

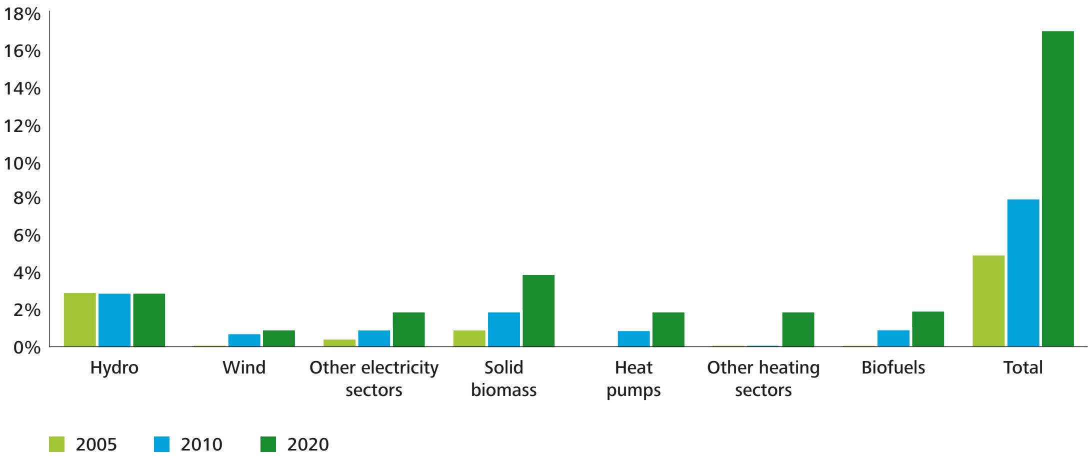
27 The initial gap between 2005 and 2020 was an increase by 13.4 Mtoe (from 8 to 21.4 Mtoe). And between 2005 and 2012, an increase by 9 Mtoe (from 8 to 17 Mtoe), has already been achieved, representing 68% of the target

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

Italy has already realized 68% of its 2020 renewable target, thanks mainly to a sharp increase in non-hydropower power production capacity between 2008 and 2012.

Italy is on the right path to reach the EU targets, and its latest energy projection for 2020 forecasts a share of renewable energy higher than the initial target.

Figure 11. Renewable energy share of final energy use by type and target for 2020, in %[29]



Italy's NAP estimates the contribution of each renewable energy technology to the trajectory for 2020 targets in the electricity, heating and cooling, and transport sectors, without necessarily establishing any binding technology target.

The SEN, published in 2013, included projections for the share of **renewable electricity** in final consumption (as foreseen by REF-E[30]) higher than the initial NAP target (2010). This is due to a higher volume of renewable energy in absolute terms and decreasing electricity consumption, mainly as a result of the economic crisis, affecting more fossil-based generation. In the SEN projection, renewable electricity production should reach 99 GWh,[31] close to gas-fired generation, the first component of Italy's electricity generation mix.

Other sectors should also contribute to the renewable energy target. In the **residential and tertiary sectors**, biomass use and other renewables are promoted for heating (thanks to the thermal energy account, mentioned above). The main national mechanisms to promote the use of renewable resources for **heating and cooling** are energy efficiency credits and tax deductions. The technologies that can benefit from these mechanisms include solar thermal installations, biomass boilers, heat pumps (aerothermal, hydrothermal, geothermal), low-temperature geothermal systems, geothermal cogeneration systems, and those fed by biomass and waste.

For **transport**, biofuel incorporation should also play a role in reaching this target. Actions will be taken mainly through obligatory minimum quotas, encouraging the use of biofuels obtained from waste and other raw materials of non-food origin. Measures will aim to support the use of a 25% biodiesel mix (for example, in public transport fleets) and new national regulations will encourage a gradual increase in its percentage of adoption. The obligation mechanism might be extended to biomethane, and greater weight might be given to the use of biogas for transportation. Finally, the energy efficiency credits scheme might be extended to include the growing use of electric vehicles.

29 EEA: Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States

30 REF-E (2013) – Energia: Rapporto sul mercato e la regolamentazione & Italian National Renewable Energy Action Plan (June 30th 2010) data

31 NREAP, Table 10ab on page 164

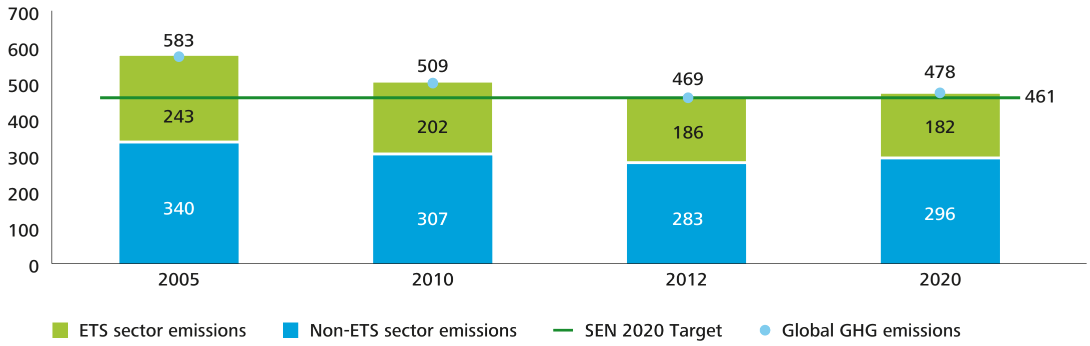
CO_2 emissions and targets

By 2020, Italy is committed to an 18% reduction in global GHG emissions, with a 21% reduction in Emissions Trading System (ETS) sectors and a 13% reduction in non-ETS sectors, compared to 2005.[19,32]

- In 2005, GHG emissions from the **non-ETS sector** amounted to 340 Mt CO_2eq. The target set by the European Commission is to reduce GHG emissions in this sector by 13% between 2005 and 2020 (i.e. by 44 Mt CO_2eq to reach 296 Mt CO_2eq).[2] **By 2012, Italy had achieved 130% of its target**.

- In 2005, **global GHG emissions** for Italy amounted to 583 Mt CO2$_2$eq.[33] Since the target to 2020 is an 18% reduction in GHG emissions, in 2012 **Italy achieved 109% of its target**.

Figure 12. ETS & non-ETS sector GHG emissions between 2005 and 2012 and targets for 2020 (2020 European target and SEN global target) (Mt CO_2)[2,33]



The achievement of 2020 European targets for Italy as of 2012 is both due to the effects of the economic crisis and to abatement measures (efforts towards energy efficiency and renewable energy) that have been put in place. However, the **National Energy Strategy** is more ambitious than European goals for Italy and targets a **21% decrease in global GHG emissions** (ETS and non-ETS) between 2005 and 2020.

The National Plan for the Reduction of Greenhouse Gases, updated with a 2013 decision of the CIPE (Interministerial Committee for Economic Planning), reinforced the country's commitment to emission reduction targets and energy saving measures. According to the SEN, energy efficiency measures should facilitate a reduction of 55 Mt CO_2eq/year, equal to 50% of the target set in the national CO_2 reduction plan.

Italy over-achieved its GHG emission target, partly because of the economic crisis.

But the country has committed to more ambitious emission reduction targets. And some additional reductions in GHG emissions are expected through energy efficiency and renewable energy measures.

Economic recovery might be an issue in terms of growing emissions, but measures for energy efficiency should support a reduction path.

32 Decision 406/2009/EC on the Effort of Member States to reduce their Greenhouse gas emissions to meet the Community's GHG emissions reduction commitments up to 2020, April 2009

33 Source: Eurostat. © European Union, 1995-2015, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=Greenhouse_gas_emission_statistics&oldid=189476#Database

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

Severely hit by the economic crisis, Italy has nonetheless set very ambitious targets until 2050.

But it remains vague on how 2030 and 2050 targets will be met.

European market reform: where Italy stands

To date, Italy has implemented several policy measures to reach its 2020 targets regarding energy efficiency, renewables and GHG emissions. **Many objectives have already been met due to the impact of the economic crisis on the country**. The main question that remains is to determine whether an economic turnaround will compromise Italy's ability to reach it efficiency objectives. After 2020, the National Energy Strategy becomes vague regarding how 2030 and 2050 targets will be met.

Despite the crisis, the National Energy Strategy contemplates Italy taking a leadership role in the adoption of the European 2050 Energy Roadmap. It has an ambitious plan aiming at **carbon reduction in the order of 80-95% relative to the 1990 level by 2050**. The goals are expected to be met through a reinforcement of the mechanisms put in place for the 20-20-20 energy package.

While the SEN does not detail how these targets may be achieved, it does indicate that the attainment of post-2020 targets is conditional on the capacity of the European Union to design a roadmap that is robust yet flexible.

Ensuring energy market competitiveness

The energy sector affects Italy's global competitiveness because of some **structural weaknesses**.

Energy (especially electricity) prices have been significantly higher than the European average for years. This may have helped Italy develop renewable energies and reduce its average energy intensity, but it may also hinder its competitiveness.

Energy prices are among the highest in Europe, and are particularly high relative to the US. That is because the energy mix, especially for electricity, is based on gas (with prices that are only recently aligning to European market ones), which differs from the average European mix influenced predominantly by nuclear and coal. Incentives for renewables also have a significant impact on electricity prices, as do a host of regulatory costs, including tariffs (to dismantle nuclear plants, conduct system research and support special regimes) and other subsidies.

Additionally, **Italy's security of supply and energy independence is at particular risk**. In 2012, 82% of national demand (163 Mtoe[2]) was met by net imports, with national production from renewables, gas and oil accounting for only 11.1%, 4.3% and 3.5%, respectively. This compares with an average import level of roughly 55% among the 28 countries of the EU.

The energy system, however, does have some **strong points**.

Italy is one of the countries with the lowest energy intensity levels (-19% of primary energy intensity vs. -14% in the Eurozone in 2011). Final energy use has been declining in recent years (equivalent to 119 Mtoe in 2012, 2% less than in 2011). This is largely due to the economic crisis, although a 5% decrease since 2005 can be attributed to improvements in electric generation performance, as well as the active adoption of numerous energy efficiency measures (i.e., fiscal, white certificates, etc.).The American Council for an Energy-Efficient Economy (ACEEE) placed Italy in third place in 2011, just behind England and Germany, in recognition of these efforts.

Italy also enjoys a good level of technological advancement, with leading programs such as smart metering – an essential element of demand side management, and the installation of one of the world's most efficient CCGTs (combined cycle gas turbines) parks.[21]

21 Source: REF-E

Italy's energy mix post-2020 and the role of renewables

Given the extent of change likely to occur in the coming years, the SEN did not set specific sectorial or technological objectives. It prefers to be **technology neutral** and flexible to changes in market **conditions as part of its long-term strategy**.

Italy plans to implement a capacity market in the power sector very shortly and is currently developing an auction model with reliability contracts. The first auction took place in 2014.

While Italy has not yet articulated a clear objective for its energy mix in 2030, the SEN anticipates that more than 29% of final energy produced will come from renewable sources by 2030. Italy has even developed a tentative scenario where 50% of final energy produced would come from renewable sources. Considering the generation potential of each energy source, **a significant solar capacity would need to be installed** to reach such a goal. According to ENEA, solar has the greatest development potential among renewables both in technological and economic terms, given that it has reached grid parity and has low installation costs.

In this context, coal is not in favor, both due to the need to reduce GHG emissions and to mounting public and local community opposition to coal (a situation amply highlighted by an Italian court's decision to shut down a coal-fired power plant for environmental health reasons in 2014). **A significant investment in coal-fired plants in Italy therefore seems unlikely, even if some plans exist to convert oil-fired to carbon-fired plants**. Some major electricity producers believe coal could still be viable, given both its falling prices and the emerging availability of improved carbon mitigation technologies, arguing that these investments would be less costly than (more efficient and environmental-friendly) gas technologies and could potentially reduce Italy's reliance on imports from largely-unstable countries.

With regard to **nuclear** power, a referendum in June 2011 repealed provisions relating to the so-called nuclear Omnibus Decree. Roughly 54% of the population turned out for the vote and more than 94% of those voters opposed the government's plan to resume nuclear power generation. **This put a definite halt to Italy's nuclear program**. Nevertheless, Italy imports electricity from countries such as France, Switzerland and Slovenia, whose energy mixes are nuclear rich. The country is also involved in international research and cooperation focused on improving nuclear safety and waste management. Should solutions be found, nuclear could arguably satisfy Italy's energy demand for a very long time.

In the short term, however, Italy will continue to rely on imports, and will need to adapt its distribution grid and expand its connections with renewable energy-exporting countries, probably in the Balkans and North Africa, to better diversify the sources of its electricity supply. **Projects to connect Italy's grid with neighboring countries are also in progress** (e.g. the ELMED project with Tunisia), and could potentially position Italy to act as an energy hub for the EU.[34]

Conclusion

Italy has already achieved most of its energy and GHG emission objectives for 2020, predominantly due to decreased energy consumption linked to the economic crisis. The challenge will be to keep meeting these targets as the economy recovers.

It is clear that the 2050 Energy Roadmap will drive structural changes in Italy's energy markets. From a competitive standpoint, and to support economic growth, it is important that the transition not penalize the Italian and European economies, particularly in those sectors exposed to international competition.

Public support in Italy may shift from a focus on renewables to one on energy efficiency. In fact, Italy's incentives system introduces distortions with respect to the cost of public resources allocated for each unit of CO_2 avoided. As part of the country's energy saving incentives, the public cost of energy per MWh is now 25 times lower than the public cost to support renewables. Although this has contributed to the adoption of not-yet-mature renewable technologies, in the long term it may not result in the system most capable of reducing emissions. As such, it is becoming more important for Italy to dedicate public resources to R&D that may result in future technological breakthroughs.

Beyond 2020, Italy has committed to an even greater market penetration for renewables and more stringent energy efficiency measures, although it is unclear on the technologies that should be implemented to support these goals.

The renewable technologies that will ultimately be favored will depend on market conditions and technological breakthroughs.

34 SEN provides that Italian Government shall identify, in compliance with EU Regulation 347/2013, Project of Common Interest (PIC) in gas and electricity sector that will benefit from procedural and financial advantages. Italy is waiting for the regulation that will provide the criteria and identification of the competent authority for PIC

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ENEA; July 2014, Piano d'Azione italiano per l'Efficienza Energetica 2014, http://www.efficienzaenergetica.enea.it/doc/paee/PAEE-2014-definitivo.pdf

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European energy market reform
Country profile: Netherlands

Contents

Current situation

Energy consumption and trade balance

In 2012, the Netherlands' energy consumption[1] totalled 82 Mtoe,marking a continuous increase since 1990. In fact, consumption rose 13% from 1990 to 2000, and almost 8% between 2000 and 2012. **More than 90% of this energy came from fossil fuels**, mainly petroleum products and gas.

