



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<sup>1</sup> 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<sub>2</sub> 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<sub>2</sub> 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, **reaching 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<sup>2</sup>); 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<sup>3</sup>. 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;
- **Affordability:** **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 CO<sub>2</sub> 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<sub>2</sub> 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<sup>4</sup>) **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<sup>5</sup> 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.

<sup>5</sup> 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<sup>6</sup>: (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<sup>6</sup>, 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.

<sup>6</sup> 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<sup>7,8</sup>

	2020 <sup>(a)</sup>	2030 <sup>(a)</sup>	2050 <sup>(a)</sup>
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% <sup>(b)</sup>	43% <sup>(b)</sup>	TBD <sup>(b)</sup>
Non-ETS sectors	10% <sup>(b)</sup>	30% <sup>(b)</sup>	TBD <sup>(b)</sup>

(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<sub>2</sub> reduction targets. These were agreed by the European Council.

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

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

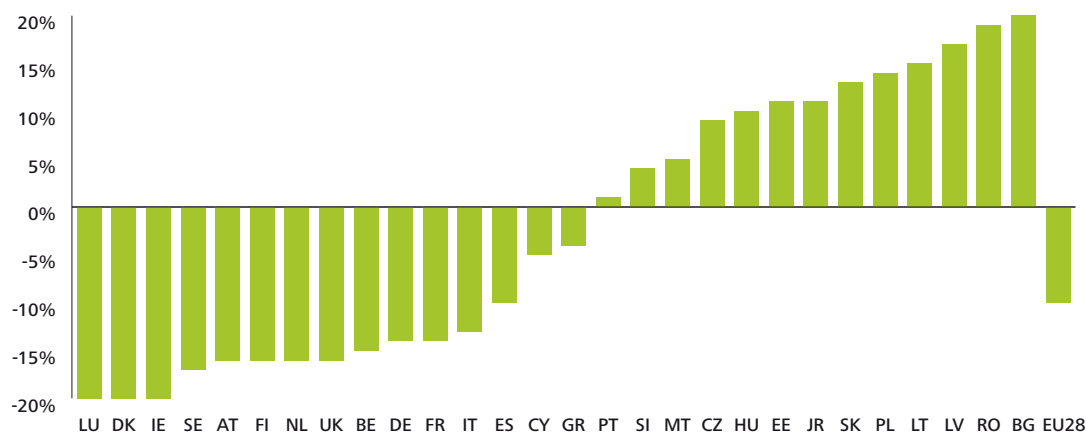
8 These targets were made public by the European Commission:

- <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](http://europa.eu/legislation_summaries/energy/index_en.htm)

9 [http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2009.140.01.0136.01.ENG](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<sup>10</sup>



By 2020, the national targets will collectively deliver a reduction of around 10% in total emissions from the non-ETS sectors (CO<sub>2</sub> 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<sub>2</sub>eq, which represents about 40% of total GHG emissions<sup>11</sup>. 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)<sup>12</sup> 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<sup>13</sup> set CO<sub>2</sub> emission limit values for new cars: it set legally-binding emission targets for new cars (fleet average) of 130 gCO<sub>2</sub>/km by 2015 and of 95 gCO<sub>2</sub>/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.

<sup>10</sup> European Commission, chart available here: [http://ec.europa.eu/clima/policies/effort/index\\_en.htm](http://ec.europa.eu/clima/policies/effort/index_en.htm)

<sup>11</sup> EEA (2014), Trends and projections in Europe 2014

<sup>12</sup> 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>)

<sup>13</sup> 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<sub>2</sub> emissions from light-duty vehicles

<sup>14</sup> EEA (2015), Trends and projections in Europe 2014

### 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<sup>14</sup>. 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.



### Where do we stand with greenhouse gas emissions targets?

Figure 3. EU-28 GHG emissions by sector, 1990-2012, and 2020 target (MtCO<sub>2</sub>eq)<sup>15</sup>



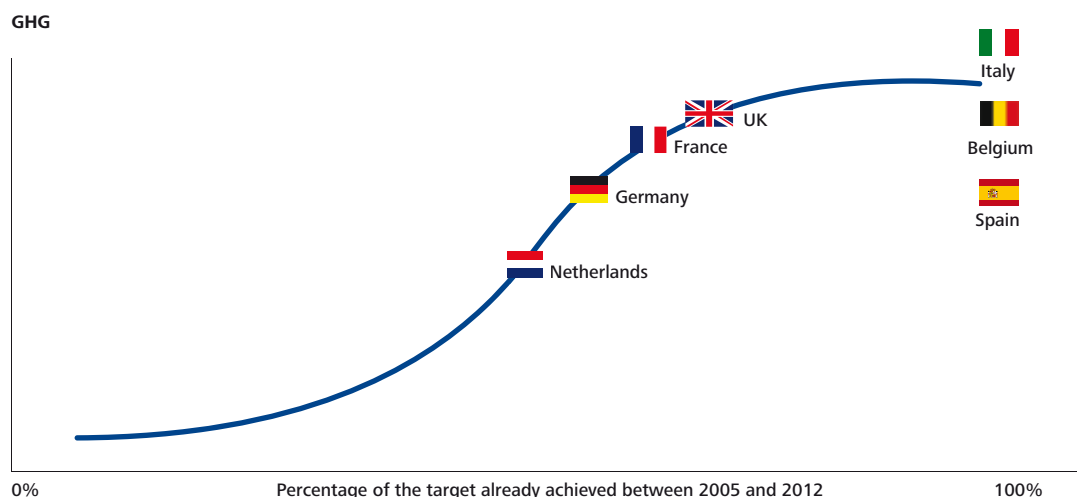
The EU-28 are well on their way to meeting their overall GHG emissions target, especially thanks to a reduction in emissions during the last few years: GHG emissions decreased by 3% in the 15 years between 1990 and 2005, and by 11% in the seven years between 2005 and 2012. A reduction of 7% is still 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 still 53% short of the target. However, there was a significant decrease in non-ETS GHG emissions in 2013 (from 117 MtCO<sub>2</sub>eq in 2012 to 108 MtCO<sub>2</sub>eq in 2013).

Figure 4. Percentage of the GHG emission target already achieved between 2005 and 2012 for seven countries<sup>16</sup>



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.

