Lessons learnt from the current energy and climate framework

A REPORT PREPARED FOR BUSINESSEUROPE

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This report contains the results of research by Frontier Economics and is not to be perceived as the opinion of BUSINESSEUROPE.

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List of Abbreviations

ARA – Amsterdam-Rotterdam-Antwerpen Area

CAPEX – Capital Expenditures

CCS – Carbon Capture and Storage

CEER – Council of European Energy Regulators

DECC – Department of Energy and Climate Change

EEA – European Economic Area

EED – Energy Efficiency Directive

EEX – European Energy Exchange

EUA – European Emissions Allowance

EU ETS - European Emissions Trading Scheme

FIT – Feed- in Tariff

GDP – Gross Domestic Product

GHG – Greenhouse Gas

NCG – Net Connect Germany (Gas Hub)

NBP – National Balancing Point (Gas Hub)

NREAP – National Renewable Energy Action Plan

OPEX – Operating Expenditures

PSO – Public Service Obligation

MWh - Megawatthour

RGGI – Regional Greenhouse Gas Initiative

RES-E – Renewable Electricity Sources – Electricity Sector

RES-H – Renewable Electricity Sources – Heating Sector

RES-T – Renewable Electricity Sources – Transport Sector

RQS – Renewable Quota Scheme

TSO – transmission System Operator

TWC - Tradable White Certificates

WACC – Weighted Average Costs of Capital

Executive Summary

Background of the project and this report

In March 2013, the European Commission launched a public debate on the future of EU's energy and climate policies with the publication of a Green Paper on a 2030 Framework for Climate and Energy Policies. Undoubtedly, future energy and climate policy will be a crucial component of the EU's industrial competitiveness. BUSINESSEUROPE is therefore preparing policy recommendations on what the 2030 framework should look like.

This report is an input to the work of BUSINESSEUROPE in the preparation of its policy recommendations for a 2030 framework for climate and energy policies. The purpose is to provide facts on key areas and to explain the main impacts of the current energy and climate policy in Europe.

Key findings – current energy and climate policies

Our analysis of the current policy framework has identified that:

- **Current EU energy and climate policy design is inconsistent and inefficient** – At EU level, three important climate policy targets (the so called 20-20-20 targets) have been defined so far. The current policy for framework setting is critical since it contains:
  - an imbalance between policy objectives – The fact, that all of the defined 20-20-20 targets are logically linked to environmental sustainability, to the exclusion of competitiveness and security of supply, tends to induce an imbalance of policy measures towards the objective of environmental sustainability;
  - a failure to coordinate targets – The 20-20-20 targets are not coordinated: It would be a coincidence if the 20% emission reduction was met with exactly 20% RES (renewable energies) share and an energy efficiency improvement of 20%. In fact, todays situation shows that the EU is on track (or even ahead) of achieving the 20% emission reduction target while at the same time the energy efficiency targets are missed;
  - inconsistency of instruments – By promoting renewable power generation (RES-E) in combination with a volume cap on CO_2 emissions (EU ETS), renewable power has no incremental impact on emissions reduction. Instead,
    - overall carbon avoidance costs are increased by building expensive RES-E technologies, while at the same time….

- other low cost avoidance options within the conventional power generation or industrial sectors are not used since those market participants only receive the weak EU ETS price signal diluted by the impact of RES-E promotion.

- **High cost impact of RES promotion** – The additional cost burden for financing RES-E promotion is the main cost driver for society. The net support (payments to RES-E above wholesale prices for the delivered electricity) is expected to increase to about 50 bn. EUR/a in 2020. This number does not include additional costs arising from strong RES-E growth such as:
  - additional costs in the conventional power plant park which is operated in a less efficient way; or
  - the costs of required grid extensions[1].

- **Internal European energy market is distorted** – National legislation and policies applied by Member States result in distortions to the internal energy market. While different national energy mixes (and prices) can be explained by differences in the resource base or demand, national policies also play a crucial role: National energy taxes, promotion schemes, exemption rules and grid regulation may all distort the internal energy market.

- **Energy prices for European industry are a competitive disadvantage compared to US competitors** –Industrial energy prices in the US are on average significantly lower than in Europe. There are indications that especially lower prices for gas and coal are the main drivers for this cost advantage. Therefore, US industry already has a "head start" in global markets – this means that any additional cost burden on the European industry will impact its competitiveness.

1 The so called "merit order effect" is also not included. The merit order effect of RES-E refers to the impact of RES-E in-feed which tends to lower electricity wholesale prices at the power exchange. So RES-E in-fed tends to reduce the wholesale prices in some hours but increases total cost of electricity supply.

1 Introduction and objectives

1.1 Background to the energy and climate 2030 study

In March 2013, the European Commission launched a public debate on the future of the EU's energy and climate policy. In this context, the Commission published a Green Paper on a "2030 Framework for Climate and Energy Policies". Undoubtedly, the future energy and climate policy will have a significant impact on the competitiveness of the European industry. BUSINESSEUROPE is therefore preparing policy recommendations on what the 2030 framework should look like.

1.2 Objectives of the report

This report is an input to the work of BUSINESSEUROPE in the preparation of policy recommendations for a 2030 framework for climate and energy policies. The purpose is to provide facts on key areas and to explain the main impacts of the current energy and climate policy in Europe.

The purpose of this report is to provide:

- a description of the current energy and climate policy framework and key inconsistencies,
- an indicative impact analysis on how energy and climate policy affects the European industry, and
- an indicative price comparison of European industry prices with industry power prices in the United States (US).

2 Description and inconsistencies of the current energy and climate policy framework

In order to provide a sound basis for discussions on the future energy and climate policy framework, we have analysed the existing energy and climate framework rules in Europe. In our report, we analyse both the EU level framework as well as developments and rules in selected Member States, which we use as examples of where today's framework requires improvement.

In this chapter, we first analyse the EU level framework and then consider selected examples of the energy and climate policy framework in Member States. Specifically, we:

- describe the main pillars of the EU level energy and climate policy framework.
- address main inconsistencies arising today, including
  - inconsistencies at EU level objectives, targets and instruments;
  - inconsistencies arising from interaction of EU level and Member State level policy targets; and
  - inconsistencies arising from a lack of coordination of individual Member State (national) targets and instruments.

2.1 Description of the EU energy and climate policy framework

2.1.1 Definitions and terms

For clarification, we use the terms objectives, targets and instruments in the following way:

- **Objective** – An "objective" is an important motivating principle for stakeholders when developing energy and climate policy of the EU or a Member State.
- **Target** – A target is a quantitative measure. It indicates to what extent a certain objective is achieved. It can be used to assess if policy makers have overshot, reached or fallen short with respect to their policy objective. An example for energy and climate policy at EU level is the so called 20-20-20 targets on renewable energy, emissions and energy efficiency.

- **Instrument** – This is the administrative tool to incentivise market participants to behave in a way that the measurable targets are reached. The EU Emission Trading Scheme (EU ETS) or renewable promotion schemes like the Renewable Energy Act (EEG) in Germany are examples of instruments.

In the following, we discuss policy objectives and targets at EU level in detail before we address the instruments put in place in order to steer market participants towards a certain target.

2.1.2 Policy objectives and related targets at EU level

Energy policy is still to a large extent the responsibility of individual Member States. Due to the importance of energy supply to the industry and economic prosperity of Member States, national governments are hesitant to give comprehensive powers to the European Commission. The energy mix, for example, is determined by each Member State individually. However, the EU Treaty of Lisbon of 2007 legally includes solidarity in matters of energy supply and changes to energy policy within the ambit of the EU. The "Lisbon Treaty on the functioning of the European Union" (Article 194[2]) names security of supply, competitiveness and sustainability to be the "central goals" (objectives) for energy policy[3].

Since 2006, several directives and communications have been published by the Commission. These include guidelines and principles which need to be transposed by the governments of the Member State into national legislation when defining their national energy policy framework. Therefore, the EU level energy policy is mainly a two-step approach consisting of

- guidelines and principles established by the European Commission at the EU level, and
- national legislation by each Member State in accordance with those principles.

The principles of today's energy policy for Europe were elaborated in the Commission's Green Paper of 2006 "A European Strategy for Sustainable, Competitive and Secure Energy".

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2 Article 194 (1): In the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, Union policy on energy shall aim, in a spirit of solidarity between Member States, to:

(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.

3 See Directorate General Energy (DG Energy) "Energy 2020" (p.4)

As a result of the decision to develop a common energy policy, the first proposals "Energy for a Changing World" were published by the European Commission, following a consultation process in the year 2007. In the year 2010, the Commission has published their strategy for their energy policy for the next decade "***Energy 2020: A Strategy for competitive, sustainable and secure energy***[4]***"***. The document shows that the Commission understands competitiveness, sustainability and security of supply as the key elements of EU energy policy. In order to achieve those three main objectives forming part of their strategy the Commission in particular considered:

- efficient use of energy;
- free movement of energy;
- secure, safe and affordable energy for citizens and businesses;
- making technological shift; and
- strong international partnerships, notably with European neighbours.

Figure 1 shows the key objectives of the EC's energy and climate policy as given by DG Energy within the "Energy 2020" publication.

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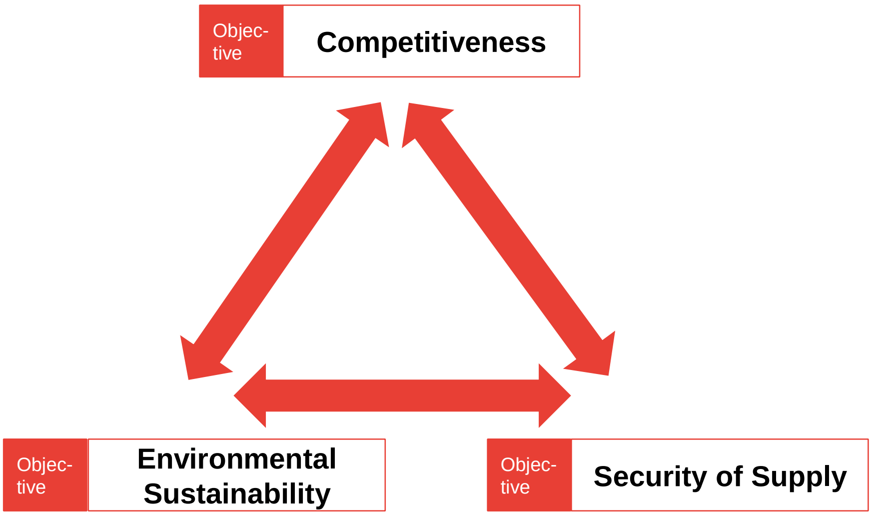
4 The European Commission's Communication "Energy 2020 – A strategy for competitive, sustainable and secure energy (COM(2010) 639). http://ec.europa.eu/energy/strategies/2010/2020_en.htm

Figure 1. Energy and climate policy objectives at EU level – as given by DG Energy (Energy 2020)



Source: Frontier

For some of the policy objectives shown above certain targets are specified which allow policy makers to measure the degree of achievement of their policy with respect to a specific objective. The position with respect to the three objectives set out above is as follows:

- **Environmental Sustainability** – Within its "Energy 2020" strategy the EU has defined the so called 20-20-20 targets which are related to:
  - emission reduction – on EU level, Greenhouse Gas (GHG) emissions in the year 2020 should be 20% below the emissions of 1990 (this relates to all sectors). The emission reduction target is a binding target for Member States;
  - renewable energy share – the EU aims at achieving a share of renewable energy of 20% of final consumption across Europe – this includes the power, transport and heat sectors; and
  - energy efficiency improvement– the EU aims at improving the energy efficiency in Europe compared to a base case projection by 20%. The energy efficiency target is a non-binding target for Member States.
- **Security of Supply** – The EU has not formulated or specified a measurable target for security of supply yet. However, some detailed rules such as safety conditions for offshore oil or gas extraction or a legal framework for nuclear safety are established. No clear rules or principles have been established so far for addressing EU level power plant adequacy or grid supply quality.