Figure 1. Gross inland consumption in 2012 (82 Mtoe)[2]

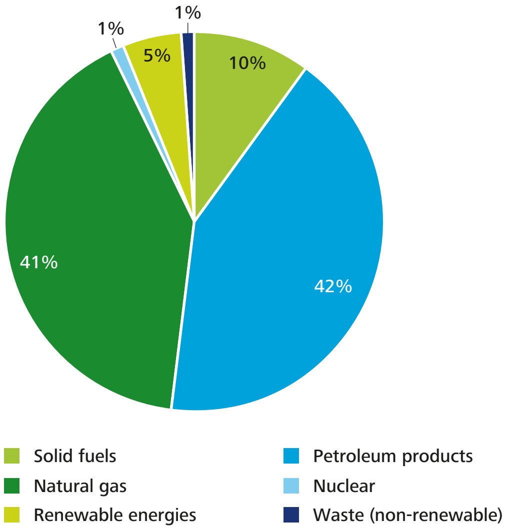
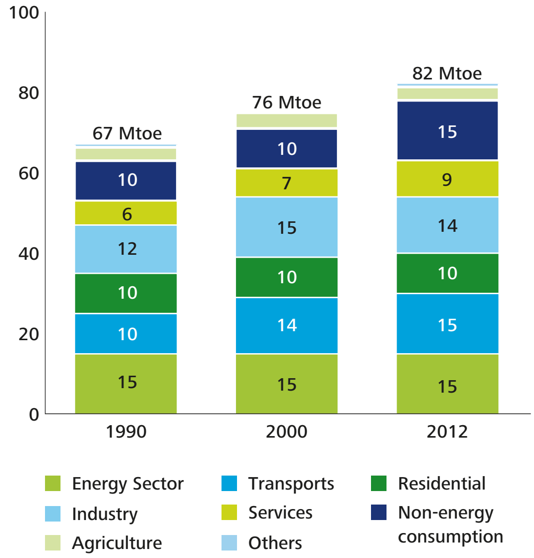


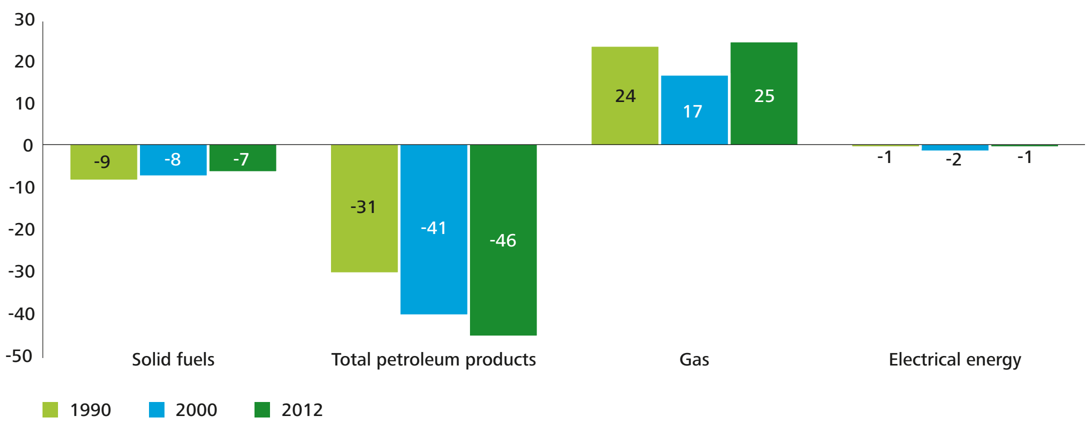
Figure 2. Gross inland consumption by sector (in Mtoe)[2]



The transportation, energy and industrial sectors each accounted for 18% of the country's gross inland consumption or 53% all together. While the energy sector's volume has remained stable since 1990, transportation sector consumption increased by 50% between 1990 and 2012, while the industrial sector has seen a 7% decrease since 2012. The additional growth of 6 Mtoe between 2000 and 2012 is attributable to non-energy consumption, which includes increasing use of natural gas as a raw material in the expanding petrochemical industry.

The country is historically an exporter of natural gas, but has a growing dependence on oil imports. Oil net imports (crude and refined) reached 46 Mtoe in 2012 and have been steadily increasing during the last 20 years, mainly driven by the petrochemical industry. Natural gas net exports amounted to 25 Mtoe in 2012, 76% of the Netherlands' gas production. As far as power is concerned, in 2013 the Netherlands exported 13 TWh globally and imported 33 TWh (almost exclusively from Germany).

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



Key figures:

Population (2013):
16.8 million

GDP (2013):
603 bn €

GDP/capita (2013):
35,900 €

GDP/PEC (2012):
8.8 €/kgoe

PEC/capita (2012):
4.03 toe/cap

Fossil fuels make up more than 90% of gross inland energy consumption.

The Netherlands is one of the most carbon-intensive countries in the EU. Petroleum products and natural gas accounted for more than 80% of the gross inland consumption in 2012.

The Netherlands is the fifth largest natural gas exporter in the world, but is a net importer of other fossil fuels.

The country depends on coal and oil imports, but is an historical exporter of natural gas. By 2025, the country is expected to shift from a net exporter of gas to a net importer.

1 For Eurostat, 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) (nrg_100a)

83% of electricity production comes from fossil fuels, 64% being delivered from natural gas.

The Netherlands relies on domestic gas resources for electricity generation. Renewable energies account-up for only 10% of electricity capacity, more than 80% coming from wind.

Power generation

The Netherlands has one of the most carbon-intensive electricity generation mixes in Europe, with more than 80% stemming from gas and coal.

Figure 4. Electricity capacity – 28 GW (2012)[3]

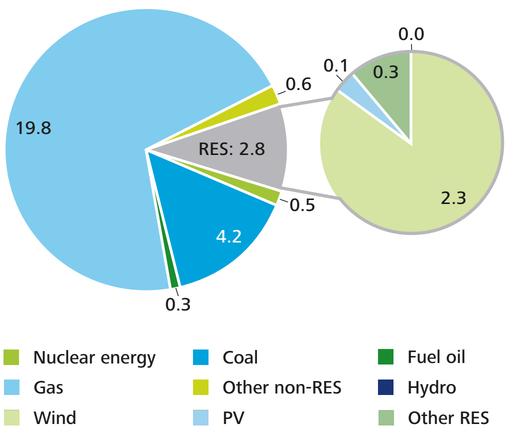
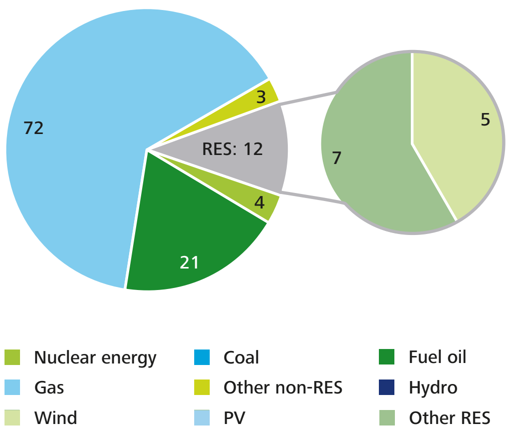


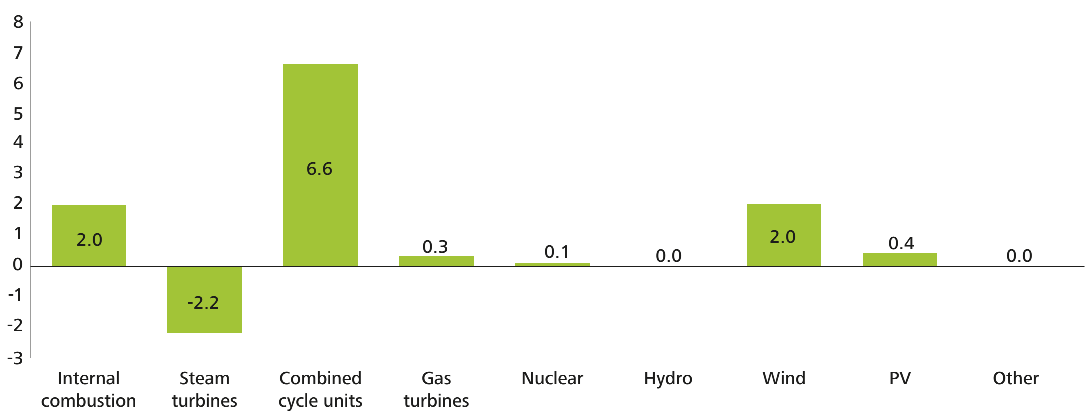
Figure 5. Electricity production – 112 TWh (2012)[3]



In 2012, gas accounted for 70% of the country's generation capacity mix (19.8 GW) and delivered 64% of its power (72 TWh). Coal was the second source of generation; it represented 15% of installed capacity and produced 21 TWh (19%) of electricity. Renewable energy sources made up only 10% of electricity generation, or 12 TWh, mainly derived from wind (82%).

Solar and other renewable energy sources represented a minor part of installed capacity, with 0.1 GW and 0.3 GW respectively.

Figure 6. Electricity capacity change from 2000 to 2012 (in GW)[4]



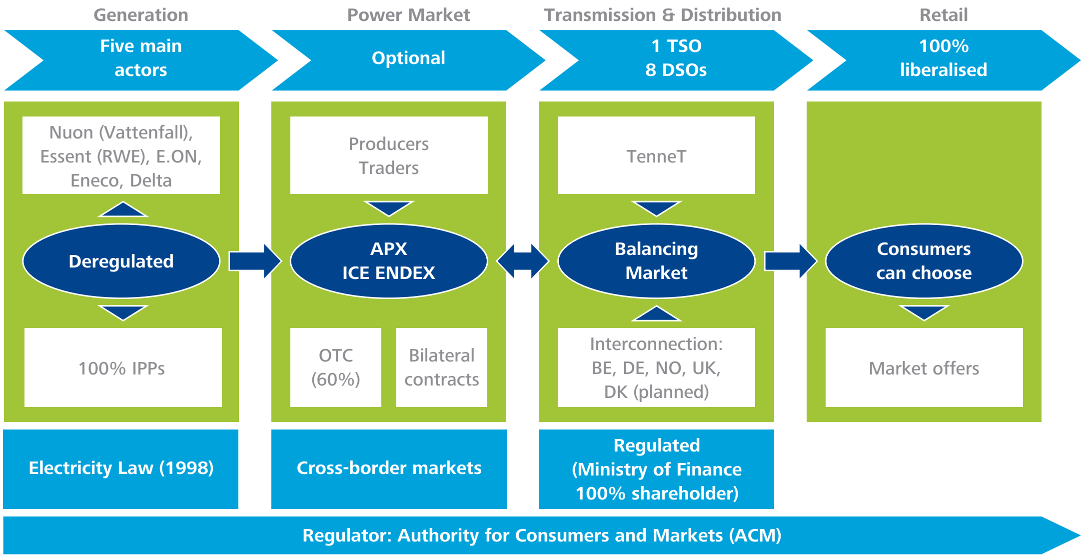
The Netherlands experienced strong growth in generation capacity during the last few years (44% since 2000 and 12% since 2010). The 9 GW of additional capacity realized since 2000 came mainly from gas combined cycle units. 2 GW of new wind capacity have been added since 2000, representing almost 85% of total added renewable energy source (RES) capacity.

3 Based on IEA data from Energy Policies of IEA Countries – Netherlands © OECD/IEA 2014, IEA Publishing; modified by Deloitte. Licence: http://www.iea.org/t&c/

4 CBS (Central Bureau voor de Statistik)

Power market: main actors

Figure 7. Market mechanism



A moderately concentrated power market at the generation level.

Dutch power generation is dominated by four players, which manage 55 % of the installed power capacity.

At the transmission and distribution level, TenneT is the only TSO and is regulated by the state, whereas retail is completely liberalized.

The Dutch power generation market is moderately concentrated, with four major players: Nuon/Vattenfall, Essent/RWE, E.ON and Electrabel/GDF SUEZ. Together, they managed 55% of installed power capacity in 2013.[5]

The Dutch electricity market has been fully open to competition since 2004 (2002 for industrial consumers).

The liberalization of the market led to the entry of large European vertically integrated companies (E.ON, Vattenfall, RWE, GDF SUEZ), which purchased assets from former national generation and distribution companies such as Nuon and Essent, now owned, respectively, by Vattenfall and RWE.

The Netherlands opted for a system of full ownership unbundling, which is designed to completely split power generators from network owners. TenneT is the single national electricity TSO.[6] It is controlled and owned by the Dutch state.

The electricity (low voltage electricity) distribution network is operated by eight distribution companies, through concession agreements. Enexis, Liander, Delta and Stedin manage more than 90% of the distribution network in terms of connections. Enexis and Liander are fully independent, directly owned by provincial and local governments. Delta and Stedin are independently governed and are parts of, respectively, Delta and Eneco. To date, these two companies have resisted full unbundling and legal procedures are currently underway regarding this issue.

5 Calculation based on company data publications

6 A similar company GTS/Gasunie exists for the high pressure gas grid

Power prices

While retail prices are not regulated in the Netherlands *per se*, suppliers are obligated to report all prices charged to the Authority for Consumers & Markets (ACM), which has the power to reduce prices in cases where suppliers cannot provide sufficient justification for the amounts charged.

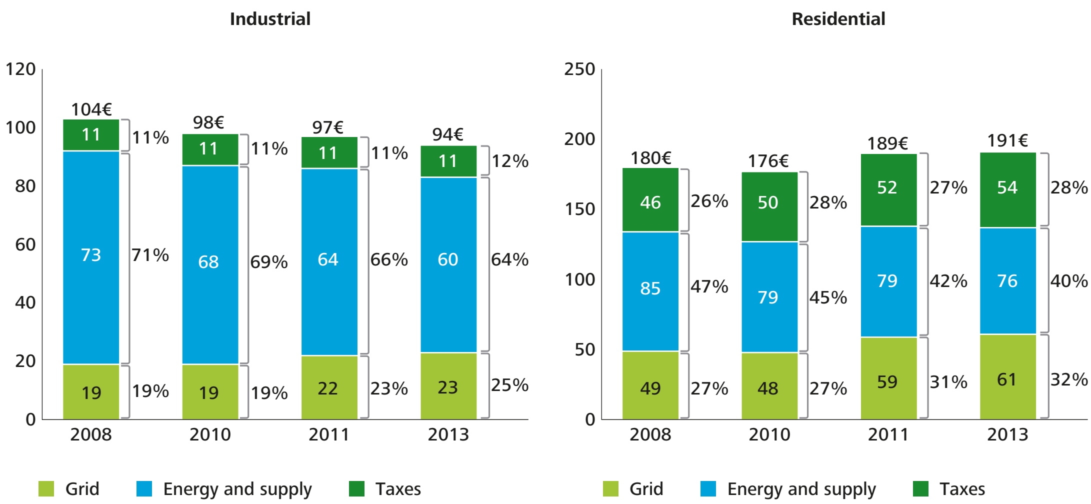
Decreasing industrial and stable residential retail prices.