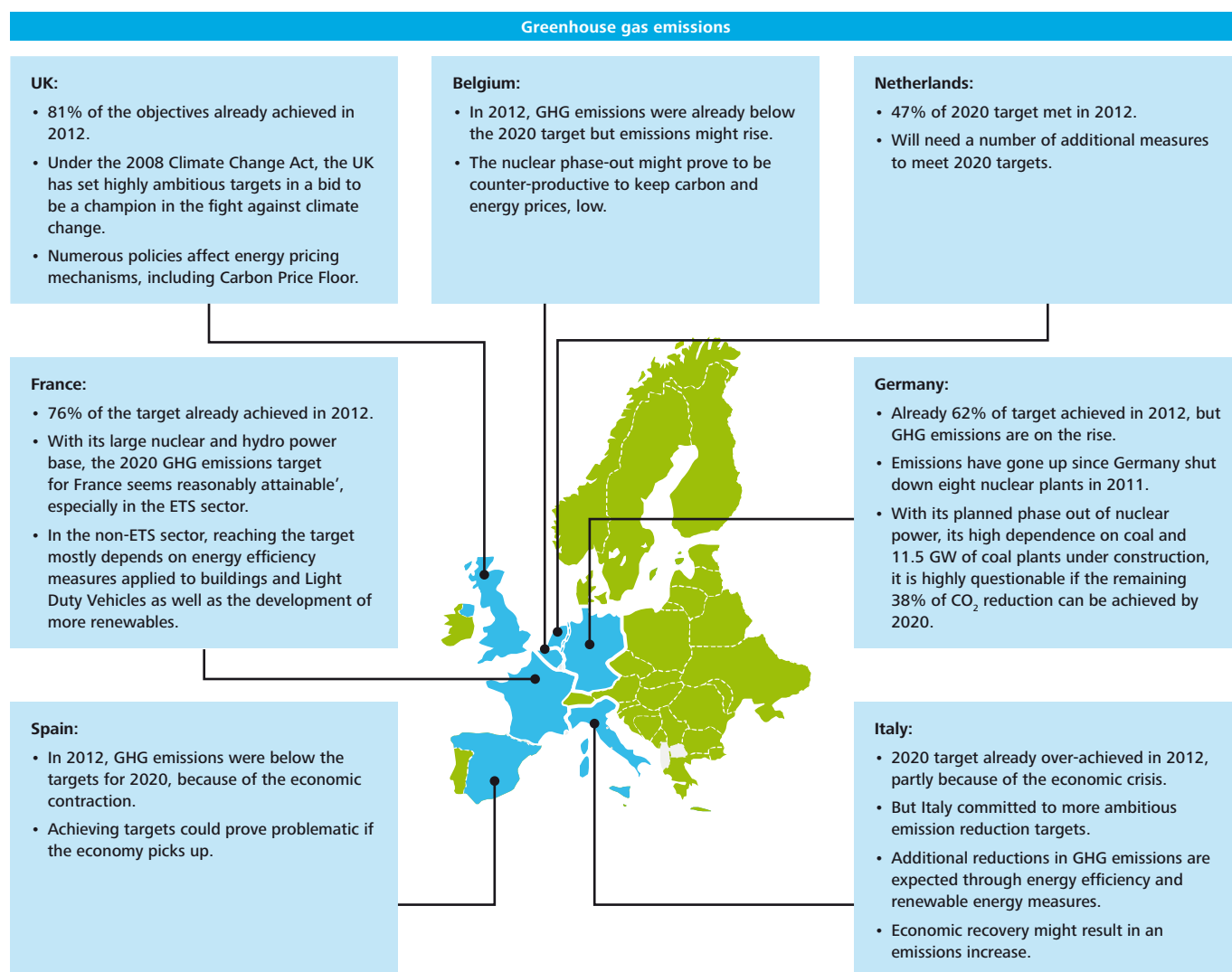




In Germany, the phasing out of nuclear power combined with the commissioning of more coal fired capacity could lead to a notable increase in CO<sub>2</sub> emissions, thus jeopardising reaching the GHG emission target.

According to the European Environment Agency (EEA)<sup>17</sup>, 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**



<sup>17</sup> 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)<sup>18</sup> 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?**

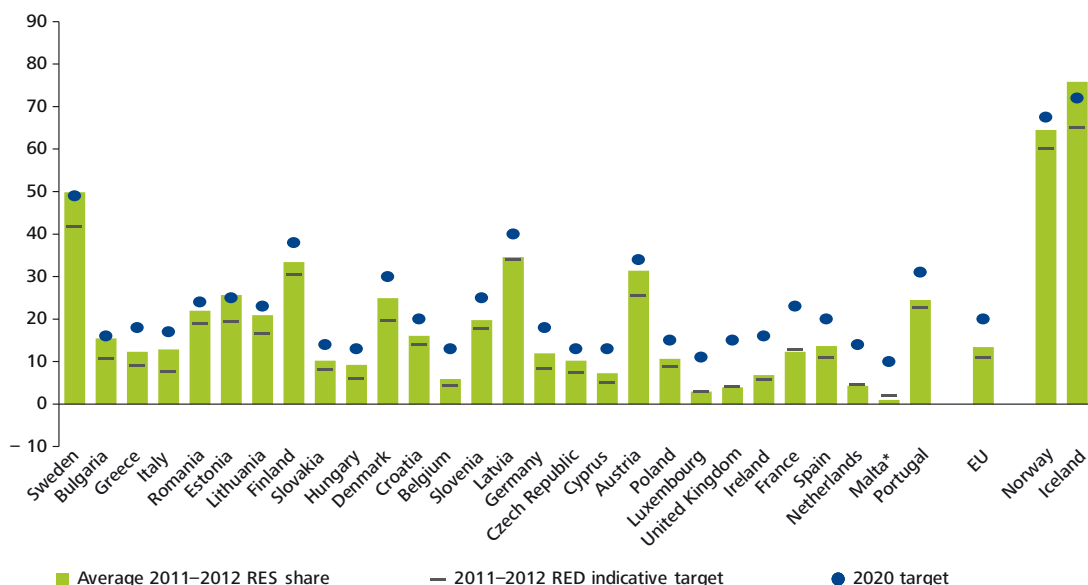
At EU level, the target is for renewable energy to account for 20% of the overall energy consumption mix by 2020 (vs. 8.7% in 2005 and 14.0% 2012).

<sup>18</sup> 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<sup>19</sup> share in gross final energy consumption (%)<sup>20</sup>

RES share in gross final energy consumption (%)



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

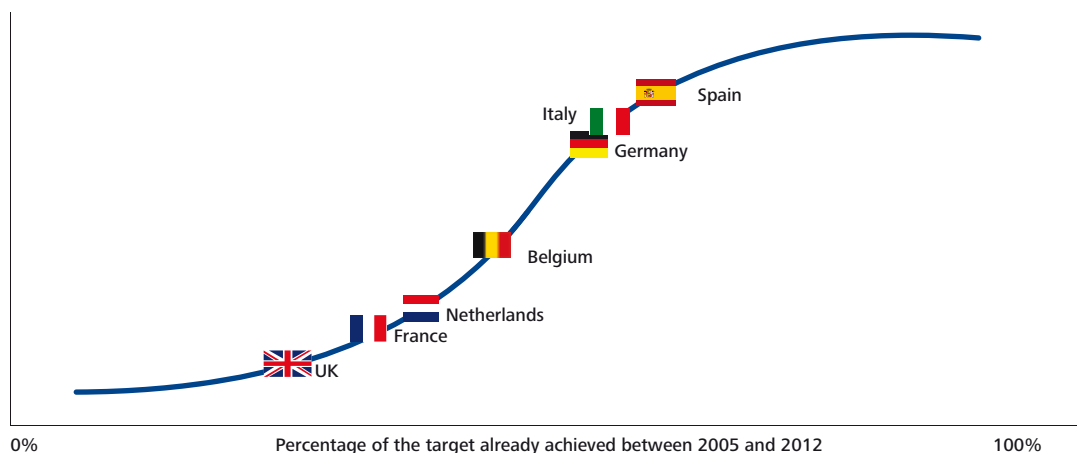
The picture is different if we compare the efforts made by individual countries between 2005 and 2012 with what needs to be done between 2005 and 2020, as the graph below shows.