- **Competitiveness** – The EU has not formulated or specified a measurable target for competitiveness yet. However, the Energy 2020 Strategy states that it aims at making energy policy more consumer friendly by fostering competition and an internal energy market. The Third Energy Package also aims at this e.g. by implementing stricter rules for unbundling of power generation and network operation or by fostering competitiveness in the retail market by making energy costs more transparent for consumers (tariff information, access to other suppliers, billing, processes for switching suppliers, etc.).

While there are some initial measures aimed at improving security of supply and competitiveness, a comparison of objectives and targets shows that the EU has identified

- three prominent targets (20-20-20) which are primarily linked to the objective of environmental sustainability (while having some impact on competitiveness and security of supply as well); whereas
- the degree of achievement of the remaining two objectives (security of supply and competitiveness) is not supported in a similar way, e.g. by clearly specified EU level targets[5].

In the following, we analyse the three main targets, which have been established, in more detail.

2.1.3 Practical implementation of the 20-20-20 targets (Instruments)

Initially, the 20-20-20 targets were set in March 2007, when the EU committed itself to become a highly energy-efficient, low carbon economy. The targets were enacted through the climate and energy package in 2009[6]. By various legislations (directives, etc.) and communications, the EU has established a set of instruments which provide administrative tools to incentivise market players so that the targets will be met. In the following we look at:

- instruments aiming at achieving the intended 20% emission reduction – primarily the EU Emission Trading Scheme (ETS) as well as non EU ETS measures such as taxes and white certificates;
- instruments aiming at achieving a 20% share of renewable energies (RES) in the primary energy supply – this includes the Renewables Energy Directive as well as some limited guidance on national support schemes for RES-E, and

5 In addition to the targets formulated as part for the energy and climate policy, the EU has defined a target that the industry's share in GDP should be around 20% by 2020.

6 The so called "climate and energy package" from 2009 is a set of binding legislation which aims to ensure the European Union meets its ambitious climate and energy targets for 2020 http://ec.europa.eu/clima/policies/package/index_en.htm

- instruments aiming at achieving a 20% energy efficiency improvement – this includes the Energy Efficiency Directive (EED) as well as the Energy Performance Building Directive.

Instruments related to the 20% greenhouse gas reduction target

The regulations governing the ETS are contained in Directive 2009/29/EC Directive amending Directive 2003/87/EC. The directive improves and extends the Greenhouse Gas (GHG) emission allowance trading scheme of the Community. The target of emission reduction is addressed by different instruments depending on the sector:

- the EU ETS sector (covers most of the emissions from power generation and from industry); and
- the "non EU ETS" sector (covers emissions from smaller power generation and industrial units as well as emissions from commerce, households, agriculture and transport).

About 50% of EU wide GHG emissions are covered by the EU ETS itself. It is worth noting that customers who are not directly covered by a certain instrument can also be affected by its costs: Electricity consuming households, for example, bear the burden of electricity price increases resulting from the EU ETS even though the household sector itself is not covered by the EU ETS.

The European Emission Trading Scheme (EU ETS)

The EU emissions trading scheme (EU ETS) is a cornerstone of the European Union's climate policy and is a key tool aimed at reducing industrial greenhouse gas emissions in a cost-efficient way. The EU ETS covers more than 11,000 power stations and industrial plants in 31 countries, as well as aviation. It covers

- the industry and power sector;
- installations located in the EEA-EFTA region (incl. Norway, Liechtenstein, Croatia);
- emissions from units larger than 20MW; as well as
- aviation (emissions from flights within and between countries participating in the EU ETS (except Croatia until 2014)).

In total, about 50% of the EU's CO_2 emissions (40% of the EU's GHG emissions) are covered by the EU ETS. Total GHG emissions in EU-27 added up to 4,610 Mt of CO_2-equivalents in 2010[7].

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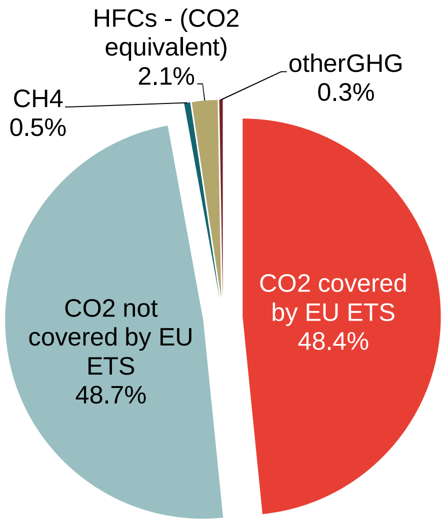
[7] See European Environment Agency (2012).

Figure 2. Share of GHG emissions within the ETS vs. the non EU-ETS sector – Total GHG emissions EU27 in the year 2010 were 4,6 bn. t CO_2 equivalents

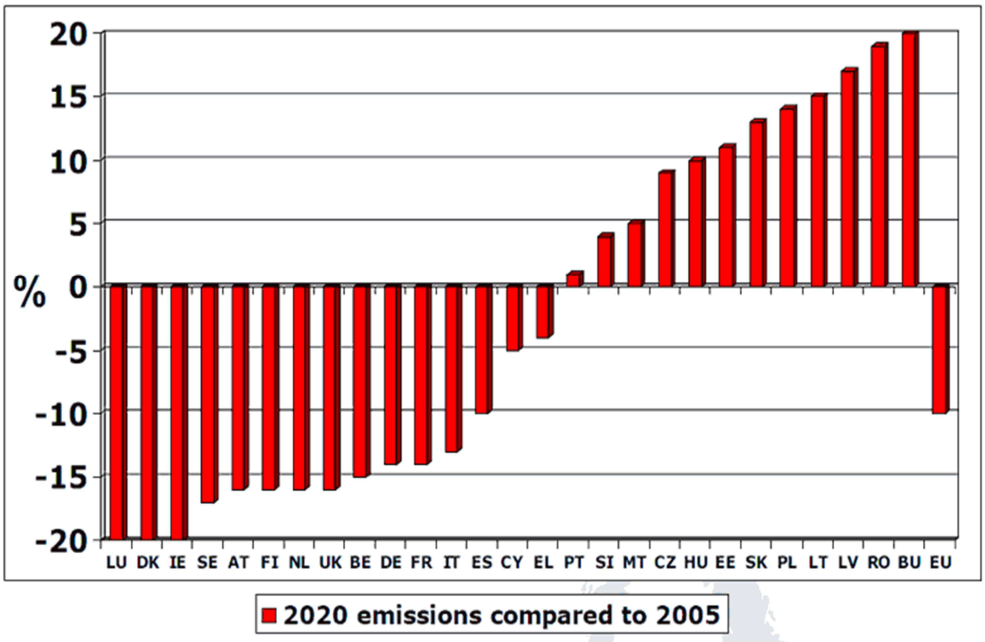


Source: Frontier based on UNFCCC and EEA

Measures applied outside the EU ETS

The remaining 60% of the EU's GHG emissions (50% of CO_2 emissions) are emitted by installations which are outside the EU-ETS and are addressed by several national instruments such as carbon taxes and tradable white certificates. The reduction that should be achieved by each Member State is defined by the Effort Sharing Decision (ESD). The ESD establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020 – see **Figure 3**. These targets are related to emissions from sectors **not included** in the EU Emissions Trading System (EU ETS), such as transport (except aviation), buildings, agriculture and waste. The Effort Sharing Decision forms part of a set of policies and measures on climate change and energy – known as the climate and energy package.

Figure 3. Effort Sharing targets for 2020 compared to 2005 emissions



Source: EC (2012), http://ec.europa.eu/clima/policies/effort/index_en.htm

Each Member State decides on its own national instruments so that the targeted reduction can be achieved. Instruments applied include:

- **Tradable White Certificates** – Tradable White Certificates (TWC) schemes have been implemented in some countries (Italy[8], France, UK) and some other countries are considering their introduction (Denmark, Netherlands). Like the EU ETS, TWC schemes are in principle cap-and-trade systems. Existing TWC schemes often include an obligation for suppliers of electricity, gas or oil to achieve a specific reduction either directly or by purchase of TWCs. In theory, such schemes could be linked to the EU ETS.

- **Carbon taxes** –Some European states have introduced carbon taxes (e.g. Norway, Finland and UK). Other countries have fuel taxes on fossil fuels which are to some extent linked to carbon content but have other important aspects as well. Tax rates are in general higher than current EU ETS prices (e.g. carbon tax rates of 27 EUR/t for households in Sweden, 34 EUR/t for

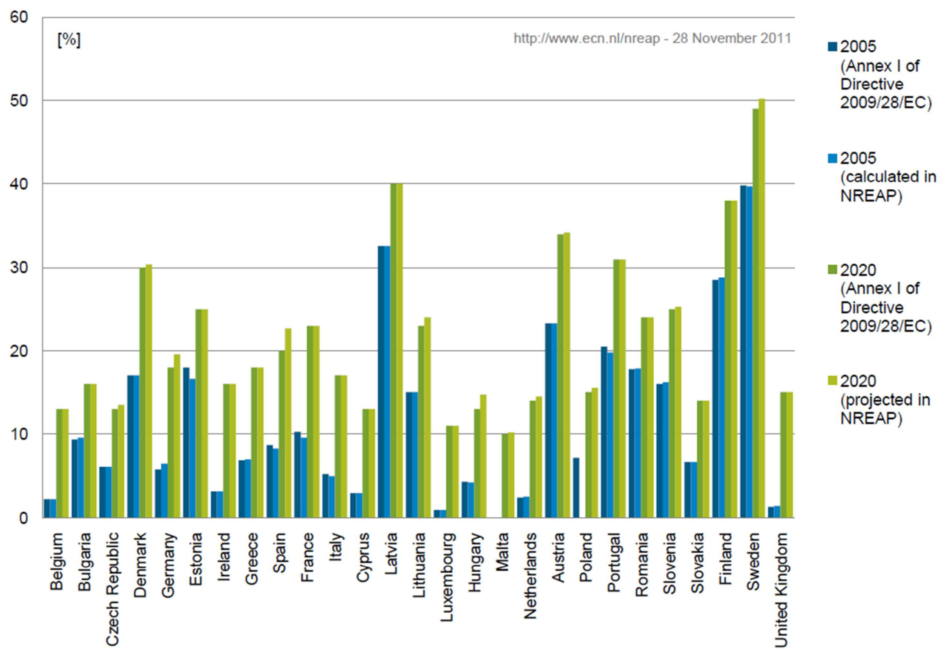
8 In Italy, for example, electricity and gas distributors are required to implement energy saving schemes directed at final customers, e.g. by promoting energy efficient appliances, boilers, insulation, fans etc. In Italy three different certificates exist for electricity, gas and other fuels. More details can be found in a Frontier report "Steigerung von Energieeffizienz mit Hilfe von Energieeffizienzverpflichtungsystemen"

non EU ETS industry[9] in Sweden and between 19 and 46 EUR/t in Norway, depending on fossil fuel type and sector).

Instruments related to the RES target

Directive 2009/28/EC supports the implementation of instruments aimed at achieving the RES target. Article 4 of Directive 2009/28/EC on Renewable Energy requires Member States to submit a National Renewable Energy Action Plans (NREAP) by 30 June 2010. The RES share to be achieved by each Member State is defined by a burden sharing agreement which was based on the technical potential and the economic capability of each Member State. The plans provide detailed roadmaps of how each Member State expects to reach its legally binding 2020 target for the share of renewable energy in their final energy consumption. Each Member State can define its own national support scheme for renewables in the electricity, heat and transportation sector. **Figure 4** shows the existing RES share per Member State for the year 2005 as well as target shares for the year 2020.

Figure 4. RES Burden Sharing per Member State as stated in the NREAP



Source: Frontier based on Energy Research Centre of the Netherlands (2012)

Summing up, the NREAP of all Member States would result in a RES share of about 20%. This is distributed among sectors as follows:

9 DG for Internal Policies (2013) – "Energy Efficiency and the ETS", p. 23.

- Electricity sector – overall, Member States aim at a share of RES-E of 34% by 2020. Main technologies to contribute are expected to be electricity generation from wind power, biomass and hydro power.

- Heating sector – overall, Member States aim at a share of RES-H of 20% by 2020. A main technology to contribute is expected to be heat production from biomass.