Retail prices are not regulated in the Netherlands. While industrial users have experienced falling retail prices for the last five years, residential users have seen a small price increase of 6% since 2008.

In 2012, retail prices for industrial users were 97 €/MWh, below the European average (125 €/MWh). Electricity prices have decreased by almost 10% since 2008 (-10 €/MWh), whereas EU industrial electricity prices went up by about 3.5% per year on average during the same time period. This shift was mainly driven by declining energy and supply costs (-13 €/MWh), although it was partially offset by a 21% rise in grid costs. Taxes stayed constant between 2008 and 2013.

In 2012, residential customer retail prices reached 189 €/MWh, which is also lower than the European average (200 €/MWh), and rose to 191 €/MWh in 2013. The 6% rise between 2008 and 2013 was mainly driven by higher taxes (+17%) and grid costs (+25%). During the same period, energy and supply costs went down by 10%.

Figure 8. Retail prices for industrial and residential users (€/MWh)[7]



Contrary to many other European countries, in the Netherlands, policy support costs (PSC) are not levied on the electricity bill but are financed directly from the state budget. In 2013, the Netherlands introduced a sustainable energy levy, which is a part of the SDE+ mechanism[8] (for more detail, see 'Renewable energy targets' below).

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

8 Eurelectric (2014)

Targets for 2020

In 2013, the Dutch government passed the Energy Agreement for Sustainable Growth, setting key actions to reach its 2020 energy and climate targets. The Agreement aims to reduce final energy consumption by an average of 1.5% per year and sets a 14% renewable energy target by 2020 for final energy consumption. Furthermore, the Agreement calls for an improved and properly functioning EU ETS to reduce overall emissions.

Energy efficiency targets

The Netherlands has made energy efficiency one of its main priorities, as set out in several national plans, including the Energy Agreement for Sustainable Growth (September 2013), the Environmental Management Act (Wet milieubeheer) and the third Dutch National Energy Efficiency Action Plan (third NEEAP, 2014).

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

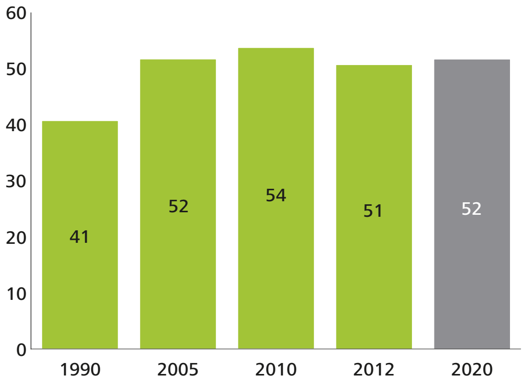
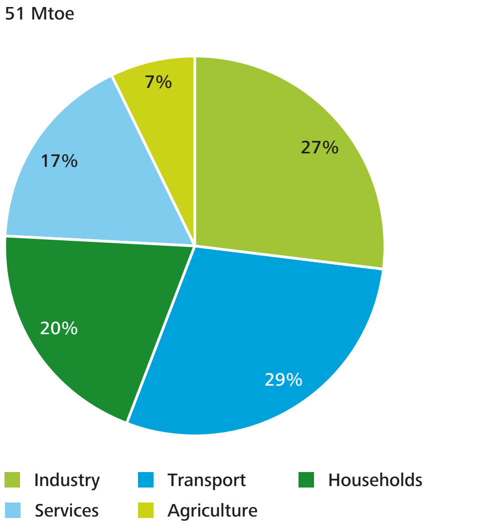


Figure 10. Final energy consumption in 2012, per sector[9]



The Netherlands' set targets are expressed both:

- in absolute terms (final energy consumption of 52 Mtoe in 2020); and
- in relative terms – energy savings of 482 PJ (11.5 Mtoe) by 2020 compared to 2007, introduced by the third NEEAP in 2014.

According to the Energy Agreement (2013), **the 2020 goal defines an indicative target for final energy consumption of 52 Mtoe, which is 2% higher than it was in 2012 and is equivalent to 2005 energy consumption**. Projections are based on national statistics and evaluation models, and any increase in energy consumption derived from GDP growth has to be compensated by equivalent savings across different sectors.

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

- Energy savings: average reduction in final energy consumption of 1.5% per year.
- 14% renewable energy in 2020 final energy consumption.
- 21% reduction in ETS emissions as compared to the 2005 level.
- 16% reduction in non-ETS emissions as compared to the 2005 level.

Energy efficiency: while an important share of energy savings remains to be realized, the indicative final energy target for 2020 was already attained in 2012.

The Netherlands chose to focus its national target on gross final energy consumption, for which the target in absolute terms was met in 2012.

However, the main goal is to reach 482 PJ (11.5 Mtoe) of cumulative final energy savings by 2020. In 2010, 85% of the target remained to be achieved. Nevertheless, the Netherlands is making good progress to reach the interim 2016 target of 4.9 Mtoe of cumulative energy savings.

9 Source: Eurostat. © European Union, 1995-2015 (nrg_ind_334a)

The third NEEAP (2014) was more ambitious than the EU target (average reduction of final energy consumption of 1.5% per year until 2020). The following table shows savings realized in 2010 compared to 2007, and savings expected in 2016 and 2020 as communicated in the 2014 NEEAP:

Table 1. Cumulative savings in final energy consumption 2010, 2016 and 2020, as compared to 2007

	Savings 2010		Expected savings 2016		Expected savings 2020
Sector	GWh	Mtoe	GWh	Mtoe	Mtoe
Built environment	9,912	0.85	31,317	2.69	NA
Industry and SMEs	1,548	0.13	5,576	0.48	NA
Transportation	2,172	0.19	10,639	0.91	NA
Agriculture and horticulture	5,706	0.49	9,750	0.84	NA
Total	**19,338**	**1.66**	**57,282**	**4.93**	**11.5**

More than 50% of the total savings are expected to come from buildings. The Environmental Management of Non-Residential Buildings Act requires the implementation of energy-saving measures with a payback period of five years or less. Further measures related to energy efficiency in buildings include:[10]

- Low interest loans for energy-saving measures.
- € 400 million for energy-saving measures in the subsidized rental sector.
- An energy saving fund for landlords.
- A guaranteed fund for energy-saving measures by homeowners' associations.
- Stricter energy efficiency requirements for new homes.
- An agreement to make rental homes more energy efficient.
- More energy-efficient heating and ventilation systems.
- A Dutch government plan to make new buildings energy-neutral by 2020.

Around 28% of the savings are expected to come from industry and SMEs. Industry has agreed to improve its energy efficiency by 2% per year. The Dutch government has put in place a so-called Green Deal program, which provides non-financial government support for environmentally-friendly measures and initiatives that will have positive effects on the Dutch economy but may encounter barriers threatening the initiatives' feasibility. Several tax incentive programs (MIA and VAMIL) also aim to encourage businesses to use environmentally-friendly equipment.

The Netherlands set several targets regarding energy efficiency, some of which are more ambitious than the initial European-level targets. The Netherlands is partly on track to meet its 2020 energy efficiency targets: while it already reached its absolute final energy consumption target for 2020, important energy savings have yet to be realized.

10 http://www.government.nl/issues/energy-policy/saving-energy

Renewable energy targets

The Energy Agreement for Sustainable Growth set a target of 14% of final energy consumption to come from renewable energies by 2020, going up to 16% by 2023, compared to 4.4% in 2012. These targets seem ambitious, since the Netherlands already missed the 5.1% expected trajectory for 2011– 2012, set up in its National Renewable Energy Action Plan (NREAP).[11]

However, if these energy efficiency targets (52 Mtoe of final energy consumption in 2020) are reached, 7.3 Mtoe of final energy consumption should come from renewables by 2020, compared to 2.3 Mtoe in 2012. This means an additional 5 Mtoe will still be required by 2020.

The major policy measure incentivizing the development of renewable energy is the SDE+ scheme (Sustainable Energy Incentive[12]), which is funded by the state budget. This market-based scheme covers the price difference between fossil energy and sustainable energy for different periods (five, 12 or 15 years), depending on the technology. The SDE+ fixes one yearly budget for all renewables categories (€ 3.5 billion in 2014) and is opened sequentially in six phases during the year.

Additionally, the Netherlands has support schemes (tax deductions) to further incentivize renewable development. For example, companies can use Energy Investment Allowances (EIA) to invest in energy-efficient technologies (including renewables) and deduct 41.5% of investment costs from the taxable profits.

Figure 11. Renewable energy share of final energy use (2012)[13]

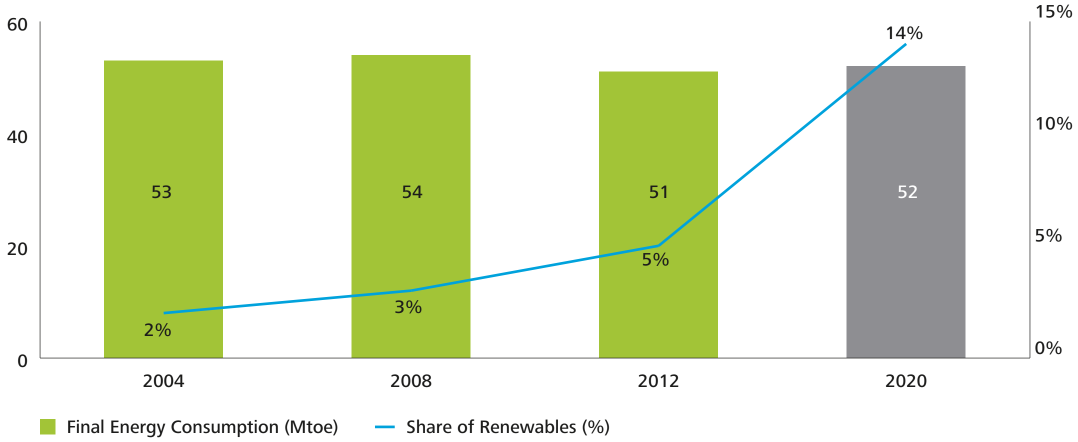
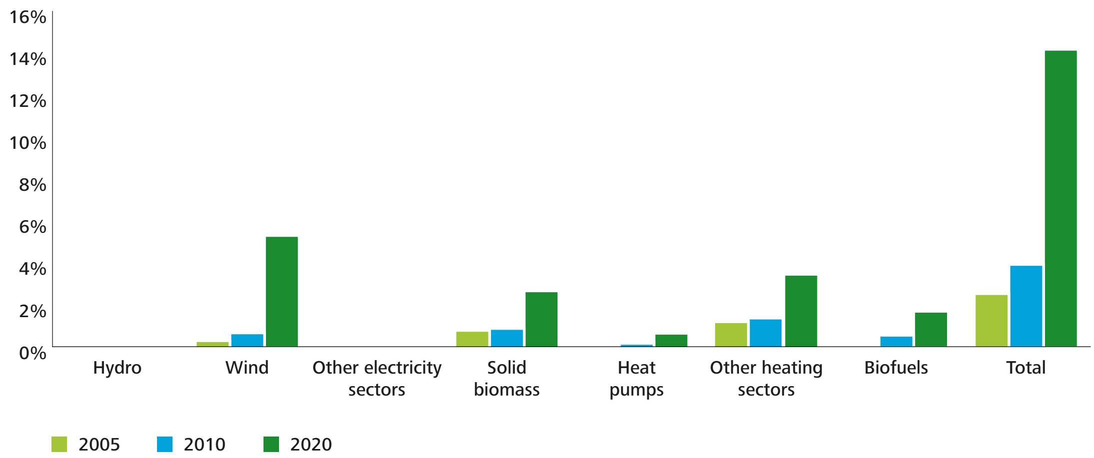


Figure 12. Renewable energy share of final energy use by type, in 2005 and 2010, and target for 2020, in %[14]



11 EEA Report No 10/2013 – Trends and projections in Europe 2013

12 http://english.rvo.nl/sites/default/files/2014/04/Brochure%20SDE%2B%202014.pdf

13 Source: Eurostat. © European Union, 1995-2015 (t2020_31)

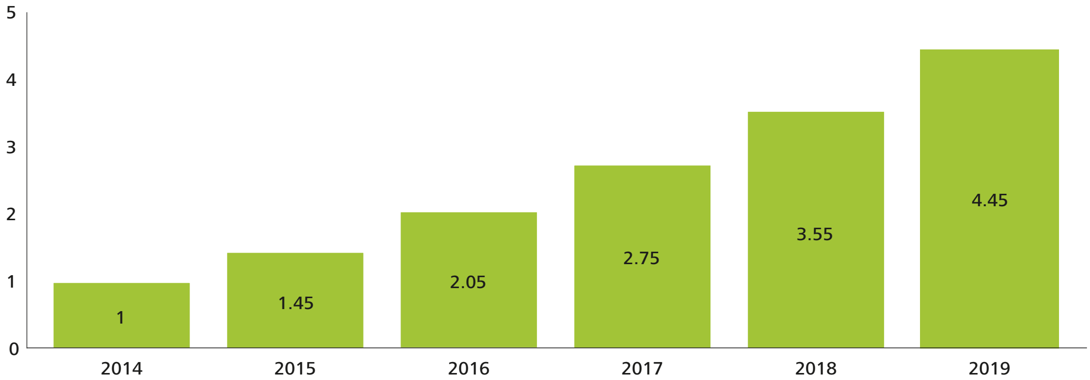
14 EEA – Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States, 2011

Renewable target: in 2012, 69% of the country's target will remain to be achieved. Wind is expected, but unlikely, to close the gap.

With 4.4% renewables in the mix, the Netherlands is still far from its 2020 target (14%). The government has set up ambitious plans to close the gap (especially for onshore and offshore wind), but the effectiveness and timeliness of these policies remain to be proven.

In 2013, biomass accounted for the largest share of all renewable energy production, followed by wind power. In the same year, the Netherlands had 2.7 GW of installed wind power capacity,[15] 0.3 MW of which were installed in 2013. The Energy Agreement aims at scaling up offshore wind power to 4.45 GW in 2020, operational in 2023. In the case of onshore wind power, targeted new capacities are 6 GW by 2020 and 7 GW by 2023.