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<sup>21</sup>

Renewable energy



<sup>19</sup> RES stands for Renewable Energy Source

<sup>20</sup> 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>

<sup>21</sup> 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



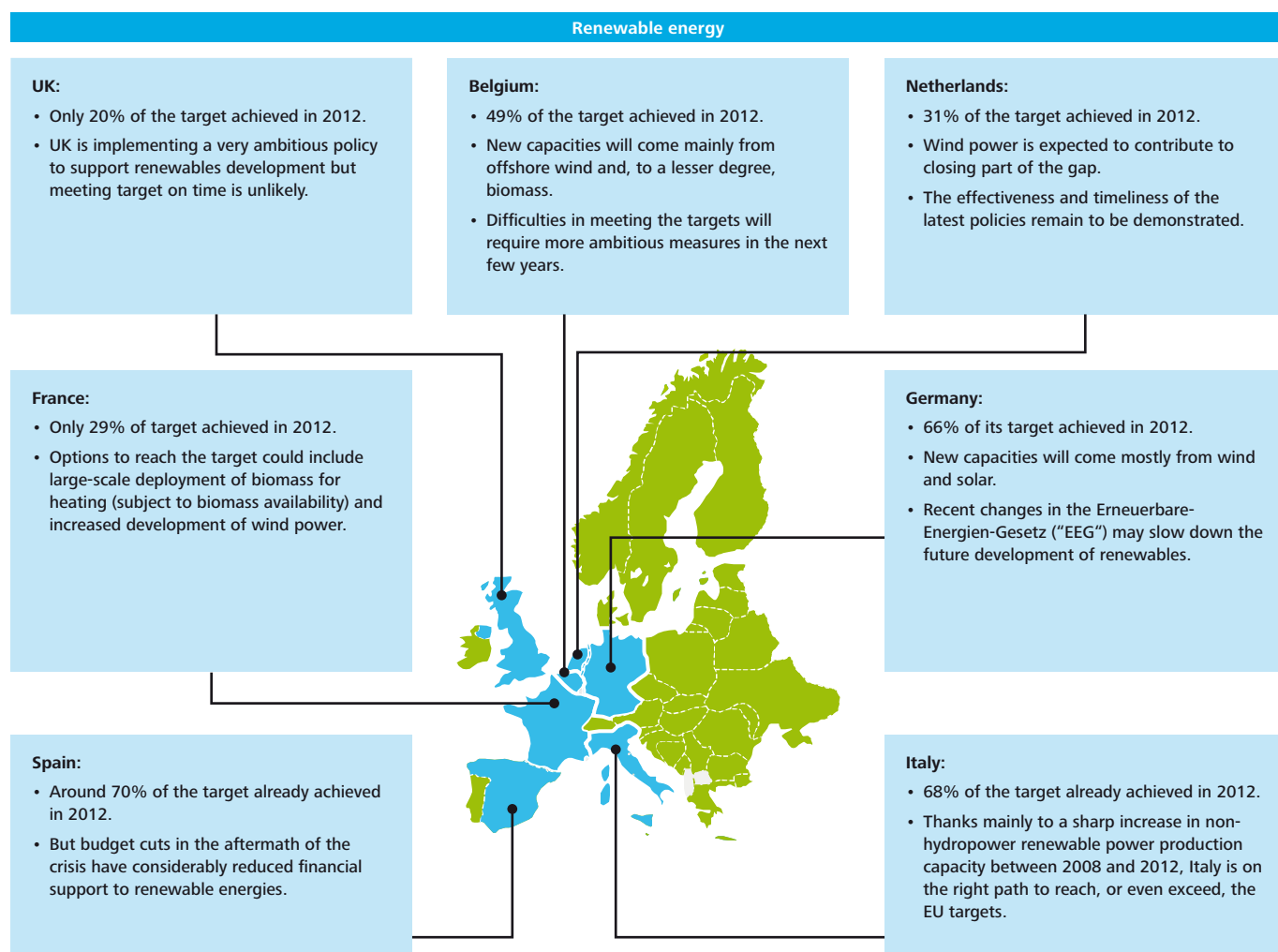
With its large hydropower base, France already had a high Renewable Energy Source (RES) share in 2005. However the distance to the goal, which will inevitably have to be covered by developing the non-hydro base, is significant. It will be a challenge for France to reach the 2020 target. **France needs 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<sub>2</sub>-free electricity<sup>22</sup>, or replacing some 15 GW of coal-fired power generation with some 40 GW of wind power.**

<sup>22</sup> 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







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<sup>23</sup>); 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<sup>24</sup>. **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<sup>25</sup> 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)<sup>26</sup>.

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)<sup>27</sup>, 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 <http://www.wiwo.de/politik/deutschland/trotz-reform-verbraucher-werden-2015-eine-milliarde-euro-mehr-eeg-umlage-bezahlen/9414526.html>

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)<sup>28</sup>

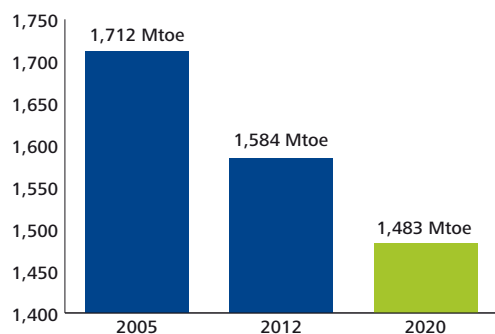
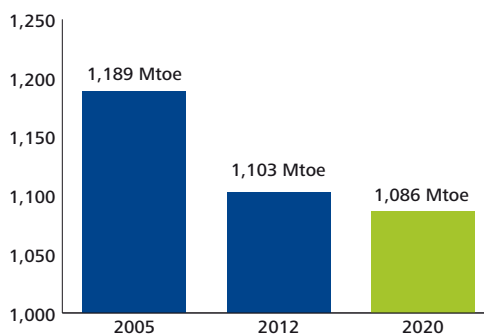


Figure 10. EU-28 final energy consumption 2005-2012 and target (Mtoe)<sup>29</sup>