- Transport sector – overall, Member States aim at a share of RES-T of 10% by 2020. Main technologies to contribute are expected to be e-cars and biofuels[10].

Member States define national support schemes to incentivize RES investments autonomously. National support instruments and budgets vary significantly between countries.

There are two main alternative mechanisms used by Member States to incentivise investment in RES-E by subsidising electricity production:

- **Feed-in tariff (FIT) or market premium models**: In their simplest form, there are fixed tariffs at which the grid operator to which the RES-E facility is connected is obliged to purchase the RES-E produced for a fixed number of years. Under the market premium model, the renewable generator sells the power produced to the wholesale market and receives a premium on the wholesale power price; and

- **Quota obligation**: In its simplest form, electricity suppliers (and in some cases large customers) are required to purchase renewable certificates which provide evidence that the power had been produced from RES-E facilities. In most cases, the obligation is defined as a "supplier obligation" – meaning that a certain percentage of the load served has to come from RES-E production (suppliers will then be the buyers of certificates). The certificates are issued to RES-E generators who sell these to the market (RES-E generators act as sellers on the certificate market).

Today, a broad range of different schemes is applied in the Member States – sometimes even several schemes are applied within one Member State[11]. **Figure 5** shows that both, volume controlled systems ("Quota systems") and price controlled schemes (Feed-in tariffs, Market price premiums) are used.

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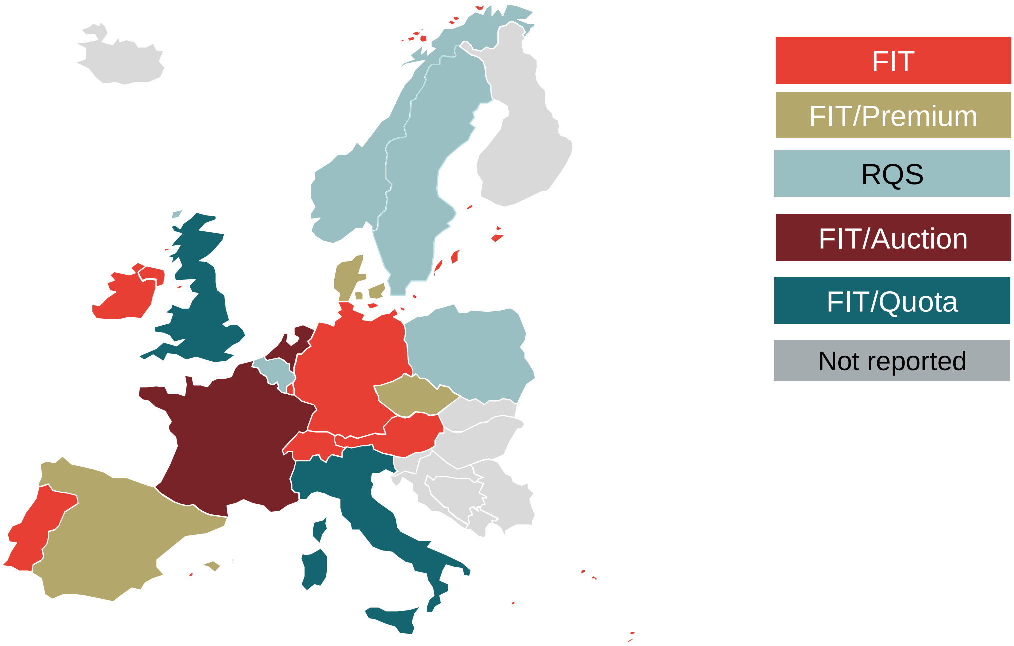
10 Total planned split of technologies can be found in the annex.

11 Germany, for example, has a fixed feed- in tariff and gives RES-E generators an option to opt out into a premiums scheme (and back) on a monthly basis. This increases profits for RES-E generators and cost burden for power consumers.

Figure 5. Overview of RES-E promotion schemes applied across Europe



Source: Frontier based on www.res-legal.eu

In Section 4.3 of Chapter 4 we provide some quantitative analysis on RES-E support budgets today and expectations for the future.

Instruments related to the energy efficiency target

On 25 October 2012, the EU adopted the Directive 2012/27/EU on energy efficiency. This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20% headline target for energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and to overcome market failures that impede efficiency in the supply and use of energy. It provides for the establishment of indicative national energy efficiency targets for 2020.

The Energy Efficiency Directive (EED) was adopted by the European parliament in September 2012 and endorsed by the Council on October 2012. It therefore constitutes the last piece of the current Energy and Climate Package (2009) after the Renewable Energy Directive and the EU ETS. The EED aims at fostering energy efficiency investments so that a further improvement of energy efficiency of 20% will be achieved by 2020 (compared to a base case). The EED formulates non-binding targets for energy efficiency.

Further details about the energy efficiency directive as well as on accompanying directives (the Ecodesign Directive and the Energy Performance Building Directive) can be found in the Annexe.

2.2 Inconsistencies in the current policy framework

We now analyse the main inconsistencies arising from the current energy and climate policy framework. We distinguish between

- inconsistencies at EU level;
- inconsistencies between EU level and Member State level (or between Member States); and
- inconsistencies at Member State level – arising from inefficient tools.

2.2.1 Inconsistencies at EU level

Arising from the overlap[12] of the three 20-20-20 EU level targets and related instruments that we have described, a number of inefficiencies arise. Inefficiencies at EU level are associated with:

- **Inefficiencies of EU-ETS vs. non EU-ETS instruments** – Inefficiencies arise from the fact that different instruments are applied to emissions falling under EU ETS and emissions outside the EU ETS. This point could be addressed by ensuring that the EU ETS carbon price signal is taken into account in the non EU ETS sectors. This does not necessarily mean that the EU ETS needs to be broadened to other sectors - the link could also be done by some form of offsetting approach (similar to the way JI/CDM links project based mechanisms which are originally outside the scope of the EU ETS to the EU ETS).

- **Inefficiencies from ex-ante allocation of reduction efforts to Member States** – Inefficiencies arise from ex-ante allocation of reduction efforts of non EU-ETS targets to Member States. The allocation to Member States burden sharing is based on parameters like GDP and political considerations – since the allocation is not clearly orientated at avoidance costs or avoidance potentials this "politically determined burden sharing" results into cost inefficiencies since some countries with relatively expensive avoidance options and higher "burden shares" might have to realize those expensive options whereas other countries would have had additional cheap avoidance potential in addition to their burden share – which then might end up being unused.

- **Inefficiencies from separate promotion of some low carbon technologies –** Another cost inefficiency arises from the fact that separate promotion of some low carbon technologies (RES, energy efficiency investments) distorts the market for those technologies which – at the same

12 By defining three 20-20-20 targets which address strongly linked topics the EC has "overdefined" the reduction

time – are meant to compete under the EU ETS. Both energy efficiency regulations and RES promotion lead to distortion and result in an over prioritisation of energy efficiency measures and RES- E technologies compared to other carbon avoidance options. Applying a combination of volume based approaches (EU ETS) to the power sector and - at the same time – promoting RES-E generation in parallel leads to a strong distortion of the EU ETS. The combination or EU ETS and RES-E support implies:

- additional costs for the energy system due to the large scale use of expensive RES-E; while
- **no extra tonnes of carbon emissions are avoided by means of RES-E promotion since the emission volumes are fixed by the EU ETS cap**. In fact, EUA price signals to avoid carbon in the "conventional technology area" (conventional power generation, energy efficiency gains in industry sector) are weakened by the RES-E promotion.

The inconsistency between RES-E promotion and the EU ETS would be less important if the impact was low or if RES-E had been a cheap avoidance option. However, this is not the case. We have carried out an indicative analysis on:

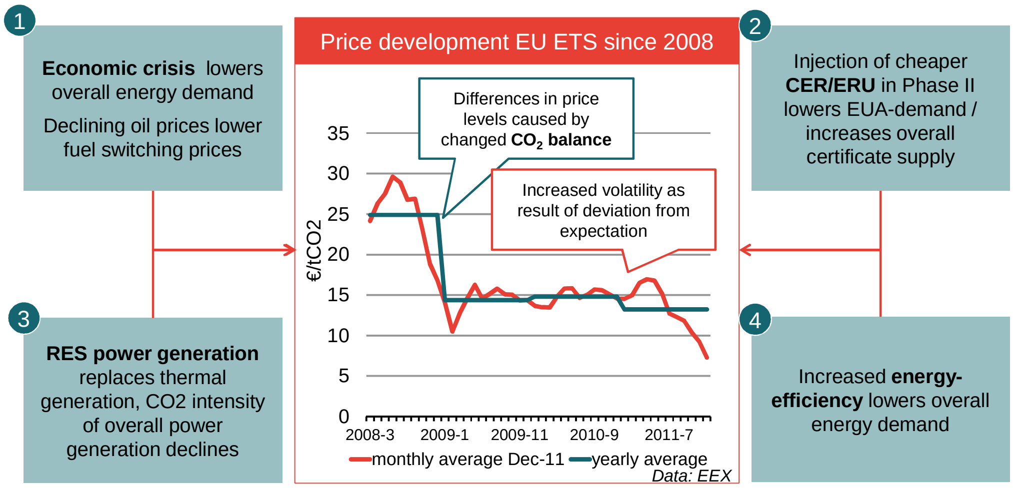
- **the impact of RES-E on emission volumes** – we analysed main drivers that resulted in the low EUA price levels observable today, and
- **the carbon avoidance costs for RES-E** – we analysed carbon avoidance costs by means of RES-E.

Impact of RES-E promotion on emission volumes

In order to estimate the impact of RES-E promotion in Europe on the emission volume, we analysed the following EU ETS market drivers, shown in **Figure 6** with the historic development of carbon prices:

- Economic growth – economic growth is an indicator for industrial production and driver of electricity demand. In a situation of an economic crisis, power demand tends to be low and emissions from industrial activity are lower due to lower production levels;
- RES–E generation – subsidised RES-E generation replaces conventional power generation based on fossil fuels - this lowers carbon emissions;
- Energy efficiency measures – increasing energy efficiency in the EU ETS sector result in lower energy demand – and thus lowers demand for carbon emitting generation; and
- Flexibility mechanism – a significant use of the flexibility mechanism (JI/CDM) effectively increases the supply of allowances within the EU ETS and therefore tends to lower carbon prices.

Figure 6. Development of EUA prices 2008 to 2012



Source: Frontier Economics based on EEX price data

Today's surplus of allowances is approximately 1 billion EUA (EC commission paper: State of the carbon market, 2012).

We estimated the impact of each driver on the scarcity of certificates within the EU-ETS[13]. **Figure 7** summarizes the analysed drivers, key assumptions as well as the indicative estimate for each driver.

13 We compare real outcomes of the time period 2009-2011 with expectations in the years 2005-2007, when the emission caps had been set.