Figure 13. Planned offshore wind capacities (in GW)



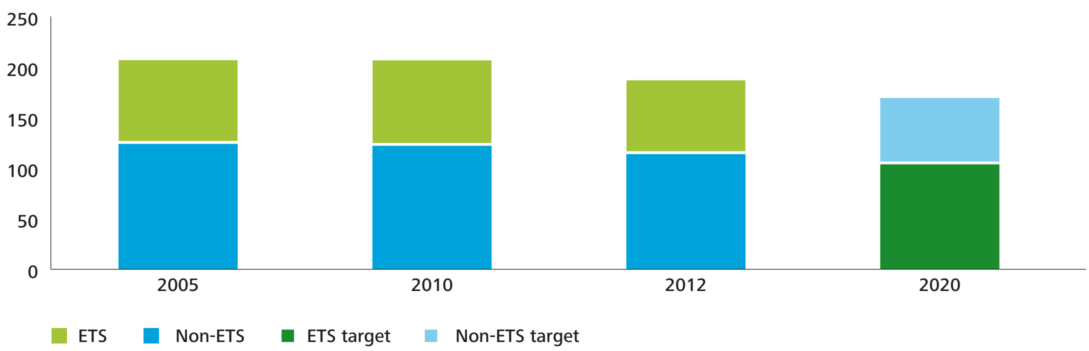
According to the Energy Agreement, the annual budget to promote renewable energy will increase progressively to € 3.8 billion in 2020.

Reaching the target of 14% renewables in 2020 depends heavily on the development of onshore and offshore wind power over the next six years. Since the planned capacities will require substantial investment, it is questionable if the Netherlands will be able to ramp up its capacities in the remaining time.

CO_2 emissions and targets

Greenhouse gas emissions (GHG) have been decreasing since 2010, but the Netherlands remains one of the most fossil fuel- and CO_2-intensive economies among EU Member States. In 2013, the energy sector was responsible for the largest share of CO_2 emissions (35%), followed by transportation (20%) and the non-energy industry (19%).[16]

Figure 14. GHG emissions and target for 2020 (Mt CO_2eq)[17]



The ETS sector is making good progress toward its target (66 Mt CO_2eq in 2020, -17 Mt CO_2eq compared to 2005 or -21%). **In 2012, its GHG emissions already declined by 8 Mt CO_2eq (75 Mt CO_2eq vs. 83 Mt CO_2eq in 2005) or half of its objectives**.

For non-ETS sectors, the Netherlands has committed to reduce its emissions by 16% between 2005 and 2020 (i.e. -21 Mt CO_2eq), which means that 11 Mt CO_2eq remain to be reduced from 2012 to 2020 (52%). It should be noted that emissions dropped from 117 to 108 Mt CO_2eq between 2012 and 2013.[18]

15 EWEA Wind in power – 2013 European statistics

16 CBS – Statistics Netherlands

17 EEA 2014a

18 EEA 2014b

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

Long-term priorities are set until 2050, but concrete targets and pathways are missing after 2020.

Long-term energy priorities but few tangible targets

Every four years, the Dutch Ministry of Economic Affairs, Agriculture and Innovation publishes an Energy Report that sets out the core energy policies for the country. The 2011 Energy Report focuses on three core long-term priorities:

1. Transition to a cleaner supply of energy, achieving a low carbon-emission economy by 2050;

2. Support the economic goals of the energy sector through green growth; and

3. Ensure a reliable supply of energy through a balanced mix of grey and green energies coming from national and international sources.

The Dutch government approaches these policies through five key objectives:

1. Pursuing a modern industrial policy focused on grey and green energy, which consists of a mix of fossil fuels and renewables;

2. Expanding the share of renewable energies in the short (2020) and long terms (2050);

3. Providing scope for all energy options towards 2050;

4. Supporting Green Deals as a way to encourage private-public partnerships and remove non-economic barriers in the energy sector; and

5. Investing in a sound European energy market with a good infrastructure.

While these objectives provide a framework for energy policies, concrete pathways and targets have not been well articulated. In 2013, the Energy Agreement provided greater detail for a pathway to 2020, but did not set out similar details past that date.

Changing from a gas net exporter to a net importer may raise several issues, due to an increasing dependency on fossil fuel imports and declining state revenues.

Gas production under pressure

The Netherlands, with its vast Groningen gas fields, is the second largest gas producer in Europe, after Norway. Gas production from the large Groningen field is declining and the outlook for domestic unconventional gas remains uncertain. **Currently a gas exporter, the Netherlands is likely to become a gas importer by around 2025**. The government emphasizes that gas will keep playing a key role in the Dutch energy mix, but this will mark a significant transition as, in 2012, 64% of final energy consumption relied on natural gas.

The Netherlands faces several challenges when it comes to the future role of gas. Due to multiple earthquakes in the Netherlands' most northern province of Groningen, the Dutch Minister of Economic Affairs decided in early 2014 to cut the annual output to 40 bcm by 2016 (the previous outlook was around 49 bcm per year until 2020) and reserves are declining. The expected reduction in government revenue will be € 600 million in 2014, € 700 million in 2015 and € 1 billion in 2016.[23]

As far as shale gas is concerned, the government is examining if and where it could be extracted in the Netherlands. A decision is expected in 2015.

Other current market developments that might influence the long-term vision of natural gas in the Netherlands are cheap coal imports (mainly from the US) and German wind electricity that may force gas-fired power plants to close down. **The shift from being a gas net exporter to a net importer will likely have significant implications on the whole energy system, requiring investments and long-term decisions**.

With the GATE[24] Liquefied Natural Gas (LNG) terminal, which came online in 2011, the government wants to counterbalance this trend. In 2014, the terminal only operated at around 10% of its capacity, due to high LNG prices.[25] However, depending on future geopolitical developments – particularly with regard to the relationship between Europe and Russia – LNG may assume a more important role. To secure revenues in the future, the government is currently promoting the establishment of a 'gas roundabout' for north-western Europe, encompassing[26] gas pipelines, with Gasunie Transport Services (GTS), gas trading through the virtual marketplace's Title Transfer Facility (TTF), ICE Endex and others, and gas storage (e.g. in the Bergermeer gas field).

23 http://www.government.nl/news/2014/01/17/natural-gas-production-reduced-and-funds-earmarked-for-groningen.html

24 GATE is a joint venture between Vopak (a tank terminal operator) and Gasunie

25 The Economist, The Netherlands' LNG terminal, Bring on the sanctions, Apr 16th 2014, http://www.economist.com/blogs/charlemagne/2014/04/netherlands-lng-terminal.

26 http://www.government.nl/issues/energy-policy/natural-gas

Renewables and nuclear power

According to the Energy Agreement for Sustainable Growth, renewable energies will play an important role in the future energy mix of the Netherlands, driven mainly by onshore and offshore wind power. The high-scale development of offshore wind farms is still rather recent and there are still uncertainties around the real costs (maintenance and depreciation) and benefits (power generation) of these farms. Precise post-evaluation of these costs and benefits in the next few years will enable a more effective assessment on the share of the energy mix that can be covered by this technology.

However, the long-term outlook is unclear, since no concrete targets have been set for after 2023. Given that it will already be challenging to reach the 2020 target of a 14% share of renewables in the energy mix, the 16% target for 2023 remains questionable.

For the time being, the Netherlands has only one commercial nuclear reactor (Borssele) in operation, producing 4% of total electricity. **However, the Dutch government is in favor of constructing new power plants in the future**, subject to strict safety and environmental conditions that are being verified and reinforced in the aftermath of the Fukushima Daiichi accident in March 2011. In 2012, Delta announced that it would postpone any decision to start building a second nuclear power plant by two or three years. The reason behind the decision was "a combination of the financial crisis, the high investment required for a nuclear power plant, the current investment climate and overcapacity in the electricity market combined with low energy prices."[27] So far, no concrete plans have been presented and the Energy Agreement of 2013 was silent on the future of nuclear.

Ambitious on wind and a blank page for the future of nuclear.

The two main types of energy the Netherlands has decided to develop are wind and nuclear. While the target and trajectory are rather clear for wind, nuclear development still remains in limbo.

Climate change

The Dutch government supports an EU-wide reduction in GHG emissions of at least 40% by 2030. It considers this 40% goal as a minimum and generally asks for tighter European agreements to reduce GHG emissions through an improved ETS. However, here again, no concrete targets have yet been announced by the government and decisions will be needed to define the pathway to decarbonize the energy mix beyond 2020.

High ambition regarding climate change, but a lack of specific targets.

As far as transport is concerned, the Dutch government wants to cap the transportation sector's GHG emissions at 25 Mt CO_2eq by 2030, 17% lower than it was in 1990; and from 2035, all new passenger cars will have to run CO_2 free.

Conclusion

The Netherlands finds itself on an historical transition path to a new energy mix. After having relied heavily on its natural gas production for many years, it has to significantly evolve its energy mix to adapt to declining gas outputs and the need to become a gas importer in the next decade. Its path forward may be twofold: a shift back to its centuries-old traditional energy – wind, combined with a move forward to more nuclear power. As of today, key challenges remain to be addressed by 2020, if the Dutch government wants this transition to succeed. Developing wind may be costly and time consuming, while the development of nuclear remains in limbo. The ability to make this transition in an energy-efficient manner while hitting GHG emission targets may require more significant policy adjustments.

The Energy Agreement of 2013 gives the direction, but will ultimately need enforcement. The energy mix will certainly remain dominated by fossil fuels in the coming decades. However, the Dutch government has also set ambitious targets to increase the share of renewables to 16% by 2023 and to fully support the European climate policy. It will be the success or failure of the implementations of the 2020 policies that will determine the longer-term policies that remain to be defined.

27 http://www.world-nuclear-news.org/NN-Mixed_news_on_Netherlands_new_build-2301124.html

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European energy market reform
Country profile: Spain

Contents

Current situation

Energy consumption and trade balance

In 2012, Spain's primary energy consumption (PEC) amounted to 127 Mtoe.[1] More than 75% came from fossil fuels. Petroleum products (54 Mtoe in 2012) represent the main source of energy consumption, followed by natural gas (28 Mtoe in 2012).

Figure 1. Primary energy consumption in 2012 (127 Mtoe)[2]

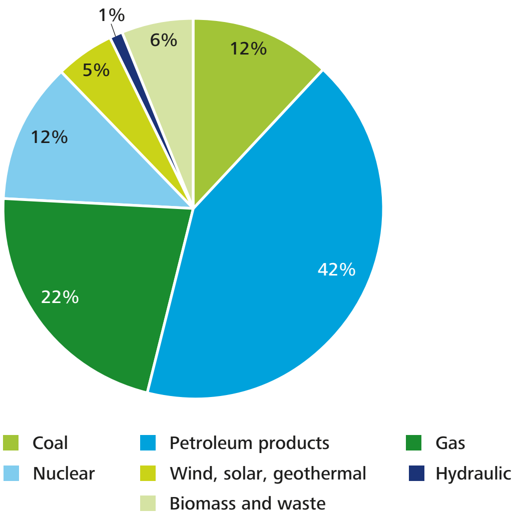
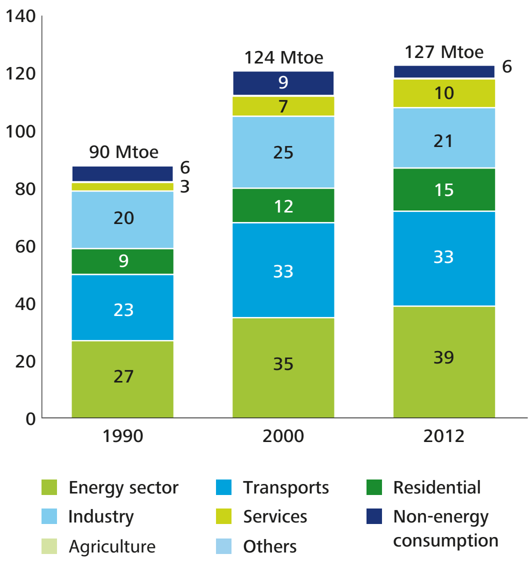


Figure 2. Primary energy consumption by sector (in Mtoe)[2]



Primary energy consumption sharply increased between 1990 and 2000 (+37%), although it grew by only 3% between 2000 and 2012. This slowing trend is mainly due to an 18% decrease of primary energy consumption in the industrial sector, which has been more than offset by a growth in the energy sector (+11%), in services (+50%) and in the residential sector (+29%). As a result, Spain's energy intensity (primary energy consumption/GDP) dropped by 15% between 2000 and 2012 (with a peak in 2004).

The energy sector represented 31% of primary energy consumption in 2012 and has grown by 11% since 2000, mainly as a result of a rapid increase in power generation. Transport is the second largest consumer, contributing 26% of primary energy consumption in 2012, although remaining stable in volume between 2000 and 2012.

Key figures:

Population (2013):
46.5 m cap.

GDP (2013):
€ 1,049 bn €

GDP/capita (2013):
€ 22,559

GDP/PEC (2012):
8.1 €/kgoe

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

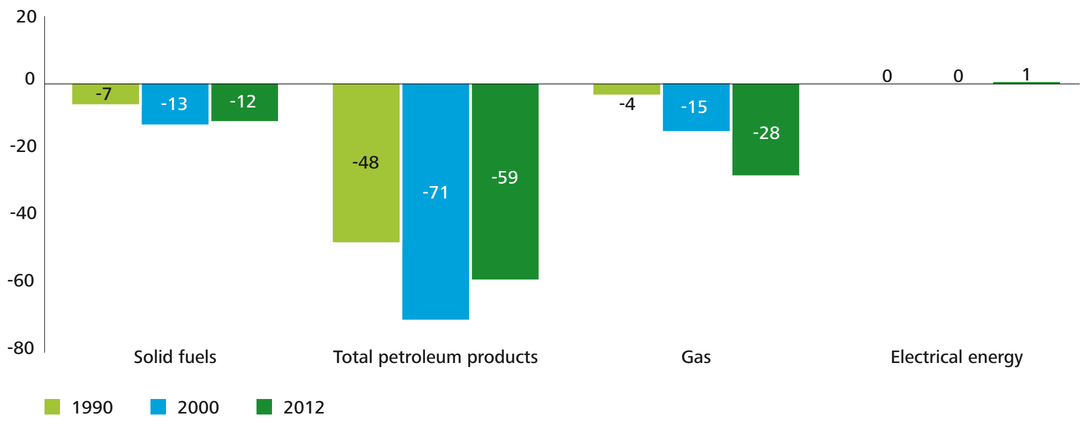
Spain's energy dependence was estimated at 73% in 2012, which is higher than the EU's energy dependence (around 50%).

The energy and transportation sectors are the largest primary energy consumers, and are highly dependent on fossil fuels.

1 The primary energy consumption value presented refer to 'Gross inland energy consumption by fuel type' in Eurostat (Data Table: tsdcc320) Source: Eurostat. © European Union, 1995-2015

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

Figure 3. Energy trade balance (Mtoe)[2]



Spain depends heavily on fossil fuel imports (petroleum products, coal and natural gas). In total, the volume of imported energy remained steady between 2000 and 2012 (99 Mtoe in 2000 and in 2012).