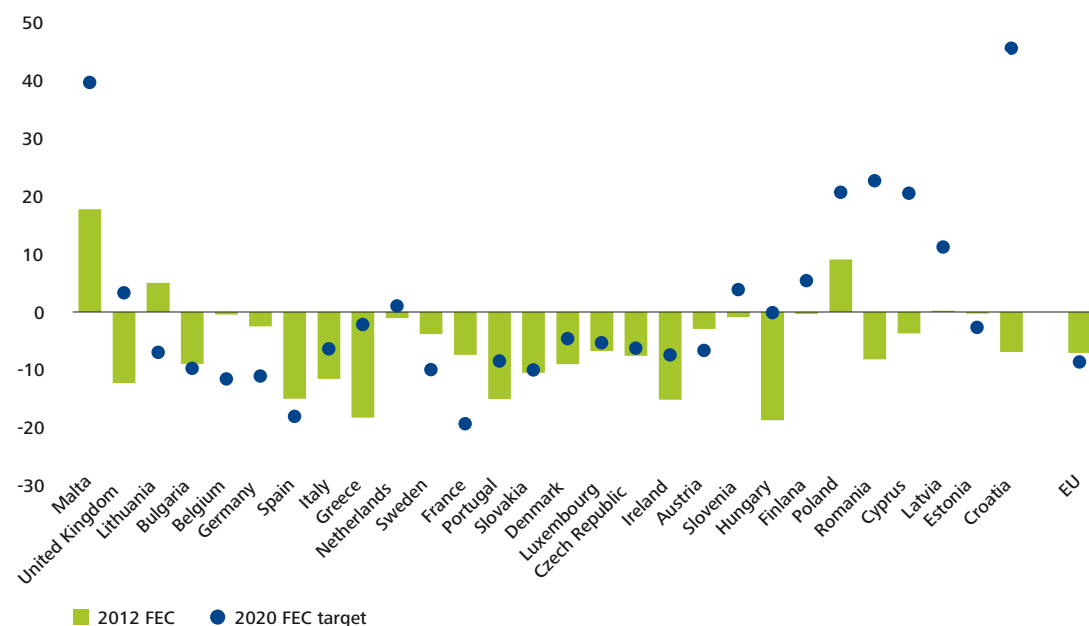


In 2012, the targets in absolute terms were reached or nearly met by a few Member States, including Spain, Italy and the Netherlands. Here again, the economic crisis and subsequent energy demand reduction played a role. But if economic recovery occurs as planned, energy consumption may rise again, endangering 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 (%)<sup>30</sup>

% change compared to 2005 final energy consumption (FEC)



28 Eurostat. © European Union, 1995-2014, [http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020\\_33&language=en](http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020_33&language=en)

29 Source: Eurostat. © European Union, 1995-2014, <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc320&plugin=1>

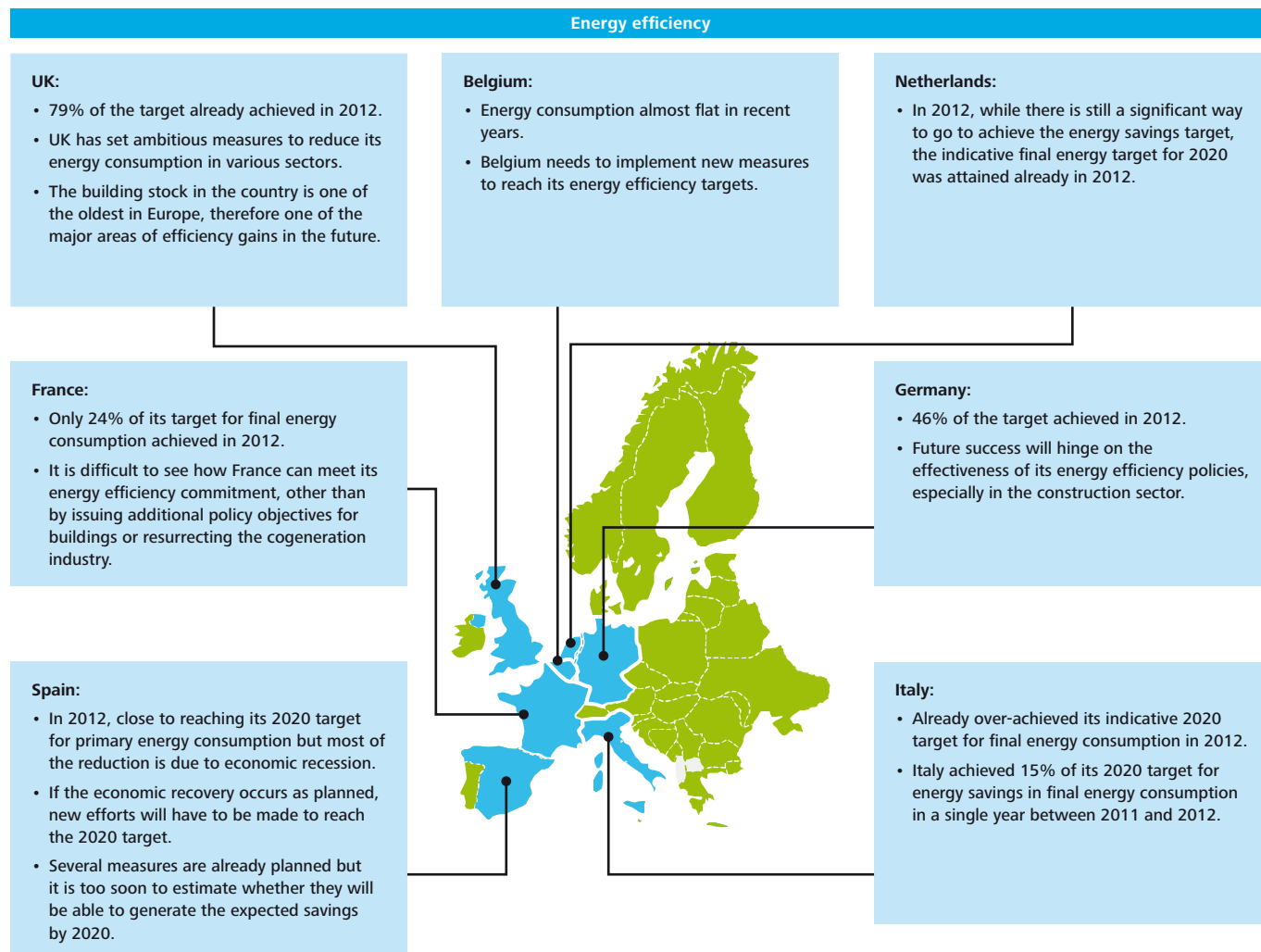
30 Figure extracted from EEA (2014), Trends and projections in Europe 2014, available online on: <http://www.eea.europa.eu/publications/trends-and-projections-in-europe-2014>

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.



Figure 12. Energy efficiency achievements in seven countries in 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.

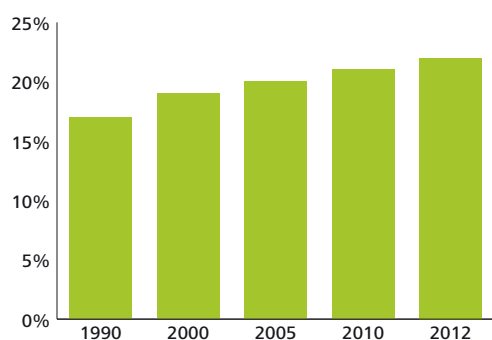
The economic crisis has played a key role in progress towards meeting targets to date. By depressing consumption, it has *de facto* reduced GHG emissions, saved energy and made the share of renewables in final energy consumption look better than it would have had the economy been stronger. Any economic 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.



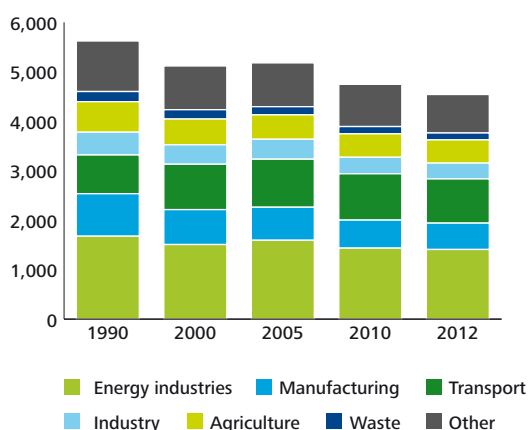
# Unintended outcomes in the power sector

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.