Figure 7. Logic applied to our analysis – and indicative estimate for each driver

	background	counterfactual	Calculation of emission	Indicative estimate
1 **Economic crisis**	• Economic crisis lowers energy demand	• GDP-expectation in 2008/9 (we use 2008 IMF GDP projections)	• GDP difference to expectation combined with declining emission factor (-5%/a)	• Reduced CO2 certificate demand of ~ **871 mn t CO2 during '09-'11**
2 **CER/ERU**	• Decreased EUA demand due to JI/CDM measures (CER/ERU)	• We assume that CER/ERU availability was anticipated in 2008	• Difference of submitted CER/ERU to assumed CER/ERU expectation	• Reduced CO2 certificate demand of ~ 99 mn t CO2
3 **RES power generation**	• Nationally promoted RES genera-tion lowers CO2 intensity	• We assume that some increase in RES was anticipated in 2008	• Difference of 2007 EU projections of RES-E share to observed RES	• Reduced CO2 certificate demand of ~ 105 mn t CO2
4 **Energy-efficiency**	• Increase in energy efficiency by energy demand	• Potentially not accounted in CO2 cap definition	• Probably very little influence on past price decline due to short time period	• Higher importance for future caps

Source: Frontier Economics

The main driver of the EUA surplus is the economic crisis. A further significant impact is the use of CDM/JI as well as RES promotion:

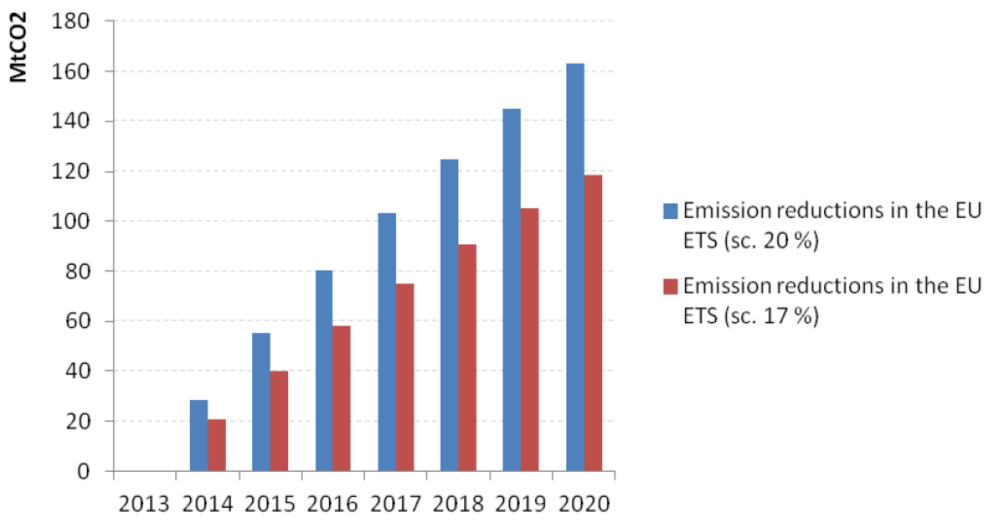
- **Economic crisis** – We compare the forecast for economic growth 2008/2009 for the period 2009-2011 with real outcomes in that time period. We take also an improvement in emission intensity of 5%/a into account (t CO_2 emitted per EUR GDP). The **economic crisis is the main driver for the EUA surplus – our estimate reveals that about 900 mt of CO_2 surplus result from economic crisis.**

- **Flexibility mechanisms (CER/ERU)** – Some oversupply can result from extensive use of project based flexibility mechanisms (CER/ERUs coming from CDM or JI projects). We assume that a certain degree of CER/ERU had been anticipated when setting the EUA caps. **Following our logic, about 100 mt of CO_2 surplus comes from the use of CER/ERU between 2009 and 2011.**

- **RES promotion** – We assume that some increase in RES-E generation had already been anticipated when setting the emission caps 2009 – 2011 (based on EU Energy Trends 2007). We then compare the actual outcome of RES-E generation with earlier projections and conclude that about 100 mt of the CO_2 surplus come from overshooting the anticipated RES-E growth. If we do not assume any RES-E growth (e.g. in a world without separate RES-E promotion) **the RES-E induced CO_2 surplus would have been in the range of 105 mt CO_2.**

- **Energy efficiency** – We have looked at the impact of the Energy Efficiency Directive on the CO_2 supply/demand balance. For the past, we assume that the EED impact is rather low since the EED (or previously the Energy Service Directive[14]) mainly[15] addresses measures which are outside the EU ETS (e.g. housing). While a separate promotion of energy efficiency measures within the EU ETS sector will - once it is effectively triggering investments – induce similar distortions to the EU ETS as the RES-E promotion today, the current distortive impact of the EED (or Energy Service Directive respectively) on the EU ETS is relatively low compared to RES-E distortion. **However, this could change in a situation with strong and effective parallel support for certain energy efficiency measures.** The Commission estimates that the binding measures under the EED would reduce primary energy consumption by around 17% across the ETS scope until 2020 (EU, 2012). **This would correspond to approx. 450 mt CO_2. If the 20% target was reached the emission reduction would be 650 mt CO_2 (see Figure 8)**.

Figure 8. Annual emission reduction impact from the EED on CO_2 emissions across the ETS



Source: European Parliament DG Internal Policies (2013) based on Berghmans (2012)

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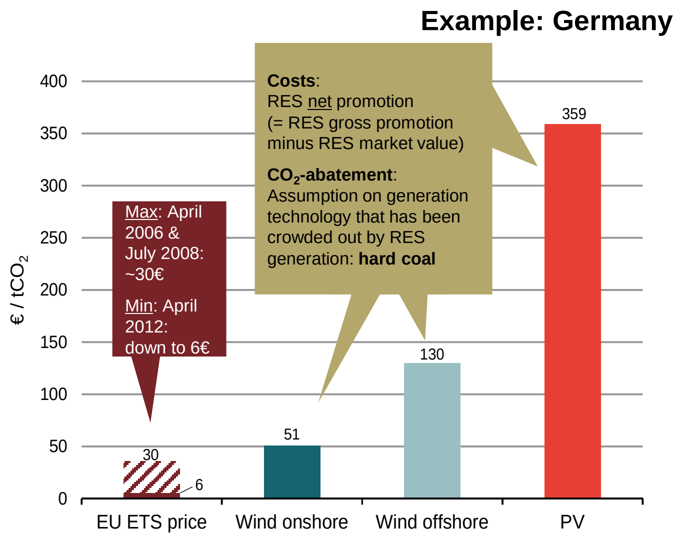
14 Directive 2006/32/EC of 5 April 2006 on Energy end-use Efficiency and Energy Services and repealing Council Directive 93/76/EEC

15 The EED also covers the power industry (e.g. 1.5%/a target) as well as the manufacturing installation (CHP). Industry is, in general, exempted but those exemptions are subject to caps.

In order to show that RES-E is not only a rather expensive option to produce electricity but also a rather expensive option to avoid carbon emissions, we compare RES-E support costs with observed EU ETS prices. Carbon avoidance costs for selected RES-E technology in Germany support this view (see the **Figure 9** below). Carbon avoidance by means of PV costs more than 300 EUR/t (2012 PV costs). Even offshore wind is a very expensive carbon avoidance option relative to historic carbon prices in the ETS.

Figure 9. RES-E support costs compared to historic EU ETS prices for carbon[16]



Source: Frontier Economics based on 2012 EEG feed-in tariffs and EEX price data for Germany

We estimated carbon avoidance costs on the following (conservative) basis:

- **Hard coal will be displaced** - RES-E generation replaces a certain type of conventional, carbon emitting generation ("the counterfactual"). As counterfactual, we assumed a coal plant with an efficiency of 40% and a carbon content of coal of 0.34 t/MWh_th (corresponds to 0.85 tCO_2/MWh). This is a rather carbon intensive counterfactual - meaning that carbon avoidance costs estimated for RES-E tend to be optimistic.
- **Additional costs per RES-E technology** – we look at additional costs for RES-E compared to general wholesale base price level of 50 EUR/MWh, taking into account the feed-in profile of the respective RES-E technology (PV: 1.28, Wind: 0.88). Indicative costs of RES-E technology are estimated using German EEG feed-in tariffs (Q1 2012

16 The observed EU ETS prices can be interpreted as a cost estimator of carbon avoidance. The support costs for wind onshore, offshore and PV have been derived by comparing official feed-in tariffs from the EEG 2011 assuming a wholesale power price of about 50 EUR/MWh and a carbon efficiency of 850g/kWh_el for the substituted thermal generation (e.g. hard coal, 40% efficiency) – so this are rather conservative assumptions.

tariffs). Wind onshore costs are estimated at about 90 EUR/MWh, costs of offshore wind at about 160 EUR/MWh and costs of PV at about 350 EUR/MWh.

- **EUA prices** - As a proxy for avoidance costs for other low carbon options, we refer to observed EUA prices which historically varied between 4 and 30 EUR/t. EUA prices are not necessarily the pure costs of certain CO_2 avoidance options, but it can be used as a rough indicator for avoidance costs in the sectors covered by the EU ETS.

2.2.2 Inconsistencies between EU level and Member State level policies

In addition to inconsistencies coming from overlap of EU level targets and EU level instruments, the transfer of EU level targets to Member States and implementation by Member State can also result in inefficiencies. We have identified the following areas of:

- **Inconsistencies if EU level targets do not match the sum of Member State targets** – inefficiencies may arise if Member States define national targets that are not fully in line with EU level targets (e.g. for the RES share, emission reduction or energy efficiency) – and burden sharing between Member States is not adapted accordingly. Practical examples are:
  - Germany – the German government has defined a 40% emission reduction target by 2020, regardless of what is decided elsewhere within the EU or internationally (the EU level 20% emission reduction target is conditional and would go up to 30% if an international agreement were achieved);
  - Germany – the Renewable Energy Act states that the RES-E share of German power generation should increase to 50 % by 2030, 65 % by 2040 and 80 % by 2050 – even though there are no EU level RES-E targets defined for post 2020 yet.
  - Denmark – in its energy and climate policy, Denmark has formulated the target to increase the share of renewable energy sources to 100% for the electricity, heating and transport sector by 2050.[17]
- **Inconsistencies from differences between national instruments**[18] – Differences in national energy and climate policies distort the level playing field for industry within Europe. In particular, national RES-E promotion schemes result in inefficient installations per Member State resulting in:

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17 http://www.ens.dk/en-US/policy/danish-climate-and-energy-policy/Sider/danish-climate-and-energy-policy.aspx

18 Details see chapter . for differences in national energy mixes or chapter 4 for further details on different industry power prices across Member States.

- inefficient investment decisions by Member States and inefficient development of RES-E potential – this means, for example, that investors aim at allocating their RES-E investment in those countries with the highest support in Europe, not with the best site conditions. The PV installations in Germany are a good example of this logic – with utilisation rates of about 900 full load hours per year, Germany would not be among the best PV sites in Europe, however, Germany is still the country with the highest PV capacity among Member States.
- distortion of power prices (wholesale and industry level) – different national RES-E levels result in different national support budgets to be paid by national consumers. This means that consumers in Member States with very high (and very expensive) RES-E pay more than in other Member States. At the same time wholesale market prices are strongly influenced by infeed from subsidized RES-E.

- **Inconsistencies from inefficient national instruments** – Apart from the distortions due to differences in promotion regimes across Europe, the applied promotion scheme in itself may be inefficient in Member States, e.g. if Member States promote very expensive RES-E technologies (PV in Italy, Spain, Germany or small biomass in Germany) total costs of RES-E generation increase in those countries. Cost inefficiencies arise from national policies – and are not necessarily driven by the EU policy framework.

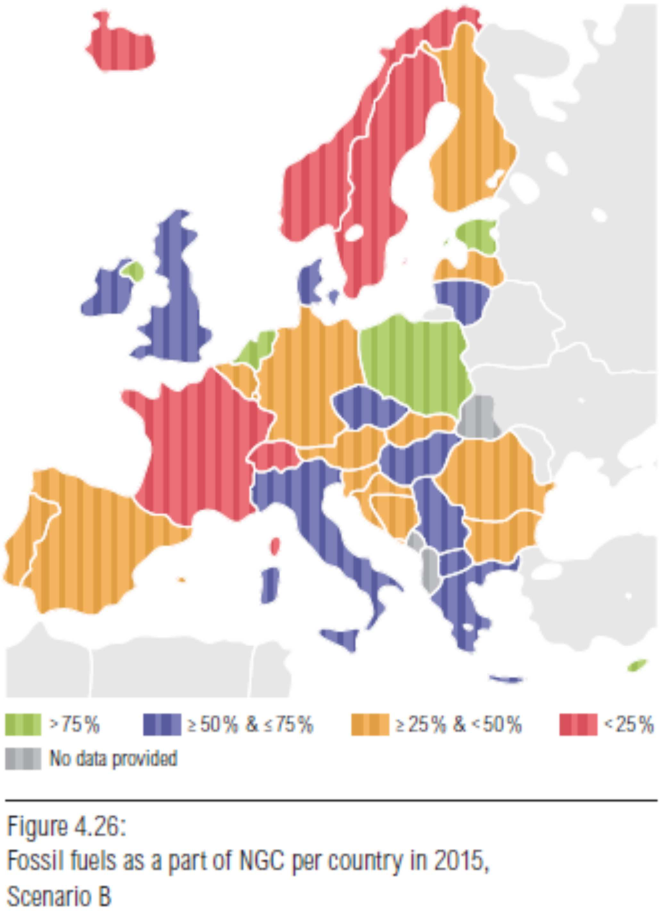
3 Impact of energy and climate policy on the internal energy market

3.1 Distortions from national energy and climate policies

In addition to distortions coming from different non EU ETS instruments and from different national renewable support schemes, further inconsistencies of the national energy and climate policies distort the level playing field for the European industry and power consumers in Europe and thus the internal energy market. This includes:

- **Differences between energy policies of individual Member States –** Each Member State has the right to decide on its own national energy mix. While the EU legislation can provide some guidelines (e.g. rules for nuclear safety, RES-E share or unbundling rules), the final call is with the government of each Member State. Experience shows that national energy mixes are very different among Member States – which is driven by the resource situation in each country as well as by policy decisions see **Figure 10** for data on the share of fossil fuels. Prominent examples for this are
  - nuclear policies – While some countries (e.g. Poland, UK, France or Czech Republic) aim at building new nuclear power plants, other Member States are decommissioning their existing plants (Germany, Switzerland) or continue to reject the technology (e.g. Austria, Italy).
  - coal plant policy – While most countries allow for coal plant generation, other countries explicitly reject coal plant investments (e.g. Switzerland) or indirectly stop coal plant investments by setting very ambitious emission standards (e.g. UK).
  - CCS policy – A similar distortion results from CCS policy - while the UK and Spain are in favour of this technology, other countries are very reluctant (e.g. Germany).