Between 2000 and 2012, petroleum product imports decreased from 71 Mtoe to 59 Mtoe, while natural gas imports rose from 15 Mtoe to 28 Mtoe. Coal (solid fuel) imports were relatively stable in euros over the same period: 13 Mtoe in 2000 and 12 Mtoe in 2012. However, the development of shale gas in the US has resulted in cheap coal entering the market, which seems to have impacted European coal imports. A 28% increase in Spain's coal imports was observed in 2012 compared to 2011,[3] although imports dropped again in 2013.

Spain has 51 GW of renewable power generation capacity (47% of total installed capacity), accounting for 41% of electricity production. There is significant excess capacity in power production.

Spain, continental system, currently uses only half of its installed capacity during peak demand (101,828 MW vs. 43,010 MW).

Power generation

Renewable energies grew rapidly over the last 10 years. Spain has 51 GW of renewable power generation capacity (47% of total installed capacity), accounting for 41% of electricity production. Wind and solar PV installed capacity were respectively 23.0 and 4.7 GW (26% of electricity capacity in 2013), generating 20% and 3% of overall electricity. Hydropower (19% of installed power capacity and 15% of production) and other renewables (3% of installed power capacity and 3% of production) – mostly solar thermal power – complete the renewable electricity generation mix.

Fossil fuels still represent 40% of electricity production. Nuclear power plants generate 21% of electricity output with 7% of the capacity mix. Currently, there are six nuclear power plants in operation in Spain, and a total of eight reactors. They were built in the 1970s and '80s and their licenses expire between 2021 and 2034. Furthermore, one reactor (Zorita) has been deactivated due to its age and another (Vandellos) is in its final phase of being dismantled after an accident occurred in 1989.[4]

Figure 4. Electricity capacity – 108 MW (2013)[3]

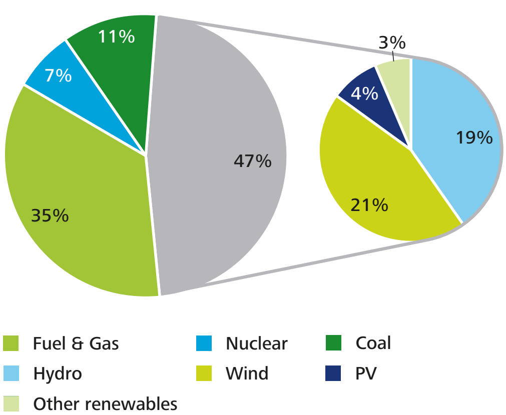
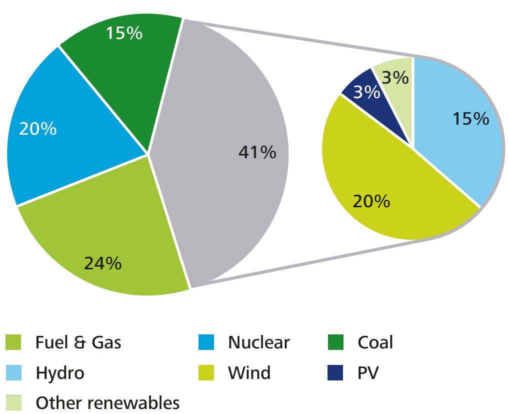


Figure 5. Net generation – 274 GWh (2013)[3]

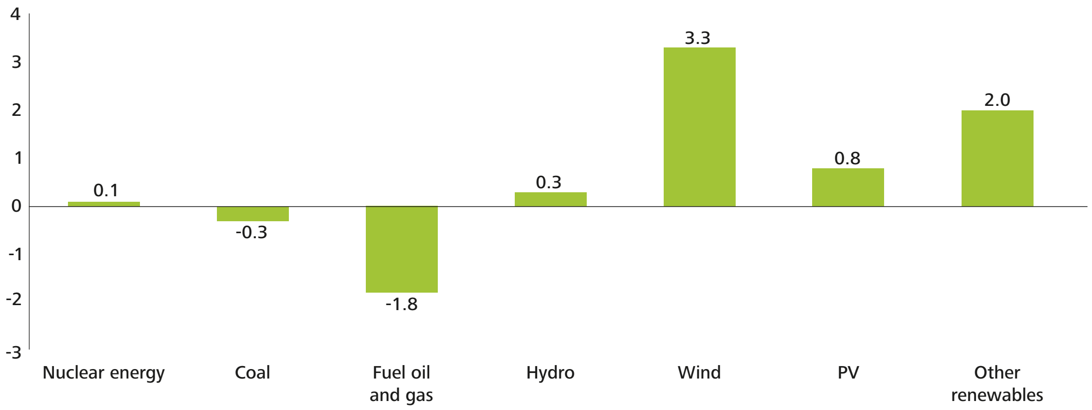


3 El Sistema Electrico Espanol 2013, Red Electrica de Espana

4 Ministerio de Industria, Energia y Turismo (2014): http://www.minetur.gob.es/energia/nuclear/Centrales/Paginas/ListadoCentrales.aspx

Wind power development began in 1997 when the Spanish government introduced incentives.

Figure 6. Electricity capacity change from 2010 to 2013 (in GW)[3]



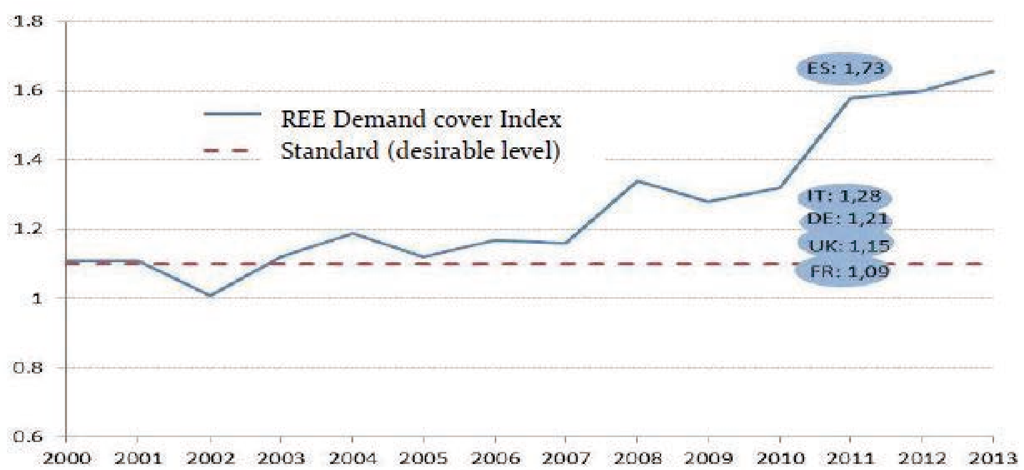
The objective in 1999 was to have 9 GW of wind power installed by 2011. This target was met in 2005 and the government set a new target of 20 GW of installed wind power capacity by 2011, which was also met on time.

20% of renewable capacity (6.1 GW), excluding hydropower, was installed over the last three years, while 1.8 GW of power stations using fuel oil and natural gas were deactivated.

Spain has significant excess power capacity: even during peak demand, roughly only 42% of Spain's power capacity is used.[4] The following figure shows the evolution towards excess capacity.

The forecasts from the mid-2000s led to large investments in renewable energies, combined heat and power (CHP) generators, and combined cycle gas turbines (CCGT).[5]

Figure 7. Evolution of the ratio between installed electricity production capacity and peak used capacity. Comparison with other member states



These investments and the associated excess capacity are one of the reasons for higher power prices.[6]

5 Ministerio de Industria, Energia y Turismo (2013) The reform of the Spanish power system: towards financial stability and regulatory uncertainty

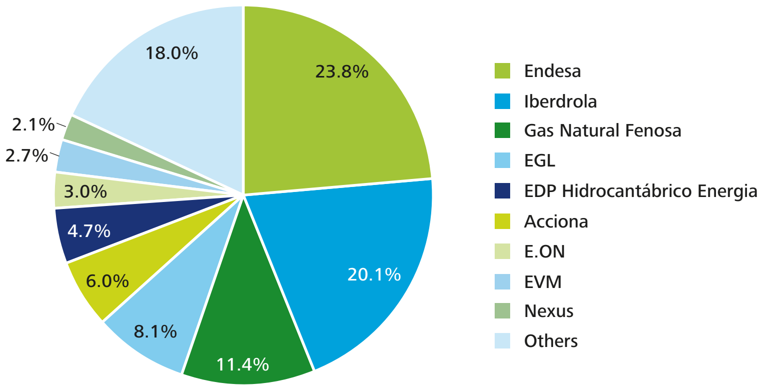
6 See "Power prices" section below

There are numerous players in Spain's power generation market, but the three largest companies have more than 55% of the market share.

Power market: main actors

Spain's electricity market was deregulated in 1998 and integrated with the Portuguese electricity market in 2007. There is a relatively high degree of concentration in the Spanish electricity market, as a few players have dominant roles.

Figure 8. Market share of electricity generation (2012)[7]



The main companies and their respective market share of electricity generation are: Endesa (23.8%), Iberdrola (20.1%), Gas Natural Fenosa (11.4%), EGL (8.1%), EDP Hidrocantábrico Energía (6.0%), Acciona (4.7%), E.ON (3.0%), EVM (2.7%) and Nexus (2.2%).[7] Smaller players, however, sell around 18% of electricity. Electricity is traded in the Mercado Ibérico de la Electricidad (MIBEL), which also includes Portuguese players.

Red Eléctrica de España (REE) is the single transmission system operator for Spain, owned by REE Group, and is neither involved in power generation nor supply.

There are more than 50 DSOs, the main ones being owned and operated by Endesa, Iberdrola, Unión Fenosa, Hidrocantábrico and E.ON.

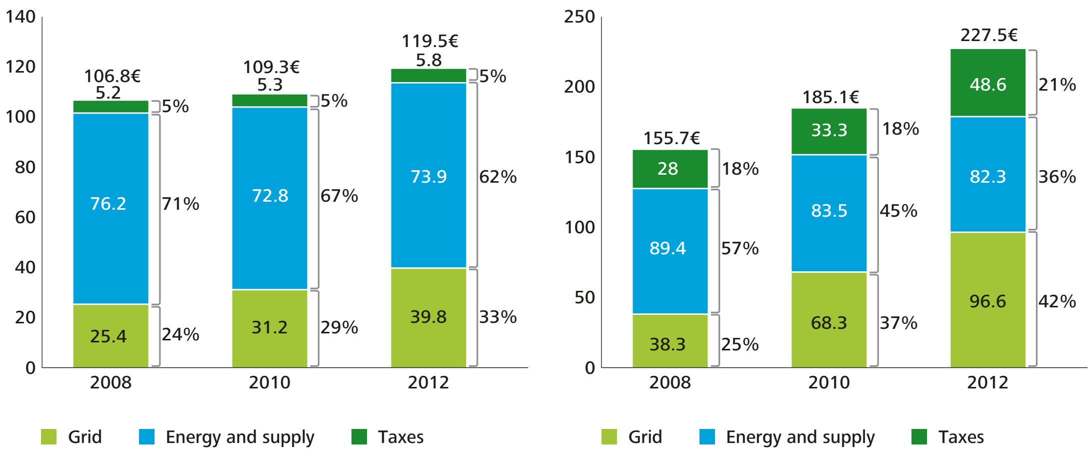
7 Comisión Nacional de Energía (CNE)

Power prices

In 2012, retail prices for industrial users were around 120 €/MWh, slightly below the European average (125 €/MWh). Prices increased by 12% between 2008 and 2012 (+13.3 €/MWh), mostly due to rising grid costs (+14.4 €/MWh), as shown in the graph below. In the figures published by Eurostat for Spain, incentives to promote renewables and other costs of the electricity system are included in grid tariffs.

In 2012, retail prices for residential customers reached 228 €/MWh, which is higher than the European average (200 €/MWh). Prices rose by 46% between 2008 and 2012 – grid costs were 152% higher in 2012 compared to 2008 and taxes were 73% higher.

Figure 9. Retail prices for industrial (left) and residential (right) users (€/MWh)[8]



Electricity prices are sharply on the rise (+46% for residential prices between 2008 and 2012), while the country struggles with a heavy tariff deficit (€ 30 billion over the last 15 years).

Strong financial incentives were implemented to support the development of renewables and are reflected in the grid component of the tariffs. According to a recent study published by Eurelectric,[9] taxes and levies represented 50% of Spain's household prices. They include policy support costs which were at 66 €/MWh, the highest level in Europe (the European average was 25 €/MWh in 2012).

For industrial users, taxes and levies were 32 €/MWh in 2012 (or 27% of the price), with 27 €/MWh to cover policy and support costs (slightly above the EU average of 21 €/MWh).

The costs of public support for renewables were supposed to be covered by a third-party access tariff, paid by consumers. However, the rapid expansion of renewable energy increased the costs higher than expected and **the third-party access tariff paid by consumers did not cover all costs**. This was one the main elements that led to an accumulated tariff deficit of € 30 billion over the last 15 years,[10] which is, at the moment, financed through a debt held by Spain's five largest energy companies and, accordingly, not reflected in the actual electricity tariffs.

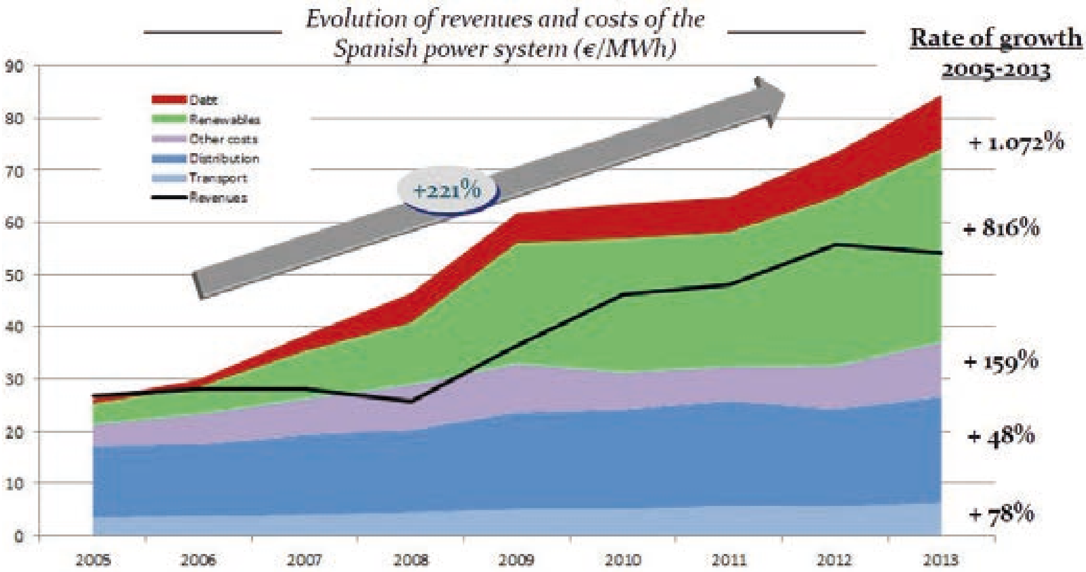
8 Source: Eurostat. © European Union, 1995-2015

9 Eurelectric (2014) Analysis of European Power Drivers

10 David Robinson (2013) Pulling the plug on renewable power in Spain. The Oxford Institute for Energy Studies

The Spanish government has been struggling to redesign electricity markets, to reduce the deficit: in recent years, support and incentives for renewable energy were not fully passed through to customers through regulated tariffs, leading to a deficit. The government has been operating the power system at a loss. Recently, it changed the feed-in-tariff system for renewables – the figure below illustrates the difference between the revenues and costs of the power system, and the country's debt accumulation.