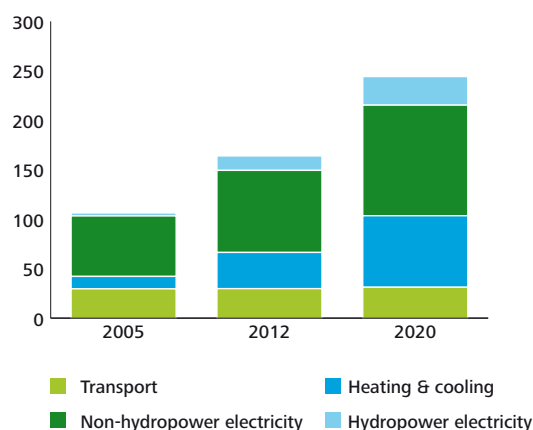
**Figure 13. EU-28 electrical energy in final energy consumption 1990-2012 (Mtoe) (%)<sup>31</sup>**



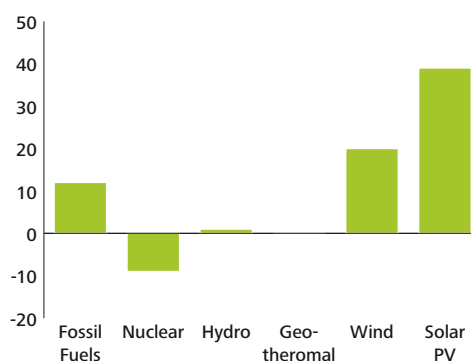
**Figure 14. EU-28 GHG emissions by sector 1990-2012 (MtCO<sub>2</sub>eq)<sup>32</sup>**



**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<sup>33</sup>**



**Figure 16. EU-28 change in electricity capacity source 2010-2012 (GW)<sup>34</sup>**



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 Eurostat. © European Union, 1995-2014: <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

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 Eurostat. © European Union, 1995-2014: [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg\\_113a&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?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 <sup>35</sup> )
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<sup>36</sup> – 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))<sup>37</sup>. 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<sup>38</sup>. Upgrading the interconnection capacity at EU level is perhaps what should have been started with, before thinking about increasing capacities<sup>39</sup>.

35 CHP stands for Combined Heat and Power

36 Power Perspectives 2030: On the road to a decarbonised 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](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](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<sup>40,41</sup> 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.

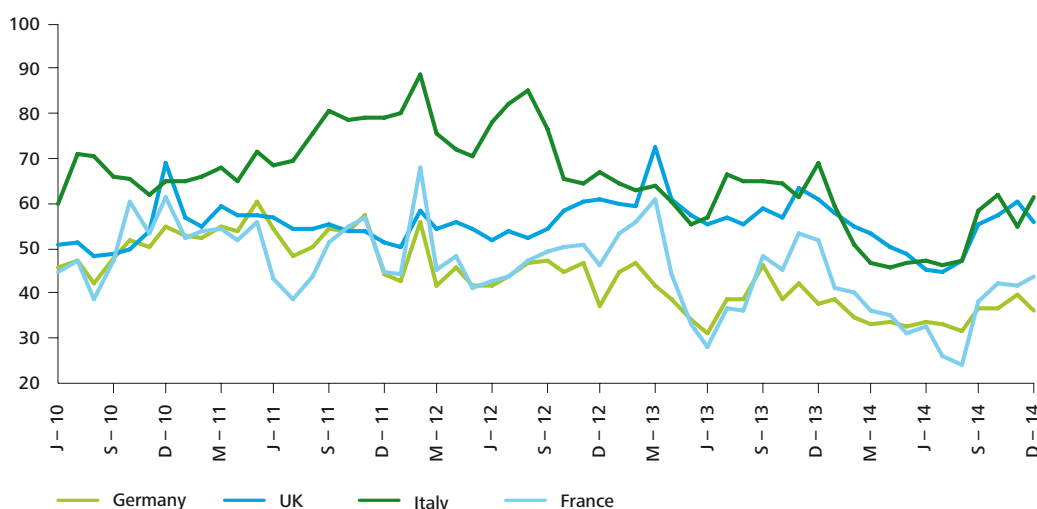
French TSO, RTE, anticipates that the effect of the Industrial Emissions Directive<sup>42</sup> (IED) legislation entering into force in 2016 will be that 3.8 GW of fuel oil-fired power capacity will presumably close. This is in addition to a reduction of 1.3 GW in Combined Cycle Gas Turbine (CCGT) capacity 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<sup>43</sup> (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<sup>44</sup>.

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<sup>45</sup>



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 Magritte Group

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)<sup>46</sup>

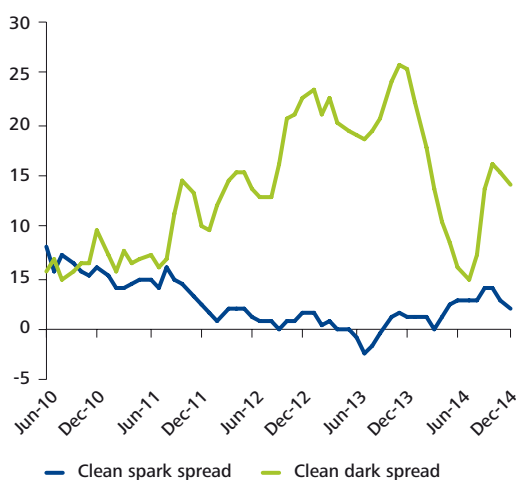
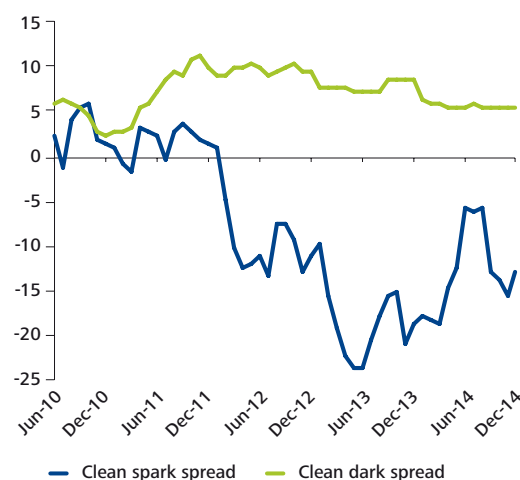


Figure 19. German clean dark and spark spreads (€/MWh)<sup>47</sup>



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

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

As the UK and Germany's Clean Dark and Clean Spark Spreads<sup>48</sup> 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.