Figure 10. Share of fossil fuel based generation by Member State in the year 2015



Source: ENTSO-E (2012)

- **Different wholesale market designs** – In addition to differences in national energy mixes, the market framework setting the rules for trading and grid access shows major differences which distort the internal energy market. These can include:
  - differences in gate closure times in the power markets of neighbouring countries;
  - differences in product specifications (e.g. peak time definitions);
  - differences in balancing rules and programming units (e.g. 30 minutes vs. 15 minutes time units); and
  - rules to access interconnectors in order to trade cross borders.

  While some of the issues are being addressed by on-going discussions around the "Target model for the internal market" and the new "Grid

Code" there is still significant room for improvement – in particular regarding short term energy trading.

Another market design element which gained importance in recent months is the question of the introduction of capacity mechanisms. Countries like France and the UK are pushing towards capacity mechanisms whereas countries like Germany, Switzerland and Austria which are linked to France are hesitating to introduce such arrangements. Even those countries that are proposing capacity mechanisms have different designs under consideration as show in **Figure 11**.

Figure 11. Capacity market design across Europe in 2012

Source: Council of European Energy Regulators (2013)

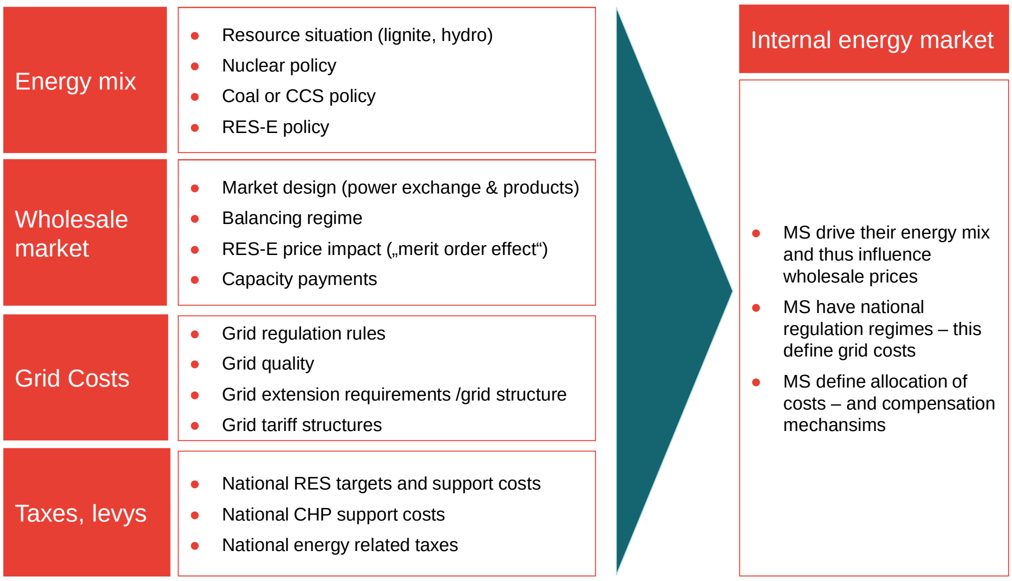
- **Different grid costs in Member States**[19] – Differences in grid fees for industrial customers can arise from:
  - different grid structures;

19 For further details – see chapter 3.2.

  - different age structure of assets;
  - different grid cost regulation;
  - different degree of supply quality[20]; or
  - different tariff structures.

- **Different Taxes, levies in Member States** – Differences in energy tax legislation and promotion budgets can result in different power prices for industrial customers.

Figure 12. Energy and climate impacts on the internal energy market in Europe



Source: Frontier Economics

These drivers have an impact on industrial retail prices that customers have to pay in European countries. In the following chapter, we analyse prices for industry across Europe and the impact of policy on energy prices.

20 There can be good reasons to aim at different supply quality levels across Member States. Countries which have "high tech" industries connected to their system tend to have a higher value for security of supply. Also costs of providing a certain level of supply security can vary – countries with wide distances and low population density might have higher cost per customer to provide a good level of supply security than small countries with a higher population density.

Comparison of industrial energy prices in Europe and the United States

3.2 Distortions to the internal energy market from recent RES-E growth

In addition to the cost implications for consumers, which have to finance the support for RES-E, the strong RES-E growth in some countries has impacts on other market participants within the internal energy market:

- **Conventional power system –** Subsidized RES-E generation reduces the utilisation rate of existing power plants. While it is to some extent the aim of RES-E promotion to replace conventional generation, this has significant impacts on existing conventional assets. These assets have - at least in some Member States - been built assuming a slower growth of RES-E than observable today. Most RES-E generation, such as wind or PV generation, is "non-dispatchable" which means that those plants can only produce when wind or solar are available. In order to provide a level of energy supply security in Europe which is adequate for industrial countries, the power system requires dispatchable plants which can be operated in hours when RES-E plants are not available for generation. This back- up flexibility can come from "dispatchable" RES-E (e.g. biomass plants which can be ramped up or down), conventional plants, storages or flexible demand. As RES-E contributes more to actual energy generation than to capacity supply adequacy (supply security) **total installed capacity (in MW) will need to be higher and generation units will be utilized in a less efficient manner (lower utilisation) compared to a situation with a lower share of non-dispatchable generation.**

- **Cross border loop flows and trading -** Volatile RES-E generation patterns induce strong electricity flows across Europe, e.g. in windy periods electricity is generated from wind power around the German North Sea coast and exported to the Netherlands and Poland. Weather conditions influence power prices in individual countries as well as physical power flows. In some hours physical flows in the transmission grid hamper cross border trade since so called "loop" flows block commercial interconnection capacity that otherwise could have been used for cross border trading.

- **Grid costs are driven by RES-E policy –** The need for grid extensions in individual Member States is also driven by RES-E policy. This holds for grid extension at transmission level but also for distribution grid levels. Typically, transmission grid extensions are driven by larger wind installations (on- or offshore wind parks) while the need for distribution grid extensions is driven by a large number of smaller PV or biogas installations. Grid costs are mainly paid by national grid users. In its Ten Year Network Development Plan, the association of European Transmission System Operators (ENTSO-E) has identified a need for new transmission lines of about 52.000 km requiring investments of more than 100 bn. Euro for the next decade (of which about 20 bn. EUR are subsea cables). **Figure 13** provides details. Following ENTSO-E, roughly 80% of the observed bottlenecks are related to RES-E flows[21]. Even including those investments the ENTSO-E still expects some Member States to be less integrated in an internal continental energy market than others. Despite new transmission investments, the Iberian region, UK, the Baltic region and Italy will still not be fully integrated with the internal European energy market. Further details of bottlenecks between Member States can be found in the TYNDP (2012).

Figure 13. Projects of pan European significance identified with the TYNDP 2012

Source: ENTSO-E (2012)

21 TYNDP(2012) – p. 12

Comparison of industrial energy prices in Europe and the United States

4 Impact of energy and climate policy on energy prices for European industry

In this chapter, we

- discuss retail energy prices for the European industry – for different Member States and consumer groups; and
- discuss the impact of EU energy and climate policies on the costs of energy as an input for the industry. We consider
  - the impact of the EU ETS in Phase III and beyond;
  - the impact on electricity prices of policies to increase RES-E; and
  - the impact of other policies on electricity and natural gas costs to industry.

Finally, we summarise the main factors driving energy prices upward and downward and discuss to what extent policy decisions have an impact on the price drivers.

4.1 Industry retail prices in Europe

4.1.1 Industry retail prices for electricity

As mentioned in the previous chapter, energy markets across Europe vary significantly. This results in differences in energy costs for the industry in Member States. **Figure 14** below illustrates how industrial electricity[22] prices in Europe varied by the size of customer across Europe in the second half of 2011.

Retail prices for industrial customers on the continent range between 7 to 13 ct/kWh. Italy has high industry prices compared to other Member States, while Bulgaria, Sweden and Finland have lower industry prices than most other European countries.

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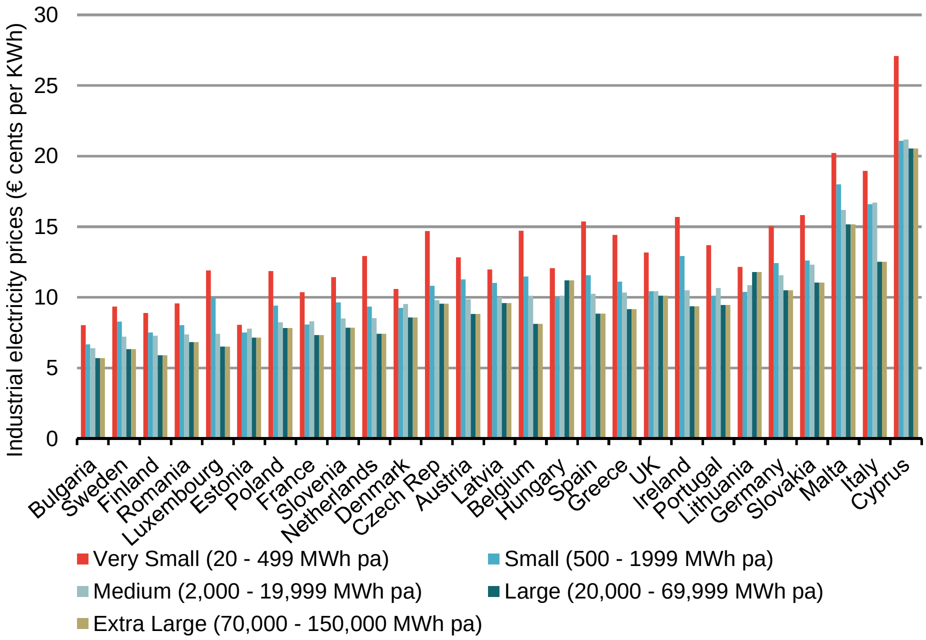
22 The data refers to a half-yearly average from Jan-Jun 2012. Prices do include taxes and levies but do not include VAT (VAT is not paid by industry).

Figure 14. Industrial electricity prices in the EU by customer size[23]



Source: Eurostat (derived from DECC) July – December 2011

Price difference between customer groups

The drivers of cost differences between larger and smaller customer groups are primarily additional grid costs for lower voltage grid utilisation. Further factors that can result in energy price differences between larger and smaller costumers within a country are:

- **Regulatory framework and exemption rules for different customer groups** - the rules to recover the budgets for RES-E promotion might include exemptions for large industry – the German Renewable Energy Act (EEG) partly exempts large manufacturing industry and transport from paying the EEG levy.

- **Different consumption profiles** - Smaller customers often have more volatile consumption profiles than large industry. This means that large consumers with baseload consumption (flat consumption profile) pay less per MWh than consumers who consume electricity mainly in hours when the whole system faces a high load (e.g. during day time on working days) ;

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23 The source data from Eurostat relates to bi-annual industrial electricity prices by category of industrial customer. This chart relates to the average price for each category from Jun – December 2012.