Figure 10. Evolution of revenues and costs of the Spanish power system (€/MWh)



A series of measures has been implemented to prevent the tariff deficit from growing. This should be achieved by charging increased access tariffs to the final customers, reducing remuneration paid to network operators and cutting incentives, including those for renewable power (reduction of feed-in tariffs).

Targets for 2020

Spain's energy and climate targets for 2020 are to be met pursuant to several national action plans (the National Energy Efficiency Action Plan or NEEAP, updated in 2014; and the National Renewable Energy Action Plan or NREAP, updated in 2011 as the Renewable Energies Plan)[11]. They include:

- a 26.4% reduction of its primary energy consumption compared to the business as usual scenario;
- a 20.8% share of renewables in final energy consumption (20.8% being a national target; the EU target for Spain's renewables is 20%); and
- a 10% reduction of GHG emissions in the non-ETS sector and an 21% reduction of GHG emissions in the ETS sector.

Energy efficiency targets

Spain recently presented its NEEAP 2014-2020. Since energy consumption has been dropping as a result of the economic crisis, new targets were defined requiring supplementary efforts for energy efficiency.

Figure 11. Primary energy consumption (Mtoe)[27]

The target for primary energy consumption in 2020 is 119.9 Mtoe, which represents a 26.4% reduction in relation to a business as usual scenario (in which the primary energy consumption was expected to be 162.8 Mtoe in 2020).

The 2020 target represents only a 6% reduction in primary energy consumption compared to 2012 (127 Mtoe). But in its projections for 2020, the Spanish government assumes a country-wide economic recovery, as indicated by the expected GDP evolution for the coming years:

Table 1. Projected GDP evolution for Spain used in the energy efficiency target calculation (Source: Ministerio de Economía y Competitividad – Spain)

2012	2013	2014	2015	2016	2017	2018	2019	2020
-1.6%	-1.2%	0.7%	1.0%	1.4%	1.8%	2.0%	2.2%	2.4%

20-20-20 EU targets: what is Spain committed to in 2020?

- Reduce its primary energy consumption by 26.4% compared to the business as usual scenario.
- 20% share of renewables in final energy consumption.
- 10% reduction of GHG emissions in the non-ETS sector.
- 21% reduction of GHG emissions in the ETS sector.

In 2012, Spain was close to reaching its 2020 target for primary energy consumption (119.9 Mtoe) but supplementary energy efficiency policies will be necessary if the expected economic recovery occurs.

Most of the reduction in primary energy consumption is due to economic recession. If the economic recovery occurs as planned, new efforts will have to be undertaken to reach the 2020 target.

Several measures are already planned but it is too soon to estimate whether they will yield the expected savings by 2020.

11 IDAE (2011) Plan de Energías Renovables 2011-2020

If the GDP evolution follows this expected trend, the country's energy efficiency targets appear ambitious. The Spanish government believes this may represent a threat to the country's economic recovery. Moreover, the NEEAP notes that a 26.4% reduction is much higher than the 20% overall reduction required for the EU as a whole.

The energy efficiency measures implemented so far resulted in final energy savings in 2012, with 2007 as a reference year, of only 2.5 Mtoe (source: NEEAP 2014). Most of this reduction in energy consumption is attributed to the economic crisis. If Spain realizes the economic growth projected in Table 1, it seems rather unlikely that the country will achieve its energy savings target unless energy efficiency policies make much additional progress. This raises speculation regarding the extent to which existing policies are compatible with the country's economic growth projections and energy efficiency targets.

Transport represents 26% of primary energy consumption and is the largest energy-consuming sector. Different policy measures have been taken:

- Economic incentives for the purchase of efficient vehicles (emitting less than 160 g of CO_2/km) to replace older ones (10 to 12 years old, depending on vehicle category).[12]

- Incentives for the use of electric vehicles: lower electricity prices during the night for vehicle battery recharge; subsidies for the purchase of electric vehicles that may reach € 6,000 for private users and € 15,000 to € 30,000 for buses and trucks, depending on the vehicle used.[13]

- Training programs to improve driving efficiency.[14]

In the **building** sector, various measures have also been implemented to retrofit existing buildings. The residential sector has mandatory energy performance certification for buildings of more than 1,000 m^2 but there are no sanctions in case of non-compliance. Special loan terms are proposed for household owners willing to optimize thermal insulation, substitute energy sources for heating installations (conventional energy source by biomass or geothermal energy) and enhance lighting efficiency. [15]There are also specific programs focused on the hospitality industry (e.g. hotels).[16, 17]

For the **industrial sector**, economic incentives (€ 120 million per year) for investments in more energy-efficient technologies have been implemented with the NEEAP and mandatory energy management systems are expected to be introduced in the near future. That said, energy savings targets for individual companies are still lacking.

Additionally, Spain decided to strengthen its policy to encourage energy savings:

- Energy Efficiency Obligations (trading certificates scheme) targeting retailers of electricity and of fossil fuel-derived products (including those used in transportation) should be operational in 2015-2016, but have yet to be developed)

- A National Energy Efficiency Fund, funded through contributions of obligated parties, is also under discussion

Renewable energy targets

In 2012, the share of renewables in Spain's final energy consumption amounted to 14.3% and the target set by the European Commission for 2020 is 20% (with a more ambitious target of 20.8% set at the national level). The share of renewables has been steadily increasing (8.3% in 2004, 10.8% in 2008, 13.8% in 2010 and 14.3% in 2012) and Spain met its indicative trajectory (presented in the NREAP) for the year 2012. This was **one of the fastest progressions in the share of renewable energies in Europe** (behind Estonia and Austria).[18] Even though the renewables target set by the EU is 20%, the NREAP set a 22.7% goal from 2010. This target was revised in 2011 and set at 20.8%.

12 PIVE (Programas de Incentivos al Vehículo Eficiente)

13 Proyecto MOVELE

14 onvenios IDAE-DGT conducción eficiente del vehículo turismo, camiones y autobuses

15 PAREER (Programa de Ayudas para la Rehabilitación Energética de Edifícios Existentes)

16 PIMA SOL (ayudas para proyectos de rehabilitación energética de las instalaciones del sector hotelero)

17 If we consider final energy consumption instead of primary energy consumption, the corresponding target is 80.1 Mtoe of final energy consumption in 2020 (in the business as usual scenario, the final energy consumption is 103.4 Mtoe). This target represents a 23.3 Mtoe reduction compared to the business as usual scenario. The above mentioned programs (amongst others already implemented in 2014) are expected to save 1.7 Mtoe by 2020 – only 7.3% of this target

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

Figure 12. Renewable energy share of final energy use (Mtoe)[19] between 2004 and 2012, and targets for 2016 and 2020

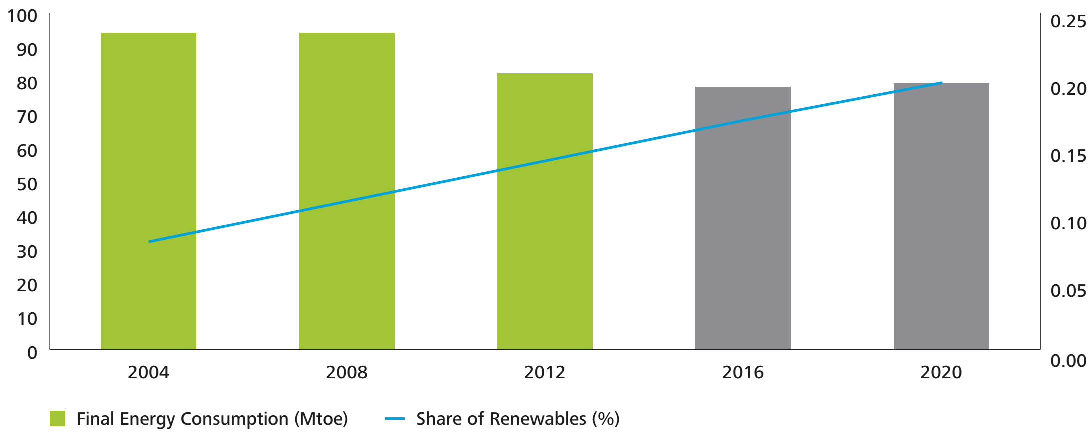
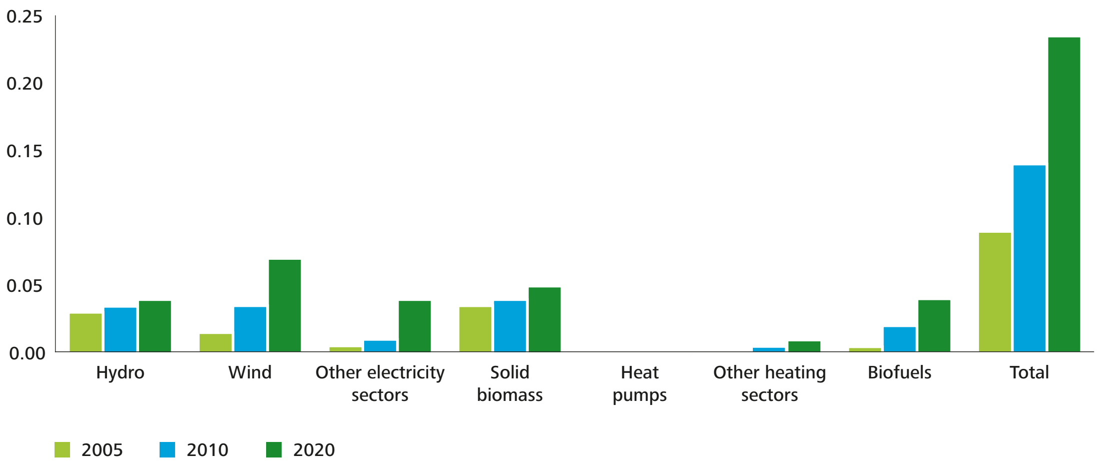


Figure 13. Renewable energy share of final energy use by type, in 2006 and 2011, and target for 2020, in %



With around 70% of its target already achieved, Spain seemed to be on track to reach its renewable energy target.

In the aftermath of the economic crisis, however, the Spanish government is reorganizing the power sector and has cut financial support for renewable energies. This could slow down the development of renewables.

If the same trend continues, this target should be easily achieved. However, new legislation reducing/phasing out renewable energy generation incentives in order to reduce the tariff deficit (which got as high as € 30 billion – see section on 'Power prices') represents an obstacle to this target. A series of measures was adopted to reduce the tariff deficit. These started with the introduction of caps for CSP, wind power and PV projects in 2010 (Royal Decree (RD) 1614/2010, Royal Decree Law (RDL) 14/2010), and the introduction of a 7% tax on all electricity sales (RDL 2/2012). These measures were later expanded with the progressive phase out of all other renewable energy incentives (RDL 1/2012, RDL 2/2013, RDL 9/2013), including the removal of incentives for cogeneration and the abolishment of electricity price regulation (guaranteed feed-in tariffs and bonus / premium). Moreover, measures forcing renewable energy producers to compete with traditional source producers on a level playing field were introduced as well (Law 24/2013, RD 413/2014).

As a result of the implementation of these measures, the annual electricity tariff deficit was 'only' € 3.6 billion in 2013,[20] which marks a partial success given the government's goal of a zero deficit for this period. On the other hand, the number of new measures, sometimes introduced with no previous stakeholder consultation, has created a lot of uncertainty in the electricity generation sector. **Investments in the sector are seen as highly risky and renewable energy deployment has slowed down significantly.**

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

20 Source: Linden, A. J., Kalantzakis, F., Maincent, E. & Pienkowski, J., European Economy. Electricity tariff deficit: temporary or permanent problem in the EU?, Economic Paper 534. © European Union, 2014

Due to the economic situation, GHG emissions are currently below 2020 targets.

However, according to EEA (2013), if economic growth is in line with expectations, it will be difficult to achieve these targets considering existing and upcoming policies.

As mentioned earlier, this debt is held by the five main Spanish electricity companies, which have started to pass it on to consumers. It is estimated that the debt contributed to around 8% of consumer electricity bills.[21]

In the **power** sector, Spain's Renewable Energies Plan (2011) set a target of 38.1% of renewables in final electricity generation. Currently, that share is 31% even though renewables represent half of installed capacity. Spain believes significant progress can be achieved by optimizing the use of pumped storage hydroelectricity (power from intermittent sources should be more efficiently used to pump water so it can be stored and used later for electricity production in hydroelectric power stations). By 2020, the installed capacity for wind power and solar power should be 35 GW (vs. 22.7 GW in 2013) and 12 GW[22] (vs. seven GW in 2013) respectively. However, renewable energy producers face significant uncertainty (especially in the power sector) due to new legislation (see 'Power prices' section) and new investments are slowing down. For instance, Spain installed 1,110 MW of new wind capacity in 2012 and just 175 MW in 2013.[23]

For **transport**, the target is 11.3%[24] of renewables share by 2020 (mainly achieved through the use of biofuels: 9.2%). According to our own calculations,[25] biofuels accounted for 6.3% of transportation fuels in 2012.[26] In 2014, there was a sharp drop in biofuel consumption due to a government decision to reduce incorporation targets for biodiesel and ethanol to 4.1% and 3.9% respectively.

CO_2 emissions and targets

Targets for GHG emissions reduction are split between the ETS (emission trading scheme) sector (essentially power generation and heavy industry) and the non-ETS sector (buildings, transports, agriculture, etc.).

- Non-ETS sector: in 2005 (base year for the calculation of emission reductions), GHG emissions in Spain amounted to 240 Mt CO_2eq. The target for 2020 is 216 Mt CO_2eq, which represents a 10% reduction. In 2012, emissions amounted to 207 Mt CO_2eq and were already below the target (they decreased further to 196 Mt CO_2eq in 2013).