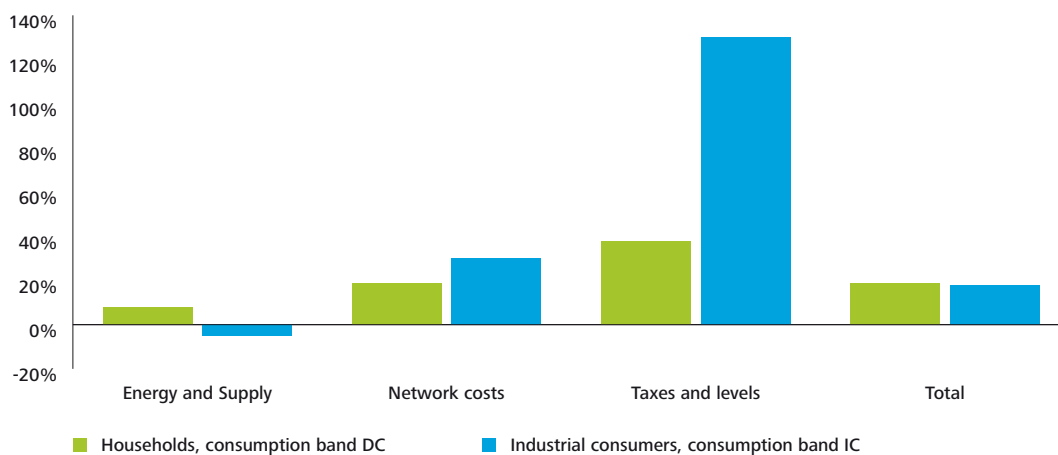
**Estimates of support for renewables show that a high level of public sector support is necessary to balance the cost of renewables:** in Germany, the renewable energy sector is currently subsidised with approximately EUR 19.4 billion per year (EUR 240 per inhabitant in 2014<sup>49</sup>); in Belgium, public sector support to Combined Heat and Power (CHP) and RES amounted to around EUR 1.5 billion in 2013<sup>50</sup>; 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<sup>51</sup>.

#### 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.

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),<sup>52, 53</sup>**



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<sup>54</sup>. 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<sup>55</sup>.

**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 be 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<sup>56</sup>. These tariff deficits will drive further tariff increases in the future.

<sup>52</sup> © 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](http://eur-lex.europa.eu/resource.html?uri=cellar:ba385885-8433-11e3-9b7d-01aa75ed71a1.0001.01/DOC_1&format=PDF)

<sup>53</sup> 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).

<sup>54</sup> EPEX Spot

<sup>55</sup> EPEX SPOT – Powernext

<sup>56</sup> 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 2000 and 2012.

Figure 21. EU-28 energy intensity 2000-2012<sup>57</sup>

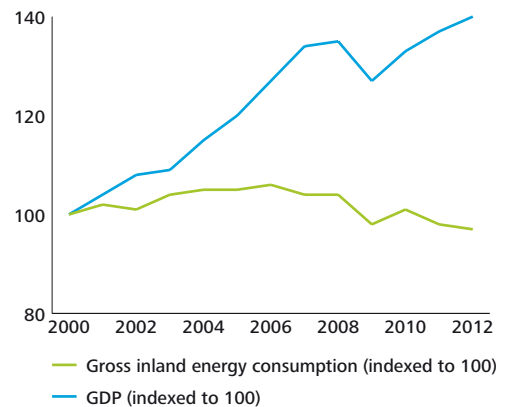


Figure 22. EU-28 GHG emissions per inhabitant 1990-2010 (tCO<sub>2</sub>eq/inhabitant)<sup>58</sup>

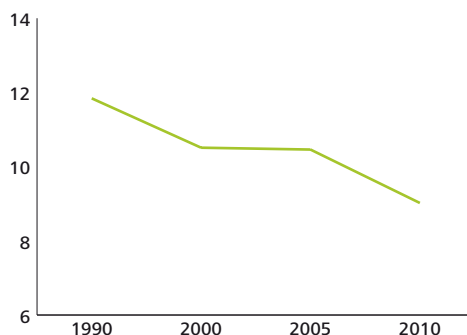
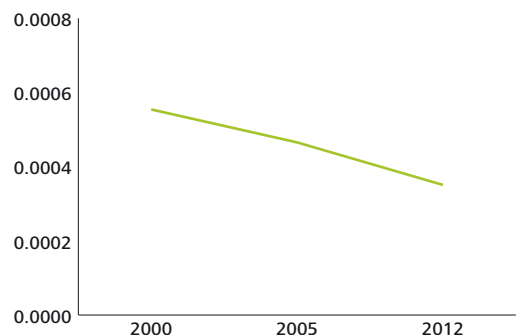


Figure 23. EU-28 GHG emissions per euro of GDP 2000-2012 (tCO<sub>2</sub>eq/€)<sup>59</sup>



<sup>57</sup> Eurostat. © European Union, 1995-2014: <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>

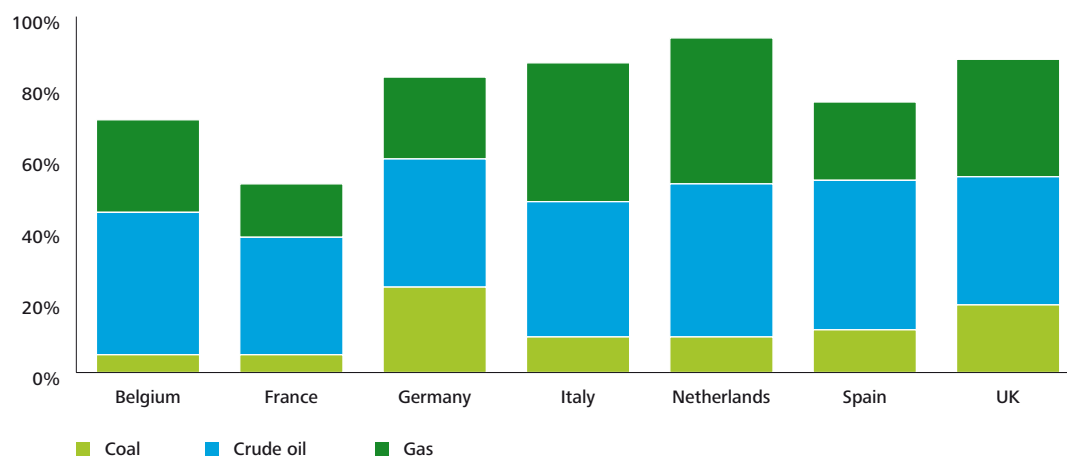
<sup>58</sup> Calculations based on Eurostat data; Eurostat. © European Union, 1995-2014: [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_air\\_gge&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_air_gge&lang=en); [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo\\_pjan&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_pjan&lang=en); [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama\\_gdp\\_c&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_gdp_c&lang=en)

<sup>59</sup> Eurostat. © European Union, 1995-2014: <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<sup>60</sup>



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<sup>61</sup>. 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<sup>62</sup>**. However, government policies are also keen on limiting the tax hit on industries in order to protect Europe's ailing competitiveness<sup>63</sup>.