- **Bargaining power of industry** - As in every market large buyers have more bargaining power than costumers buying only limited amount of a certain product; and

- **Flexibility options** – In some occasions, industry (or other flexible costumers such as heat pumps) receive a discount on the retail electricity price by offering the supplier (or the TSO/DSO) a certain flexibility to interrupt the supply under certain conditions.

Price difference between Member States

Price differences between Member States can be explained by

- **Different fundamental market drivers** – Power price differences can be explained by different fundamentals, such as the supply/demand balance in a Member State, the resource situation (e.g. lignite or hydro availability), the type of power plants installed, fuel prices or internal transport costs for coal and gas;

- **Different energy policies of Member States** – The energy mix is not only driven by fundamentals but is also influenced by energy policy decisions such as nuclear policy, RES policy and attitude towards coal fired power generation and CCS.

- **Interconnectivity to neighbouring markets** – Electricity wholesale prices in a Member State are influenced by interconnected neighbouring markets. Examples for this effect are the ad hoc nuclear phase out of 8 nuclear power plants in Germany in 2011, which had an impact on power prices in France; another example is the hydro situation in Norway which also influences power prices in Sweden and vice versa.

- **Different grid costs** – Grid quality and grid costs also vary between Member States. Different grid tariffs between Member States can be explained by the grid structure, grid age or the regulatory treatment of grid costs.

- **Different exemption rules for industry** – exemption rules and cost burden allocation towards consumer groups can vary between Member States;

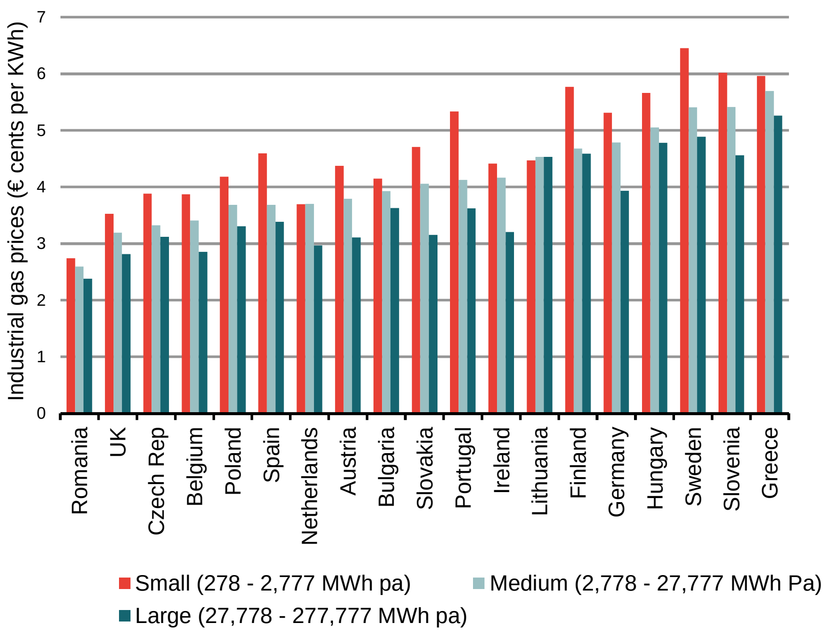
- **Different taxes to energy** – energy tax legislation varies across Member States. This holds for fuel taxes as well as for taxes on electricity.

Finally, the role of regulation and markets in price formation for the non-grid elements of the tariff differs between Member States. In some countries (e.g. Bulgaria), energy prices for selected customer groups are to a large extent still regulated. In others (e.g. Germany), retail industry prices are a result of market interaction of supplier and customer – however, even in this situation, politically determined framework conditions (taxes, levies exemption rules) still play a key role.

4.1.2 Industry retail prices for gas

With respect to gas prices a similar logic applies. Gas prices vary between Member States and customer groups. The reasons for this are similar to those for electricity. **Figure 15** below illustrates how industrial gas prices in the EU Member States varied by customer size in 2012.[24]

Figure 15. Industrial gas prices in the EU by customer size in 2012



Source: Eurostat (derived from DECC)

As for electricity, price differences can be explained partly be fundamental differences in the resource situation, partly by the regulatory framework.

- **Different fundamentals** - An important price driver is the gas supply situation. The supply is driven by domestic gas supply (Norway, UK, Netherlands have significant gas sources) as well as by connection to the main gas exporting regions delivering to Europe. Main gas exporters tor European member States are Russia, Norway, the Netherlands, Algeria and LNG imports from other regions such as Qatar.

- **Different energy policies of Member –** In recent years, gas trading hubs have been established such as NCG in Germany or NBP in UK. Even

24 The data refers to a half-yearly average from July-Dec 2012.

though gas trading has gained speed long term, oil price linked supply contracts with exporters still have an impact on gas price levels in Europe. Also national attitude towards shale gas policy varies between countries. While countries like Poland or UK appear to promote domestic shale gas production, other countries like Germany are hesitant due to potential ecological impacts of shale gas production.

- **Interconnectivity to neighbouring markets –** Interconnectivity of countries is also an important driver for gas prices. The attitude towards LNG terminals is also different between Member States: While countries like Italy, Spain or UK use LNG for gas imports, countries like Germany mainly rely on pipeline gas. Rules for cross border trading of gas are not harmonized yet but cross border trades already have an impact on gas prices in neighbouring countries.

- **Different grid costs –** As for electricity, gas network tariffs vary between countries due to differences in grid costs (grid structure, age), supply quality and regulatory rules.

- **Different exemption rules for industry** – exemption rules and cost burden allocation towards consumer groups can vary between Member States;

- **Different taxes to energy** – energy tax legislation varies across Member State.

4.2 Effects of EU ETS on industry (direct and indirect costs)

In Phase I and II of the ETS, ending in 2012, most Member States allocated a limited number of emission allowances free of charge to power generators and other sectors covered by the ETS. The 2003 ETS Directive was amended in 2009 to widen the scope of the ETS and to introduce compulsory auctioning of EUAs, subject to certain exceptions explained below. In other words, the general rule is that henceforth EUA will have a real cost.

The EU ETS will affect industrial costs in two ways:

- those sectors which fall within the scope of the EU ETS must buy allowances in order to cover their emissions of CO_2 and, in a few other sectors, other GHGs (the direct cost effect); and
- through increased electricity prices as a result of fossil-fired generators falling within the scope of the EU ETS (the indirect cost effect) and having to buy EUA to cover their own emissions of GHG.

In both cases, the amended EU ETS directive envisages methods to compensate industries deemed to be at risk of "carbon leakage" and to maintain a level playing field for global competition of the EU industry. If the EU industry which is under competition with industry from other regions would be burdened with significant costs for RES-E promotion or emission reduction (which is not paid to a similar extent by other competing industries outside Europe) there can be a risk of industries moving outside Europe. Such an "industry leakage" would result in carbon leakage (emissions will be done in regions where they are not punished in a similar manner), fewer investments and employment in the European industry as well as more imports of industrial goods from outside the EU.

4.2.1 Direct cost effect

The sectors falling within the scope of the EU ETS from 2013 are defined in Annex I of the ETS Directive, as amended in 2009. They include the combustion of fuels in any installation with a rated thermal input exceeding 20 MW[25] (which covers almost all power generation), the production of ferrous and non-ferrous metals, large scale ceramic production (including cement clinker), large scale production of a range of chemicals and aviation.

These sectors are, subject to the transitional free allocation arrangements described below, liable to purchase allowances to cover their emissions either in the primary auctions or in the secondary market. The cost impact on the final product depends on:

- the carbon intensity of the product; and
- the market price of EUAs which is currently around €5-7 per EUA[26].

However, under Article 10a, the Directive provides, on a transitional basis, harmonised Community-wide rules for some continued *free allocation* for all sectors other than power generation over the period to 2020. The free allocation is based on ex ante benchmarks linked to the performance of the most efficient 10% of installations in each sector and is subject to reduction from 80% of the eligible amount in 2013 to 30% of the eligible amount in 2020 with the perspective to fall to zero free allocation in 2027 (paragraph 11).

Free allocation of EUA is determined based on historic production, rather than actual production in the relevant period.

For installations in sectors considered to be at risk of carbon leakage, the free allocation shall be 100% of the eligible amount (up to the best available technology benchmark). For this purpose, the Directive calls on the Commission to prepare a list of the relevant sectors based on criteria given in the Directive[27].

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25 An exception is made for hazardous and municipal waste generation.

26 Point Carbon, 3rd April 2013.

27 These criteria concern the intensity of trade with third countries and the impact on production costs as a proportion of value added.

The first list was published in 2009[28] and has been updated twice; a new list is to be published in 2014.

Sectors that are accepted as being at risk of carbon leakage are not exempted from the ETS and may still bear additional direct costs to the extent that their carbon efficiency is lower than that of the industry leaders. For sectors not classified as subject to the risk of carbon leakage, the exposure depends on the factors set out above.

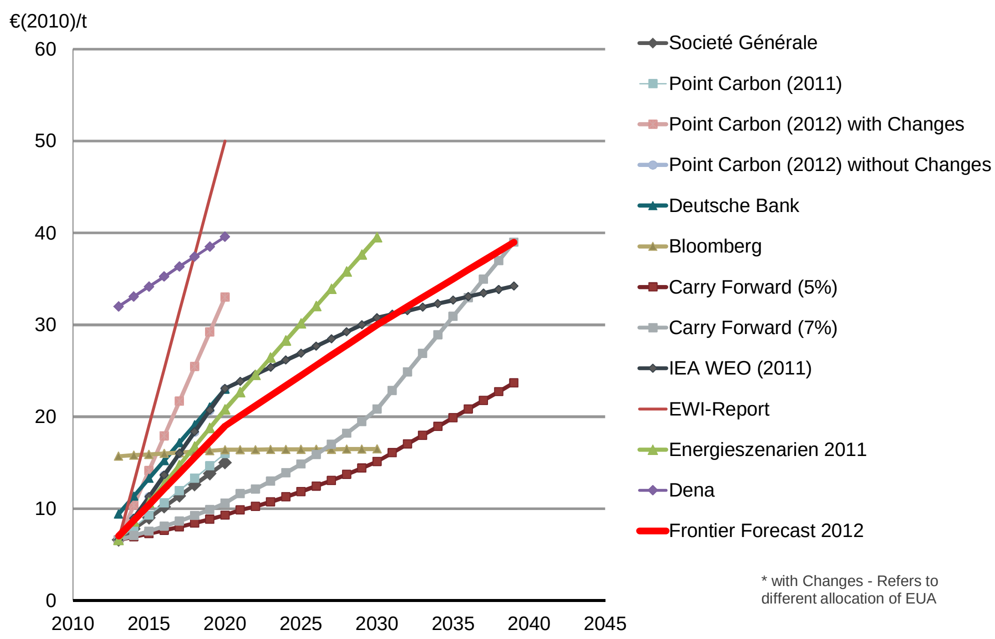
4.2.2 The indirect cost effect

Electricity producers reflect carbon costs in the wholesale market price to the extent that the generators burning coal, gas or oil products are the highest cost plants scheduled to operate. This is independent from the fact if certificates are allocated for free or have to be purchased on the market.

Carbon price projections

The future EUA price is very uncertain and will depend on the policies to be adopted after 2020 for the EU ETS. **Figure 16** shows the spectrum of current carbon price projections from market analysts.

Figure 16. Overview of current carbon price projections



Source: Frontier Economics (2012) based on Bloomberg, Societe General, et al.

As stated, the range of projections from market analysts mirror the uncertainty related to future carbon prices. Market analysts expect a carbon price increase in

28 Commission Decision 2010/2/EU of 24 December 2009.

the coming years of about 10 to 40 EUR/t. Having looked at avoidance costs such as fuel switching costs in the power sector or costs for CCS plants on the longer term, Frontier also expects an increasing carbon price for the next years. The main reasons for the high price uncertainty for EUA are

- **Uncertainty about regulatory rules (post 2020)** – The carbon market is subject to a high degree of political or regulatory uncertainty. For example, the conditionality of the current EU emission reduction targets (-20% without international agreement by 2020 and -30% with international agreement) or the fact that there are no longer term emission reduction targets defined post 2020 (e.g. for 2030 or beyond) result in uncertainty for potential investors in low carbon technology since those investments often come with high investment costs that need to be recovered over a period of several decades.