- ETS sector: in 2005, emissions amounted to 193 Mt CO_2eq. The target for 2020 is a 21% reduction, which is equivalent to 152 Mt CO_2eq. In 2012, emissions amounted to 134 Mt CO_2eq, already below the target, as in the non-ETS sector.

To a great extent, this quicker than expected progress can be attributed to the economic crisis. And, according to EEA, **if economic growth is in line with expectations, the existing and upcoming policies are probably not ambitious enough to avoid an increase in emissions that would prevent Spain from reaching its 2020 target**.[27]

Figure 14. GHG emissions and targets in the non-ETS sector (Mt CO2 eq.)[27]

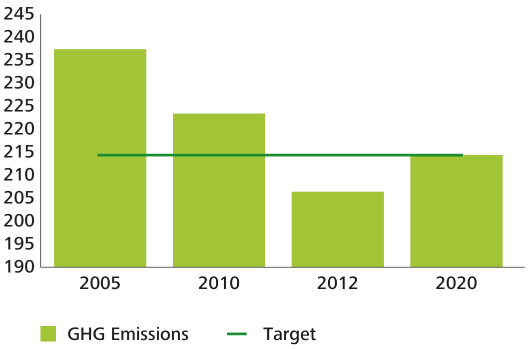
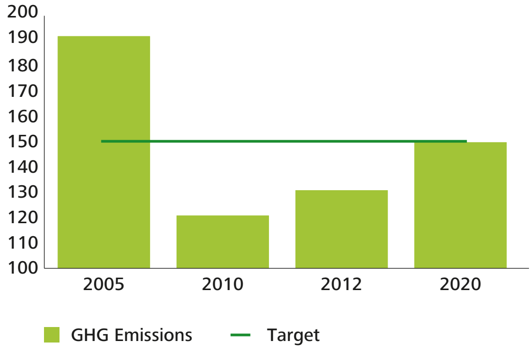


Figure 15. GHG emissions and targets in the ETS sector (Mt CO2eq.)[19]



21 El País (2014) The shocking price of Spanish electricity (01/01/2014) http://elpais.com/elpais/2014/01/01/inenglish/1388590410_230748.html

22 In the NREAP sent to the European Commission in 2010, the target for solar power was 13 GW; this target was updated to 12 GW one year later in the IDEA (Plan de Energias Renovables 2011-2020)

23 Global Wind Energy Council (2013) Global Wind Report 2013 – Annual Market Update

24 IDAE (2011) Plan Energias Renovables

25 In 2012, Spain reported this share to be 0.4% in its "Report on progress in the promotion and use of energy from renewable sources pursuant to article 22 of Directive 2009/28/EC". This figure is erroneous since the biofuels incorporation mandate was 7% in diesel fuel and 4.1% in petrol at the time

26 EurObserv'ER reports 201 455 toe of ethanol consumption and 1 899 294 toe for biodiesel in 2012. Final energy consumption in the transports sector in Spain was 33 348 000 toe (Eurostat) in 2012

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

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

Today in Spain, decisions in general (including policies in the energy sector) are driven by the country's economic crisis. GDP dropped by 16% between 2008 and 2013[28] and the unemployment rate is around 25%.[29] All of the indicators in the energy sector have been strongly affected by the macroeconomic situation and this blurs visibility for the coming years. Energy dependence has been steadily dropping (but is still above the European average), final energy consumption in 2012 was only 3.7% higher than the 2020 target, and both the ETS and non-ETS sectors' GHG emissions are already below 2020 targets. It is hard to quantify how much of Spain's progress towards its 2020 objectives is attributable to policies designed specifically for these targets, given that the economic recession probably had a stronger impact than the policies.

Strongly hit by the economic crisis, Spain has not defined policies in the energy sector beyond 2020.

Current policies focus on mitigating the economic crisis and the lack of long-term planning in the energy sector is evident.

Moreover, Spain has not formally adopted any energy policies for the period after 2020. This reflects a need for better long-term planning. Modelling activities, with the aim of investigating the economic, social and environmental impacts of energy policies, are essential for the country's long-term planning. Establishing roadmaps is also an important step to reduce investment uncertainty.

One of the main concerns in the power sector is overcapacity and, accordingly, the very low load factors for gas-fired power plants, which produce an average of 800 hours per year (which means that they lose money).

Energy dependence

One of the main characteristics of the Spanish energy sector is its dependence on fossil fuel imports (oil, coal and gas). Spain's energy dependence[30] (the extent to which it relies on imports to meet its energy needs) peaked in 2006 (82%) and has been steadily decreasing since 2008. By 2012, it was estimated to be around 73%. By means of comparison, the average European energy dependence is 50%.

Spain's energy dependence is very high and current measures do not aim to reduce it.

Even if this indicator's decline has been mainly due to a slowdown in industrial activity as a result of the economic situation, supplementary efforts are necessary to achieve energy independence, especially in the transportation sector. However, biofuel incorporation targets were significantly reduced in 2014. The main objective of these new targets is to reduce the price of fuel in order to reactivate the Spanish economy. **This clearly illustrates the trend of decision-making driven by the economic crisis instead of the European objectives for the energy sector.** Besides the development of new biofuel technologies, the market uptake for electric cars is another potential way to diversify the energy carriers used in Spain's fleet and to channel its current excess power capacity. Electric cars would be able to take advantage of the already-installed renewables capacity for power generation – especially by charging batteries during off-peak periods.

Furthermore, coal imports have increased as a result of the US shale gas boom. Coal consumption (hard coal and lignite) rose by 28% in Spain in 2012.[31] US coal has been exported mainly to Europe at cheap prices, leading to coal power plants being more competitive than gas-fired ones. As a result, carbon market prices do not send the correct price signals. Beyond drawing attention to the Spanish dependence on foreign energy sources, this fact negatively affects the country's efforts to reduce GHG emissions.

28 World Bank

29 Trading economics – http://www.tradingeconomics.com/spain/unemployment-rate

30 Following Eurostat's methodology

31 Source: http://ec.europa.eu. © European Union, 1995-2015

The development of a cross-border energy transport network is key, both if Spain wants to export its excess power and if it wants to play a key role as an energy bridge between North Africa and Europe.

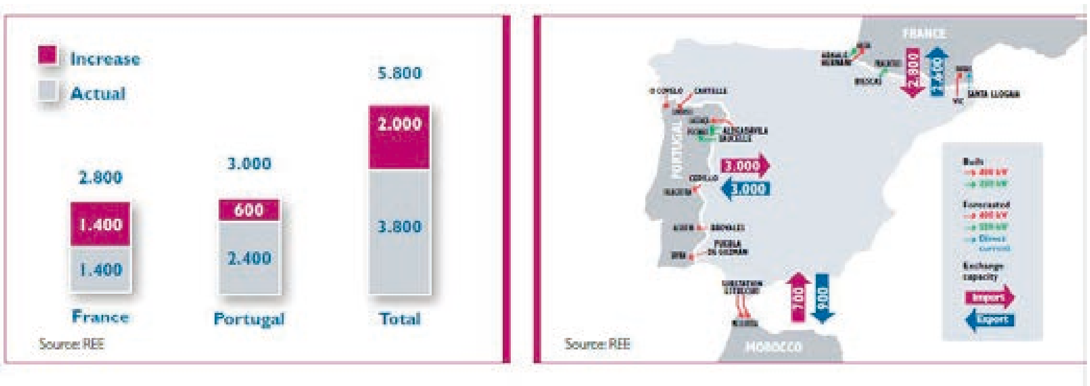
International energy trade

Spain also has an important role to play in reducing Europe's energy dependence. Efforts are needed to diversify supply options and this involves North African natural gas passing through Spain. Investments in gas transportation infrastructures (increasing flow capacity) may be very useful in the coming years.[32] Furthermore, Spain is the European leader in LNG storage (3 Mm3) and regasification (52 bcm/year) capacity, accounting for around 40% and 32% of Europe's total capacity respectively.[33] With an increase of interconnections in Europe, Spain should play a key role for the diversification of gas supplies.

Transmitting power to other countries could also be the focus of new investments, to take advantage of Spain's excess power generation capacity. Currently, the ratio between peak demand and available permanent capacity (not taking into account intermittent power sources) is 1.3-1.4 and Spain cannot export more than 1,400 MW to France, 2,400 MW to Portugal and 900 MW to Morocco. Power exchange capacity is expected to grow in the coming years, especially with France (2,800 MW forecasted for 2016 – see the following figure) but this is still a far cry from the minimum established by the EU (10,000 MW). Expanding interconnection capacity has been an historical challenge for Spain since France has been reluctant to expand its infrastructure in order to protect its nuclear industry from the competition posed by Spain's renewables.

An ambitious energy efficiency policy has to be implemented, lest the potential economic recovery make the recent reduction of energy consumption disappear.

Figure 16. Expected growth in interconnection capacity in Spain (Source: REE)



Energy efficiency

As mentioned earlier, the significant decrease in energy consumption was mainly driven by the economic crisis. In a scenario with an improved economic situation, both existing and future energy efficiency measures are unlikely to be sufficient for Spain to achieve its 2020 targets. Moreover, according to energy efficiency experts, the Spanish NEEAP "lacks a long-term vision until 2050."[34]

Renewable power generation

Spain has seen a strong progression of renewable penetration in its energy mix (the share of renewables in final energy consumption rose from 8.3% in 2004 to 14.3% in 2012). **The main reasons for this increase were the policies providing financial support for these sources.** The relatively good availability of solar and wind resources is also a factor that should not be forgotten. The Spanish case is a relevant example for other EU countries that will experiment with a high level of renewables penetration in the short and mid-terms.

32 SUSPLAN (2011) Development of regional and Pan-European guidelines for more efficient integration of renewable energy into future infrastructure – D5.2 Report on implementation strategies for technical and system solutions and recommendations for policy makers

33 Council of European Energy Regulators (2013) CEER Status Review and evaluation of access regimes at LNG terminals in the EU

34 Energy Efficiency Watch (2013) Energy efficiency in Europe – Assessment of energy efficiency action plans and policies in EU Member States – Spain Country Report

As already noted, the combination of declining energy demand and the fast increase of renewables in the energy mix, along with a badly designed feed-in tariff, has resulted in a € 30 billion tariff deficit for Spain. In 2008, this tariff deficit had already reached € 15 billion. In the last few years, in an attempt to deal with this deficit, the government introduced a series of regulatory changes, including retroactive actions (i.e. introduction of a 7% tax on all electricity sales – conventional and renewable; abolishment of the so-called "premium option," which allowed renewable power producers to sell their electricity directly into the market at premium prices; abolishment of feed-in tariffs that grant above-market rates for power from clean sources; cap for incentives). These changes have created uncertainty for existing and future projects, and investments have come to a complete standstill (-96% in the first quarter of 2013 compared to the first quarter of 2012).[25] These developments have even caused reputational damage for the renewable energy industry worldwide[35] and have been the subject of legal actions against the Spanish government from investment funds.[36] Moreover, the debt has been reflected in the electricity bills of consumers (around 8%, as mentioned in the 'Renewable energy target' section).

With an excess of power production capacity and budgetary capacity hindered by the economic crisis, Spain has to find new ways to promote renewable energy.

Today, **uncertainty remains high but there are still options for the development of renewable energies**. Producers should stop relying on unpredictable government decrees in the development of their business models. For instance, they can develop projects with off-take agreements signed with consumers willing to consume renewable power for sustainability reasons.

Similarly, if the power generation sector shows excess capacity, there is a potential for development of renewables in the transport sector since the share of biofuels is not very high and the dependency on fossil fuel imports is significant.

Future policy support for renewable energies should be carefully designed to prevent over-compensation and uncontrolled deployment.

Conclusion

Spain's pathway towards its 2020 targets has been masked by the country's economic situation and there is considerable uncertainty about the country's ability to reach these goals. There is little to no planning for the period beyond 2020. Spain would benefit from policies in the energy sector focusing on long-term sustainability rather than on short-term actions to mitigate the effects of the economic crisis.

Many questions remain unsolved. Major concerns still need to be addressed regarding the future of Spanish nuclear power plants, dependency on coal and electricity generation overcapacity, especially with regard to the low load factors of gas-fired power plants. This makes energy planning for the coming years key.

35 Bechberger M (2013) Pain in Spain: New retroactive changes hinder renewable energy. Renewable Energy World. http://www.renewableenergyworld.com/rea/news/article/2013/04/pain-in-spain-new-retroactive-changes-hinders-renewable-energy

36 Coats C (2014) Spain deals another blow to renewable power. Forbes. http://www.forbes.com/sites/christophercoats/2014/06/12/spain-deals-another-blow-to-renewable-power/

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European energy market reform
Country profile: UK

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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]

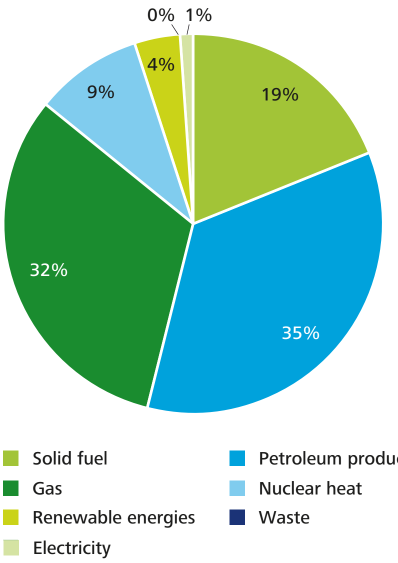
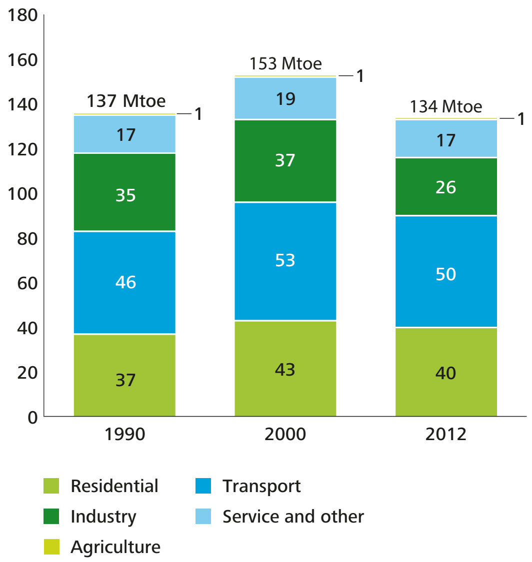
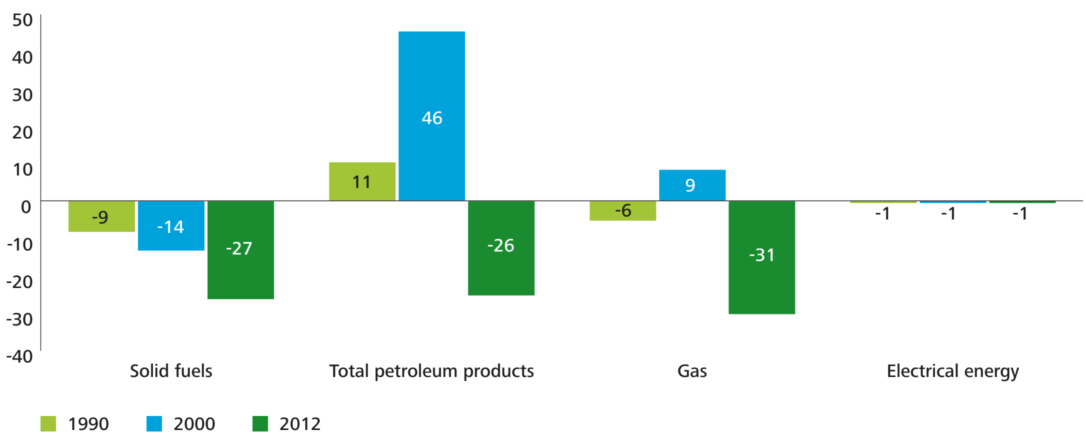