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

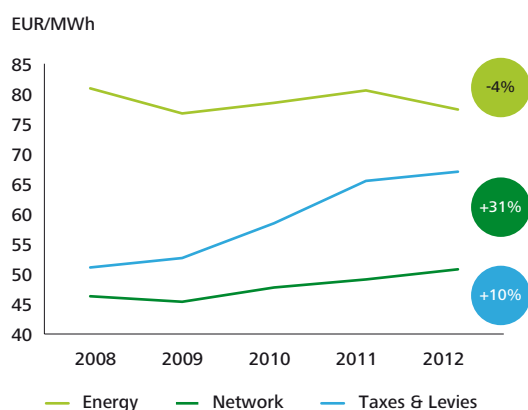
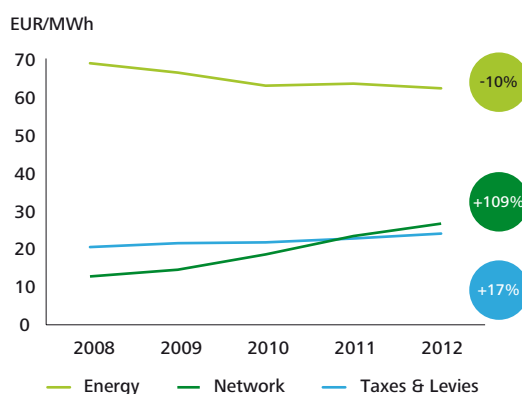


Figure 26. Evolution of European average industrial price components (in €/MWh) between 2008 and 2012



60 Eurostat. © European Union, 1995-2014, <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](http://www.eurelectric.org/media/131606/prices_study_final-2014-2500-0001-01-e.pdf)

63 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](http://www.cep.eu/Analysen/COM_2014_21_Energiepreise/Staff_Working_Document_SWD_2014_20.pdf)

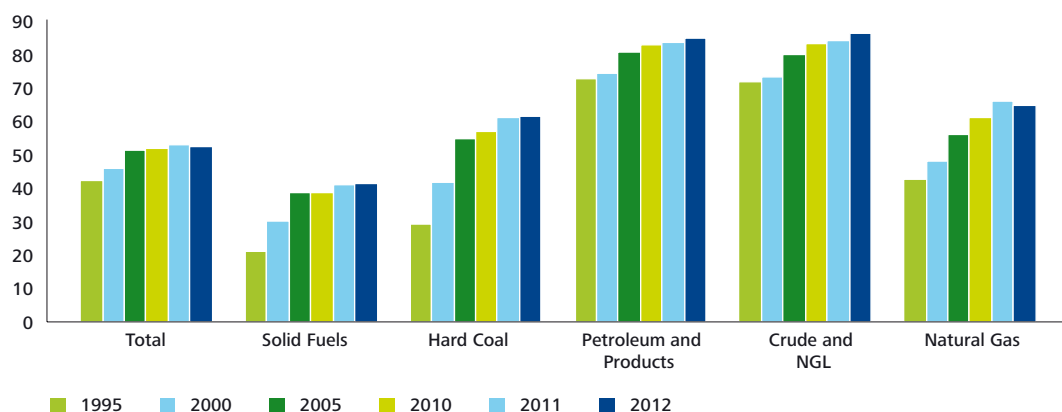


### • Security of supply?

**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))<sup>64</sup>**



<sup>64</sup> Eurostat data in EU Energy in figures. Statistical pocketbook 2014. © European Union, 2014 [http://ec.europa.eu/energy/sites/ener/files/documents/2014\\_pocketbook.pdf](http://ec.europa.eu/energy/sites/ener/files/documents/2014_pocketbook.pdf)

<sup>65</sup> 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)

<sup>66</sup> 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](http://www.cdcclimat.com/IMG/pdf/14-05_climate_report_no44_-_analysis_of_the_kp-2.pdf)

The security of energy supply in an increasingly dependent EU also relies upon a diversification of energy suppliers and routes, in addition to 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<sup>65</sup>.

This surplus today represents up to 7 billion tons of CO<sub>2</sub> credits<sup>66</sup> (around two thirds of one year of CO<sub>2</sub> 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<sub>2</sub> 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.

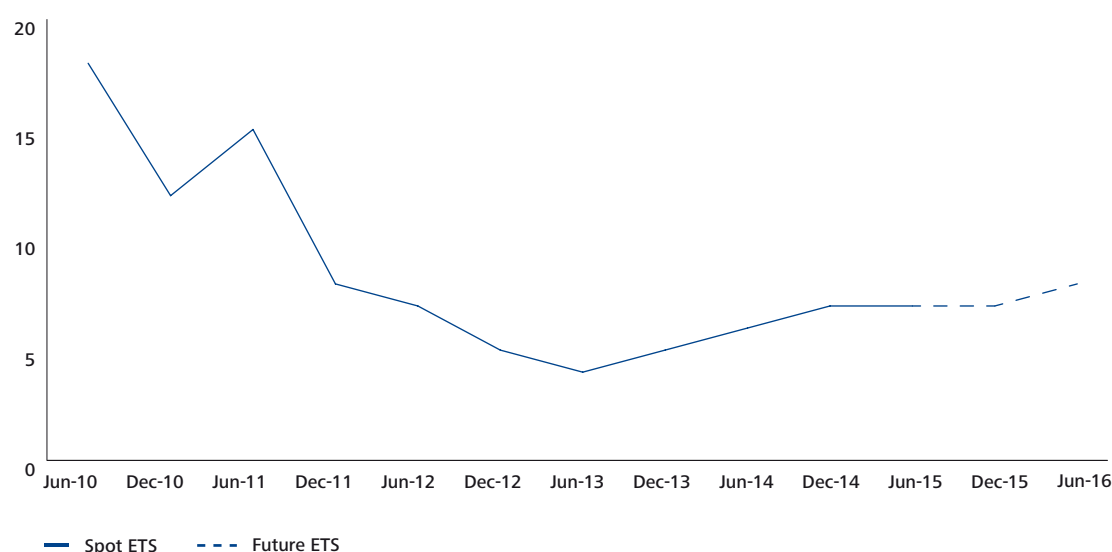


In spite of the EC's decision to back-load most of the surplus within the Reserve Margin Mechanism starting in 2021, the carbon price signal could stay low across the EU for the foreseeable future and fail to support the financing of the transition to a low carbon economy.

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<sub>2</sub> 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<sub>2</sub> allowances on the ETS (€/ton)**



During the very early years of carbon trading, most analysts and brokers were forecasting an average CO<sub>2</sub> 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<sub>2</sub> 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<sup>67</sup>.