- **Uncertainty about ad hoc intervention** – In addition to the long run uncertainty of targets, on-going political discussions about market interventions are also increasing the risk for investors. Ad hoc interventions such as back-loading or set aside aiming at increasing the carbon price can make market participants believe that further ad hoc interventions might occur in the future – which are hard to anticipate as they are subject to political discussions.

- **Inelasticity of the price cap** - The current EU ETS volume cap does not respond to EUA prices. As shown above the surplus of EUA from economic crisis, CDM/JI imports and RES-E support has lowered the current prices to about 4 EUR/t – this price reflects the option value of certificates as they can be banked and used later. The absence of price elasticity of supply tends to make EUA prices volatile. However, we expect EUA price volatility to be reduced if long term banking rules are applied.

Impact on indirect cost for industry – today and likely developments

Impact of carbon costs on indirect costs today

The impact of carbon prices on power prices depends on the carbon intensity of fuel used to produce electricity. The impact varies by Member State due to different energy mixes but spill over effects need to be taken into account as well as price effects are carried over to neighbouring energy markets due to cross border trading where possible.

Today the impact of carbon costs on industry retail prices is quite low:

- at recent carbon price levels of 5 to 15 EUR/t the price impact on wholesale electricity prices in Europe is in the range of 0.25 to 1 ct/kWh; and

- with industry retail prices[29] which are for most Member States between 5 and 20 ct/kWh this means that the indirect cost impact from carbon on industry retail prices is typically less than 10%.

Expected impact of carbon costs in future

If carbon prices increase in future – as expected by most market analysts – this will also increase the impact of carbon costs on the electricity wholesale price. High carbon prices will increase production costs for power generators emitting carbon and thus will increase the wholesale price level. The size of the price impact varies depending on the type of fuel and the efficiency of the plant.

It is important to note that the impact of carbon pricing on electricity prices in a Member State does not necessarily depend on the carbon emissions of generating plant in that specific Member State. With growing interconnections between electricity markets, a fossil fuelled generator in one country with high emissions may set the price of electricity in a neighbouring country that has low emissions. This means the carbon price effect will spill over to other Member States. For example, power prices within the mainly hydro based Austrian power system are likely to increase with higher carbon prices since the carbon intense German market will be affected. Higher German prices will lift up power prices in Austria offering a chance for Austrian generators to export to Germany in order to substitute carbon intense power production within Germany.

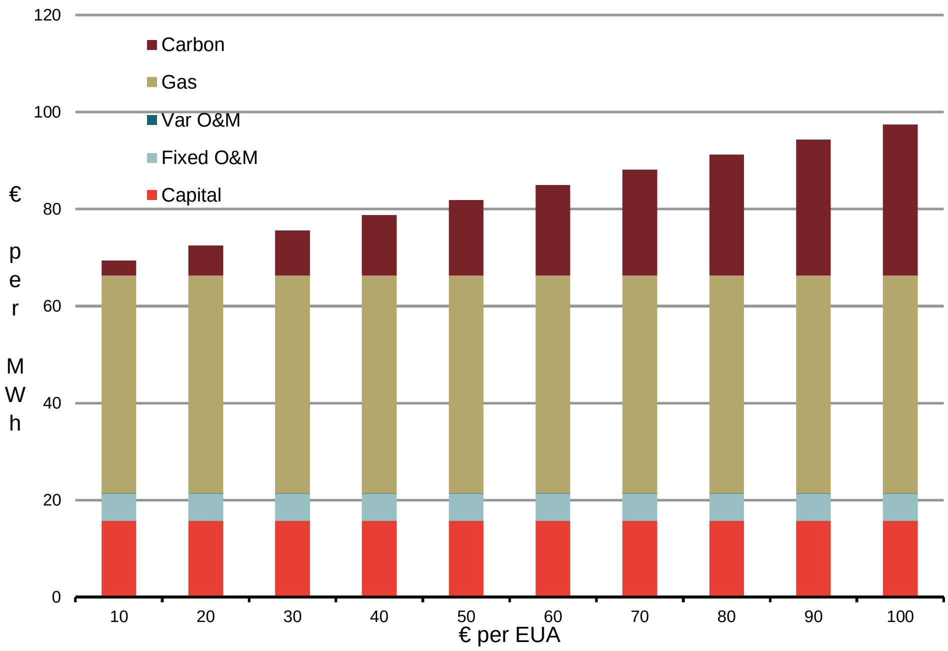
The price for CO_2 certificates has a direct effect on the variable costs of fossil fuelled power plants. For example, for a gas-fired plant, which is likely to become increasingly important after 2020 with respect to electricity price setting[30], about 30% of the EUA price translates into an increased electricity price per MWh. In other words, an EUA price of €30 would add some €10 per MWh to the wholesale electricity price.

The cost components of a new entrant gas-fired plant at a range of EUA prices are shown in **Figure 17**. The calculation assumes a gas price of €26 per MWh (thermal). Other assumptions are a plant efficiency of 58% and cost of capital of 8% (real, weighted average cost of capital consisting of debt and equity).

29 Compare **Figure 14**.

30 Flexible, gas-fired plant CCGTs will be the thermal plant of choice in most Member States in order to act as back-up plant in combination with growing RES-E.

Figure 17. Impact of carbon prices (€ per EUA) on cost of gas-fired generation.



Source: Frontier calculations

Direct use of gas in industry for heating or as a chemical feedstock is also impacted by the EU ETS if the sector falls within the scope of the ETS (includes all boiler plant has a thermal input of > 20 MW).

Article 10a (6) of the revised EU ETS Directive offers the possibility of financial compensation for the indirect costs of the ETS to the extent that an industry is exposed to the risk of carbon leakage because its competitors in third countries do not face similar carbon costs. However, the compensation mechanism is not an integral part of the EU ETS arrangements, and the effect of the Directive is to permit (but not oblige) Member States to make such compensation from their own resources subject to state aid guidelines published by the Commission in 2012[31].

Important provisions of these guidelines are:

- the list of sectors for which compensation is permitted on an ex ante basis is shorter than the list defined in the 2009 assessment under the EU ETS[32] described above;
- the aid intensity is capped at 85% of the eligible costs and this reduces to 75% by 2020; and

31 Guidelines on certain State Aid measures in the context of the GHG emission allowance trading scheme post 2012 (2012/C 158/04).

32 E.g. mining industry or some electricity intense salt production is not included

- the maximum aid payable is based on efficiency benchmarks for the specific electricity consumption associated with a unit of production in order to ensure the incentive is preserved.

It is too early to say how effective these arrangements will be in practice. Most Member States are still in the process of policy formulation. For example, the UK Department of Energy and Climate Change has recently completed a consultation on a proposed scheme but no decision on the details has been announced so far.

However, it does seem to be very likely that the arrangements will differ significantly across the EU, depending on the Member State, whilst staying within the EC state aid guidelines.

Case Study: Drivers for low carbon investments

Investments in mature low carbon technologies

Our analysis shows that low carbon investments are not only driven by carbon costs coming from the EU ETS or a carbon tax. In fact, industry retail power prices in Europe are in a range of 7 to 13 ct/kWh – of this the carbon price effect is in range of 0.5 to 1 ct/kWh[33] - so the price effect we expect for the medium term will be about 5 to 10% of the retail price.

While this is not negligible, the internalisation of carbon emission costs is just one pillar that could drive low carbon investments. Other important drivers can also play a key role such as:

- **Energy price levels** – High energy prices for fossil fuels are often a driver for "low carbon investments". High energy prices for fossil fuels
  - will make innovative non fossil fuel based power generation more attractive (e.g. RES-E)
  - will make it attractive for generators to invest in modernisation or replacement of existing plants operated with fossil fuels - a higher conversion efficiency is of more value the higher the energy prices are[34].
  - will make it attractive for consumers to invest in energy efficiency measures – high prices for primary fuels often translate into higher prices for electricity.
- **Regulatory framework –** The regulatory framework plays a key role and

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33 Assuming a carbon price of 10 to 30 EUR/t and a carbon intensity of the price setting power plants of about 0.4 t/MWh_el (corresponds to a gas fired CCGT with 50% efficiency) carbon cost would increase power prices for industry by 0.5 to 1.2 ct/kWh_el.

34 An exception is investments into CCS which is linked to conversion efficiency losses – in a situation with high energy prices those losses of conversion efficiency become more expensive.

drives low carbon investments:

- Retail prices – high cost burdens for consumers through taxes, levys, etc. drive investments aiming at energy efficiency.
- Direct support schemes - promotion schemes such as RES-E promotion or CHP support can result in more auto-generation investments.
- Indirect support - distortions of grid provided electricity consumption vs. auto-generation costs can also trigger investments. Exemption rules for auto-consumption can result in incentives to invest into decentralized auto-generation facilities such as CHP plants or RES-E.

- **Age structure of existing plants** - the age structure of the existing industrial facilities also drive the degree of low carbon investments. In a situation with high demand for replacement of old assets the opportunity to invest into low carbon equipment is higher than in a situation with sufficient mid-age facilities.
- **Financing conditions** - capital costs of investors are a key driver for investments. As most low carbon investments aim at spending money (Capital expenditures – CAPEX) today (for the new facility) in order to save variable cost (operational costs - OPEX) in the future (e.g. fuel, carbon costs) the interest rate and capital costs play a key role. In a situation with low interest rates and low capital costs low carbon investments are more likely to occur.

Investments in innovative low carbon technologies

In contrast to more mature and close-to-market low carbon technologies, there will also be a long term aspect of R&D in order to invent the low carbon technologies of the longer term future. Those technologies which are either technologically or economically not ready to be used on a larger scale in today's market will need to be developed. **In this context, an adequate R&D framework can also help to foster innovation of new technologies.** As low carbon technologies are a potential market for the future, providing an adequate R&D framework can also facilitate investments into new low carbon technologies. R&D should concentrate on early development stages of technology innovation such as pilot plants or demonstration units – not on large scale market implementation. **As the example of RES-E support shows, it can become very expensive if immature and expensive technologies are rolled out at large scale at an early development stage.**

Comparison of industrial energy prices in Europe and the United States

4.3 Effect of RES promotion on industry

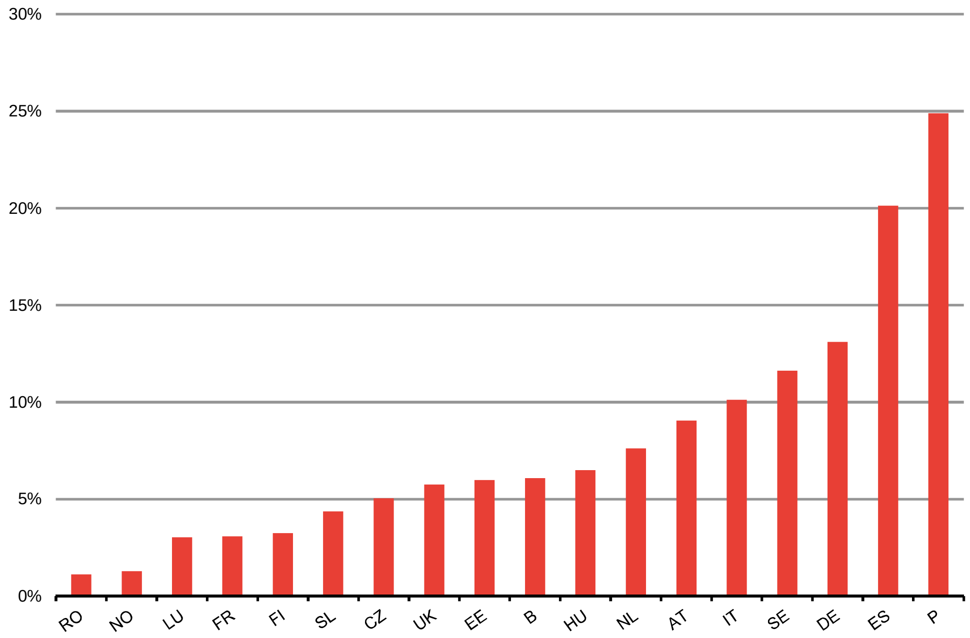
In **Section 2.1** of Chapter 2, we described the framework at EU level and at Member State level for RES-E promotion. We now look in more detail into RES-E promotion budgets and delivered RES-E production in the past as well as some projections for the future.