Figure 2. Final energy consumption by sector (in Mtoe)[3]



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]

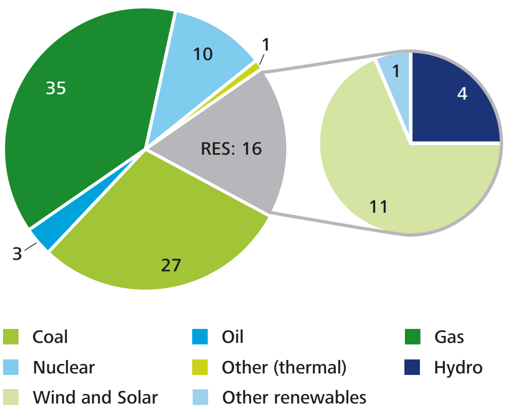
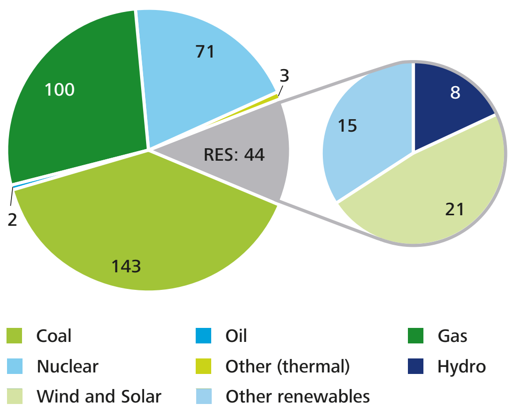


Figure 5. Gross electricity generation – 364 GWh (2012)



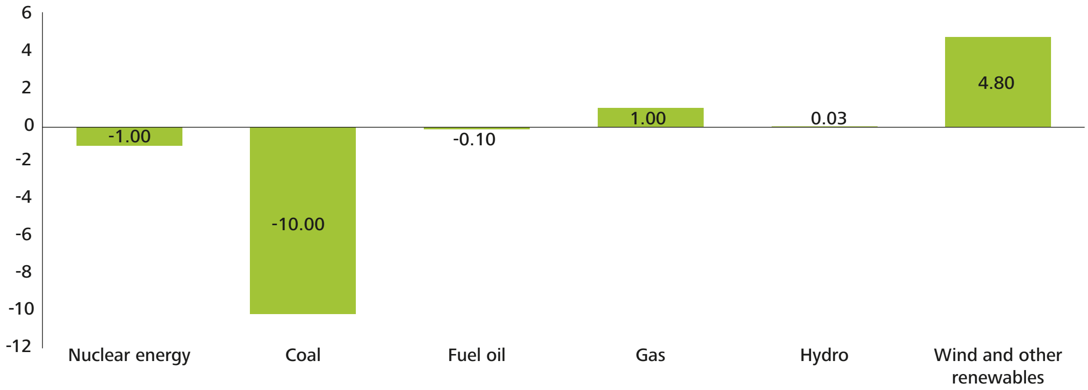
Source: http://ec.europa.eu © European Union, 2014

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).

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.

A competitive and dispersed market.

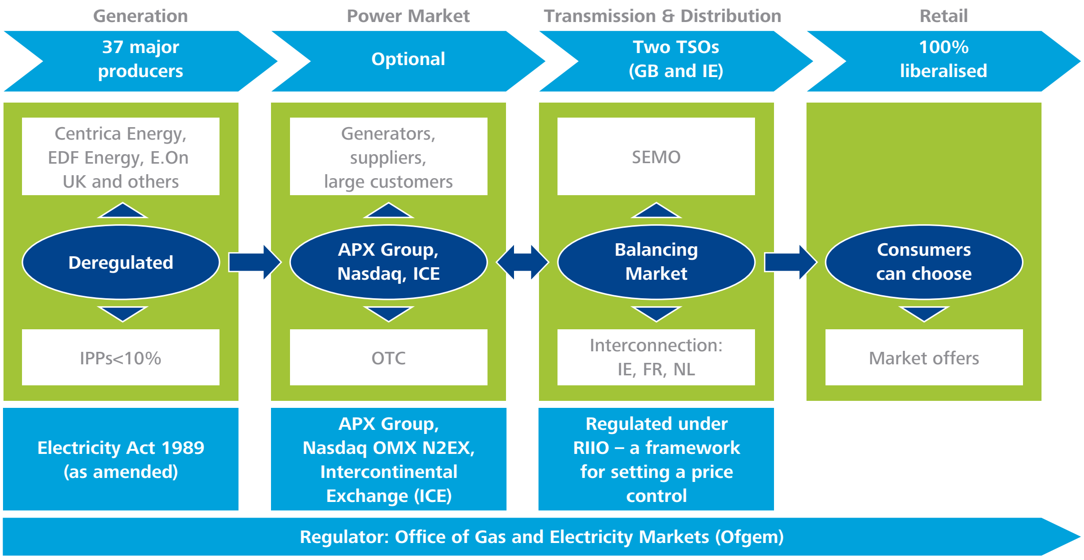
Thirty-seven major power producers operate in the UK. Despite this number, six big companies dominate the generation and the retail markets. Their competitive position is under scrutiny by the Competition and Markets Authority.

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]

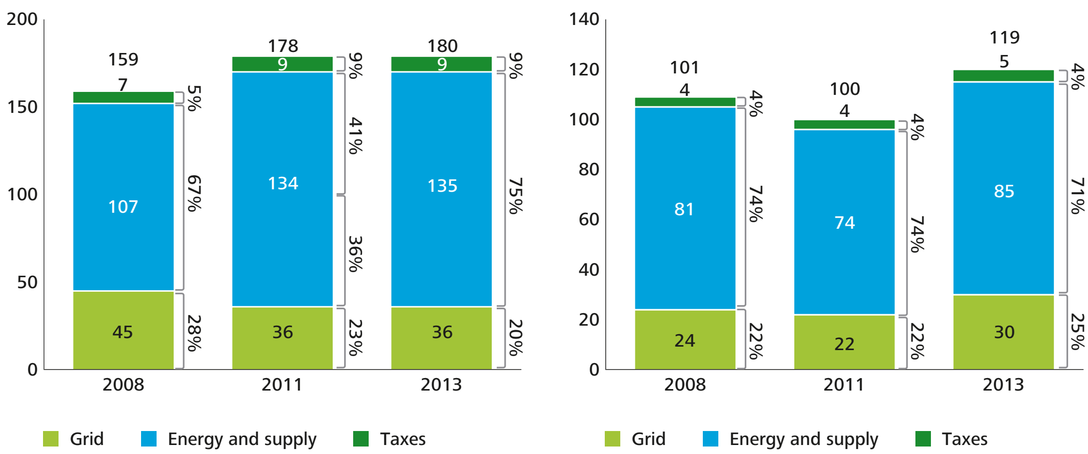
In 2012, the **electricity price for industrial consumers** was 119 €/MWh, slightly below the European average (125 €/MWh). Between 2008 and 2012, the price increased by 10%, driven by rising grid costs (+24%), taxes (+23%) and generation and supply costs (+5%).

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.

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.**

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.

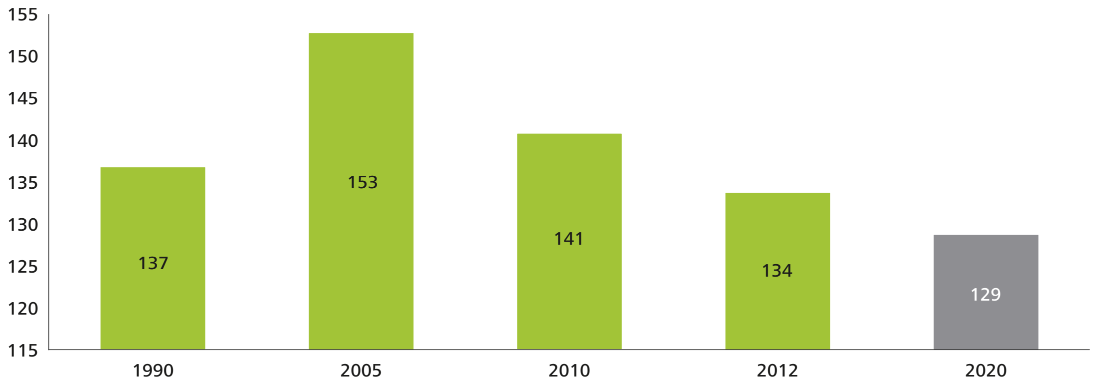
The UK is implementing the EU Energy Efficiency Directive through 19 policies, which include the following three energy company obligation schemes: the Carbon Emissions Reduction Target (CERT), the Community Energy Saving Programme (CESP) and the Energy Company Obligation (ECO). While the UK target is 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]



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 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]

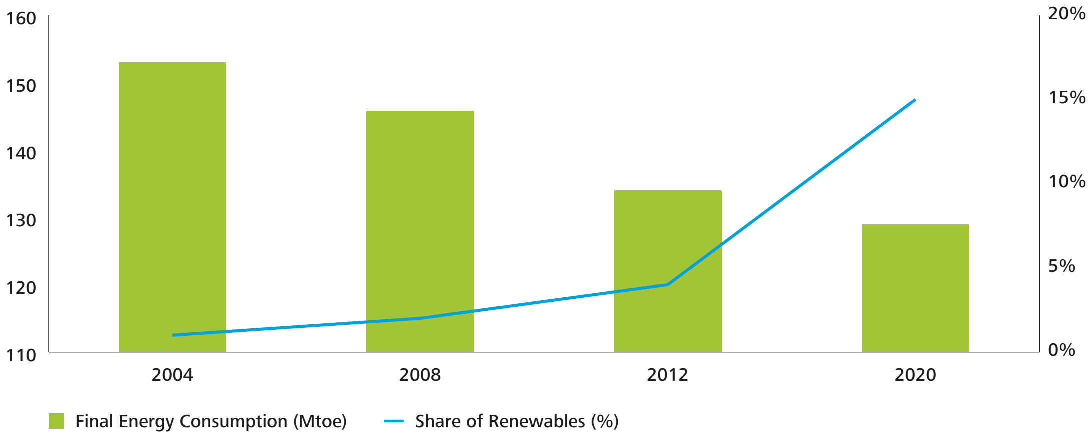
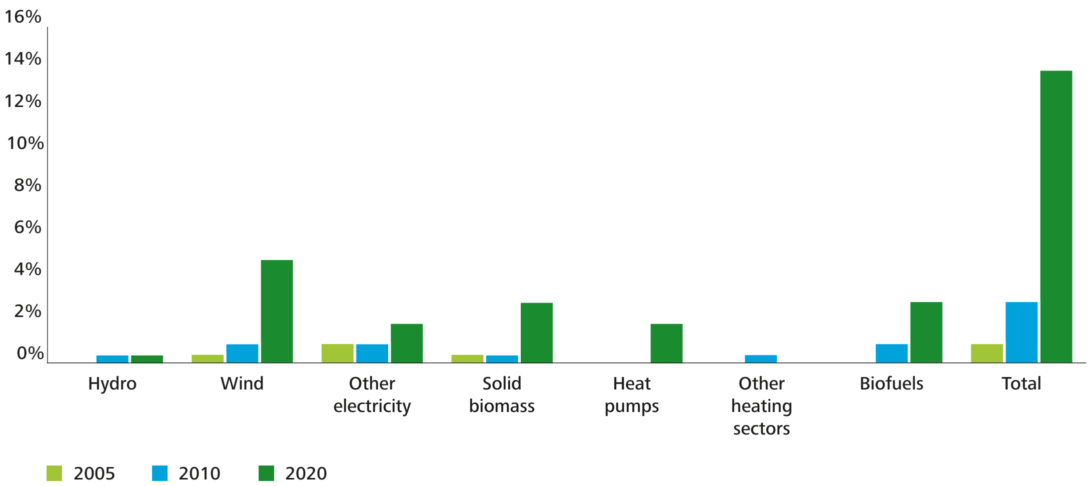


Figure 11. Renewable energy share of final energy use by type, in 2006 and 2011, and target for 2020, in %[16]



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.

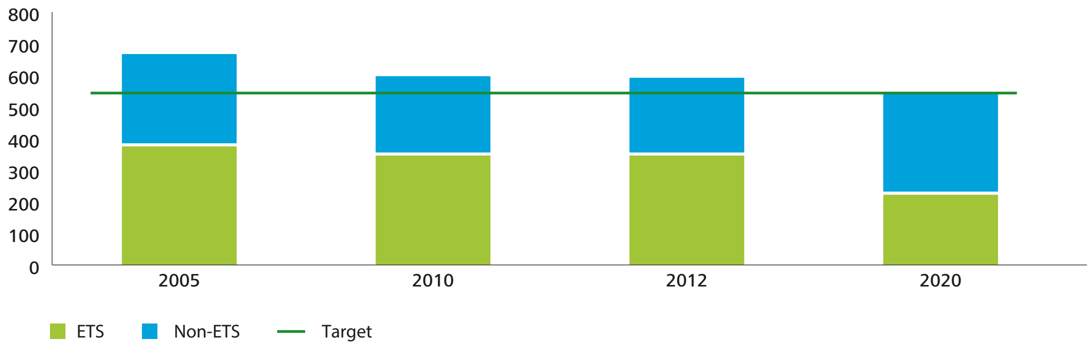
In 2013, 452 MW of renewable electricity capacity was added thanks to the support of feed-in tariffs. The total capacity promoted by feed-in tariffs reached 2.3 GW. The feed-in tariffs differ according to sector and type of installation.

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.

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.**

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.

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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Notes

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