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)<sup>68</sup>

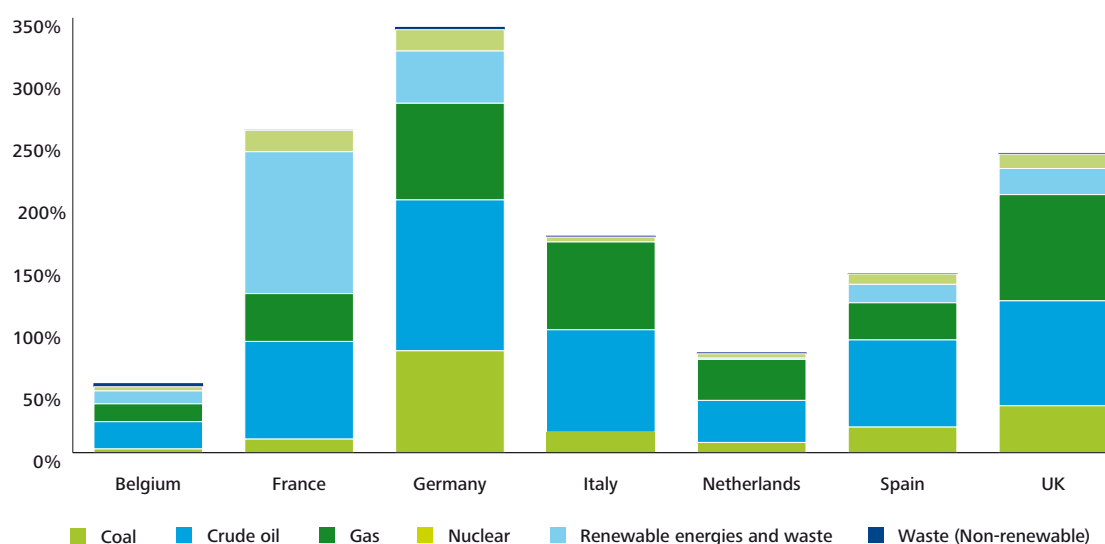
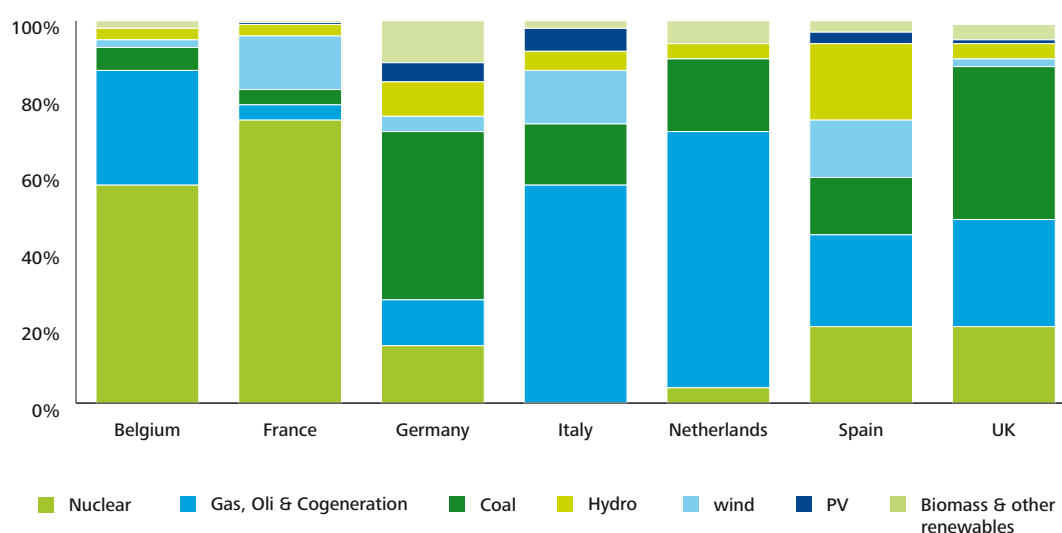
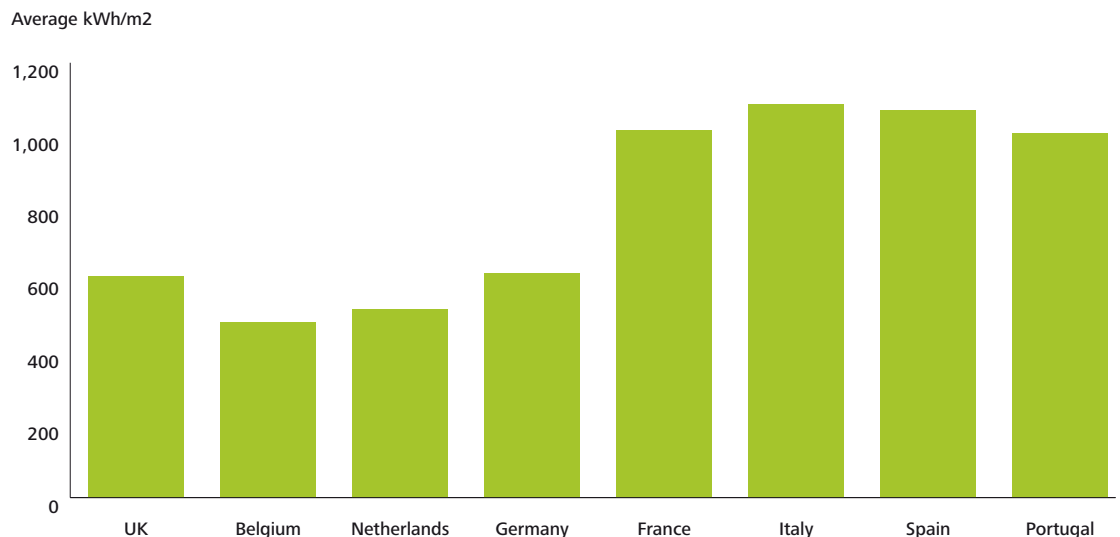


Figure 30. 2012 Power production mix in seven countries (percentages of generation)<sup>69</sup>



68 Source: Eurostat. © European Union, 1995-2014: <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/m<sup>2</sup>)<sup>70</sup>**

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.

<sup>70</sup> 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/solreurope.htm>

<sup>71</sup> 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>

**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'<sup>71</sup>, 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'<sup>70</sup>, 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.





### 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<sup>72</sup>, 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](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 <sup>73</sup>	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 <sub>2</sub> 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 <sub>2</sub> 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

<sup>73</sup> 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 <sup>73</sup>	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 <sup>74</sup>	Challenges
State Aid <sup>73</sup>	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. <sup>75</sup>	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.

74 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.

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.



### 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)<sup>76</sup>. 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<sup>77</sup> 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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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<sup>78</sup>, 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<sub>2</sub> 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)<sup>79</sup>. 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<sub>2</sub> 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.

<sup>78</sup> EEA (2014), Trends and projections in Europe 2014

<sup>79</sup> 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)<sup>80</sup>.

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”<sup>81</sup>. 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 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](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](http://ec.europa.eu/priorities/energy-union/index_en.htm)

# List of acronyms

BAU:	Business as usual	FEC:	Final Energy Consumption <sup>82</sup>
CAGR:	Compound annual growth rate	FQD:	Fuel Quality Directive (Directive 2009/30/EC)
CER:	Certified Emissions Reductions	GHG:	Greenhouse Gas
CCGT:	Combined Cycle Gas Turbine	IEA:	International Energy Agency
CCS:	Carbon Capture and Storage	IED:	Industrial Emissions Directive (Directive 2010/75/EU)
CHP:	Combined Heat and Power	IPP:	Independent Power Producers
CPS:	Carbon Price Support	LCPD:	Large Combustion Plant Directive (Directive 2001/80/EC)
CSP:	Concentrated Solar Power	MS:	Member State
CSPE:	Contribution au service public de l'électricité (France)	PEC:	Primary Energy Consumption <sup>76</sup>
EC:	European Commission	PV:	Photovoltaic
EE:	Energy Efficiency	RED:	Renewable Energy Directive (Directive 2009/28/EC)
EEA:	European Environment Agency	REN:	Renewable energy
EED:	Energy Efficiency Directive (Directive 2012/27/EU)	RES:	Renewable energy source
EEG:	Erneuerbare-Energien-Gesetz (Germany)	SDE+:	Stimuleren Duurzame Energieproductie (Netherlands)
EII:	Energy-Intensive Industries	toe:	Ton of oil equivalent
ERU:	Emission Reduction Units	TSO:	Transmission System Operator
ESD:	Effort Sharing Decision	UK:	United Kingdom
ETS:	Emissions Trading System	UNFCCC:	United Nations Framework Convention on Climate Change
EU:	European Union		
EU-28:	European Union, 28 Member States		
EUA:	EU Allowance Unit (under the ETS)		

<sup>82</sup> 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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