4.3.1 RES-E support budgets of Member States today

Thanks to the implemented promotion schemes, the share of RES-E in Member States' energy mix has grown in recent years. **Figure 18** shows the shares of RES-E in national production receiving financial support in 17 Member States plus Norway based on a recent survey carried out by the CEER. The average for the countries given is 9% of total electricity generation. Note that the share of total RES-E based production in Member States because some countries (e.g. Norway, Sweden, Spain) have significant volumes of RES-E which receives no financial support (primarily hydro). Portugal, Spain and Germany have a very high share of promoted RES-E generation within their generation portfolio.

Following the Council of European Energy Regulators (CEER), about 37 bn. EUR have been paid to RES-E generators as a net support in the year 2011 (net support means that this payment comes on top of the value the delivered electricity had at the power exchange). The delivered RES-E electricity added up to about 328 TWh.

Figure 18. Shares of supported RES-E in % of national electricity production for 17 MS + Norway – 2011 data



Source: Frontier based on CEER Status Review of Renewable and Energy Efficiency Support Schemes in Europe, 2013

High targets for RES-E are often associated with incentives to build more expensive RES technologies such as photovoltaic and thus in a higher average level of support for each MWh consumed.

4.3.2 Impact on final energy prices today

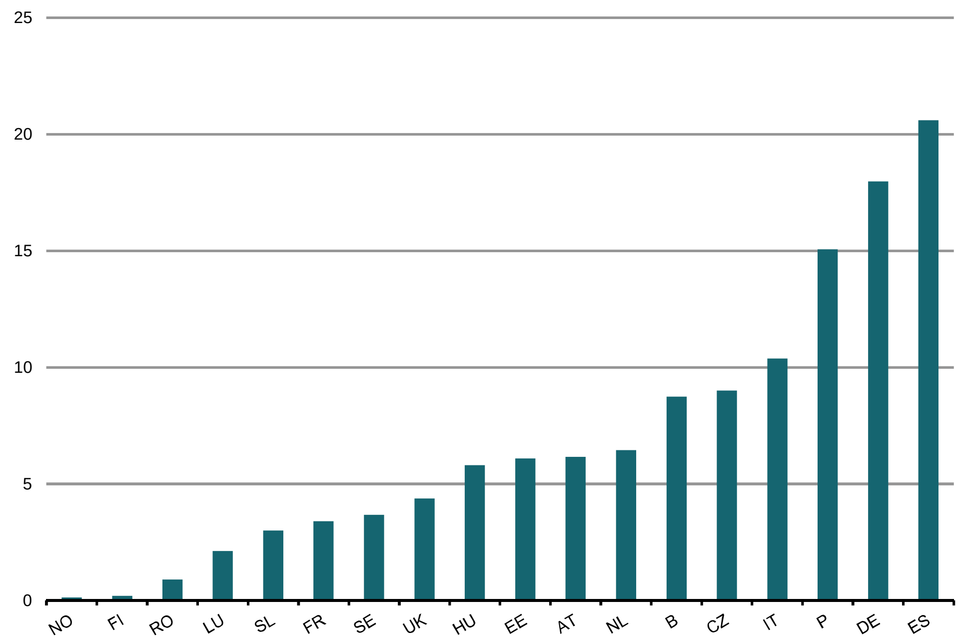
Direct costs of RES-E promotion

Independent of the support mechanism, the customers have to pay for the higher costs of RES-E power generation and the costs of integrating renewables into the system. With a feed in tariff, the usual method of recovery is a regulated environmental levy on final customers (in effect a tax). With a quota obligation mechanism, the costs are borne directly by the energy supplier and are then passed on to customers in the tariff. Only Finland, Luxembourg and until 2012 the Netherland pay for the subsidies out of general taxation revenues.

Therefore, the customers of those Member States which offer the most financial support for RES-E per MWh are exposed to the highest costs in final tariffs at a level which is similar to that shown in **Figure 19**. Portugal, Germany and Spain which have the highest promoted RES-E penetration also have the highest costs. As explained below, depending on how the subsidy is recovered, these high support levels translate into higher energy prices for final consumers:

- In Spain final electricity consumers pay more than 20 EUR/MWh (2 ct/kWh) for RES-E promotion, if promotion burden was simply spread on a per MWh basis.
- In Germany consumers would pay 18 EUR/MWh for the year 2011. Today, German households pay 53 EUR/MWh as EEG levy which reflects that RES-E promotion costs in Germany have grown further compared to 2011[35].
- Consumers in Scandinavia or France paid on average less than 5 EUR/MWh.

Figure 19. Financial support or RES-E in € per MWh of final consumption in 17 MS + Norway – 2011 data



Source: Frontier based on CEER Status Review of Renewable and Energy Efficiency Support Schemes in Europe, 2013

However, the amount to be paid by each consumer in Member States varies depending on the rules of burden sharing between consumer groups within a Member State. Many Member States recognise that cost recovery has an impact on the global competitiveness of their industry. A range of different mechanisms have therefore been designed to acknowledge the competitiveness aspect. These may include one or more of the following measures:

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35 In addition, the EEG levy is not spread simply by a per MWh rule – consumers in manufacturing industry or transport pay less than households.

- a degressive recovery rate in € per MWh as consumption increase so that large customers pay less;
- a cap on the total financial value of the levy that must be paid, protecting customers above the threshold;
- exemptions on consumption above certain thresholds; and
- in the case of quota obligations, a lower rate of obligations on higher tranches of consumption which it is assumed that the supplier will pass on the customer concerned.

These mechanisms may be associated with conditions determining eligibility for relief – for example, that the cost of electricity represents at least a certain proportion of the economic value added or that the consumer needs to face demonstrable international competition.

Neither the RES-E promotion nor the cost recovery measures are subject to any coordination and are determined by Member State governments at national level as part of the design of the support mechanism for RES-E. However, RES support itself is a state aid by the European Commission but is exempted subject to compliance with the Community Guidelines on State Aid for Environmental Protection of 2008[36]. Although primarily concerned with granting of support for RES production, Section 4 of the guidelines do provide some criteria for granting of aid in the form of reductions of or exemptions from environmental levies/taxes i.e. for recovery of the cost of support. For example, aid must be proportionate and necessary in terms of the price elasticity of the sector in the relevant geographic market. All national schemes to protect the competitiveness of industry are subject to these state aid guidelines.

The impact of RES integration on transmission tariffs has been noted above but is difficult to quantify in general terms since TSOs do not declare what proportion of their costs are due to RES-E integration. However, the amounts in many countries are already significant and will grow as RES-E penetration increases.

Further promotion aspects

Financial support directly paid to RES-E producers is only the most visible form of support for RES-E producers. The intermittent nature of wind and solar energy and the need to locate plants in specific regions with adequate space and/or where the resource can be tapped (including offshore in the case of some wind energy projects) imposes a number of additional costs on national transmission system operators. These include:

36 The 2008 guidelines 2008/C82/01 are the subject of a recent consultation by the EC.

- additional investment in transmission lines and connections to permit RES-E plants to inject energy into the grid, including expensive submarine cables for offshore plants;
- the cost of dealing with transmission constraints where RES-E production competes with conventional plants for limited transmission capacity – the latter must be compensated if legal priority grid access is given to RES-E infeed; and
- the cost of maintaining a higher level of reserve power plant capacity to deal with the intermittent nature of some RES-E and the associated higher costs of maintaining a balance between supply and demand on the system.

TSOs EU Ten Year Network Development Plan for 2012 gives some indication of the significance of the costs for the system integration of RES-E power production:

"The TYNDP 2012 identifies the need to invest €104 bn in the refurbishment or construction of roughly 52 300 km of extra high voltage power lines clustered into 100 investment projects across Europe. 80% of the identified 100 bottlenecks are related to the direct or indirect integration of renewable energy sources (RES) such as wind and solar power. Such massive development of RES is the main driver behind larger, more volatile power flows, over longer distances across Europe."

The costs incurred by TSOs are recovered from all consumers as part of national transmission charges. These are subject to approval by the National Regulatory Authorities.

Furthermore, the increasing penetration of RES-E into the electricity market displaces conventional generation that is competing in the wholesale power market. This effect was highlighted above in terms of the inconsistency of the different 2020 targets. However, it has two important effects on the wholesale price of power[37]:

- Average price levels are reduced because the most expensive plant required to operate will have lower marginal costs than would otherwise be the case –this effect does not offset all of the extra costs attributable to RES-E; and
- Prices are more volatile and unpredictable and hedging using long-term contract can become more expensive.

37 These changes have an impact on the industry that uses cogeneration power plants, the majority of which is gas-fired. These plants rely on selling electricity surplus to requirements into the wholesale market but are not economic to operate in this manner if the spread between input gas prices and wholesale electricity prices, after allowing for conversion efficiency, is not positive

4.3.3 Likely developments of RES-E support costs

Even assuming significant learning potential and cost reductions for RES-E technologies in combination with increasing power prices, most RES-E will not be cost competitive before 2025. **Figure 20** provides an indication for wind power (onshore, offshore) and PV with different utilisation rates. The higher utilisation rates correspond to good sites (e.g. wind plants located at the windy coasts or PV in sunny areas). Even when applying very strong learning effects for offshore wind and PV in combination with rather good site conditions, cost competitiveness cannot be expected within the next 10 years. This means:

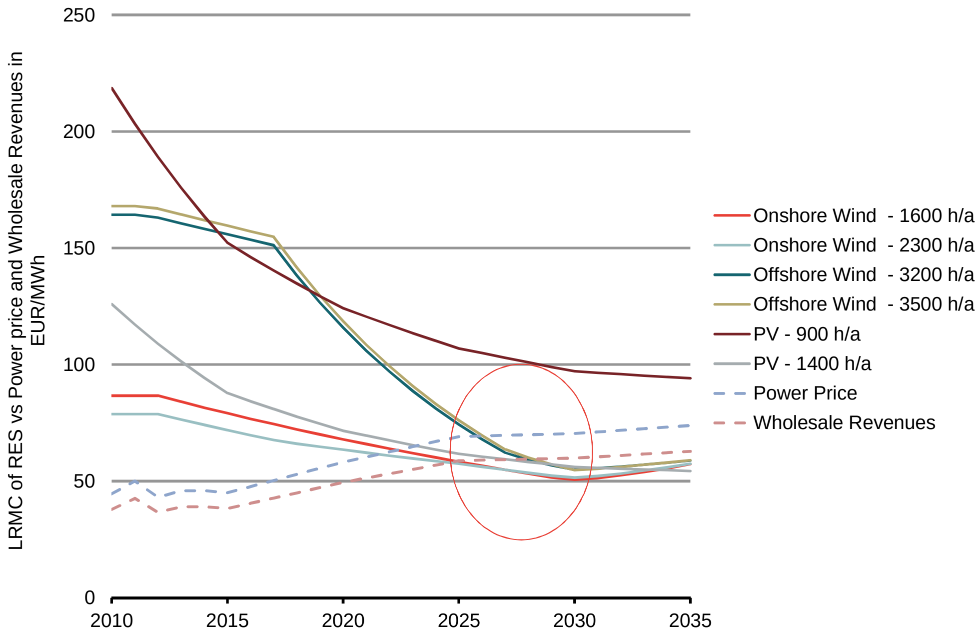
- Low carbon prices will most likely not incentivize RES-E investments[38]. In this case, costs of CO_2 abatement with other measures is lower than with RES-E. At the same time, costs for RES support will increase as the legacy of past investments still needs to be paid[39] plus additional budgets for new RES-E.

- The choice of RES-E technology to be supported will be crucial – focussing on more mature technologies (onshore wind) and good sites will induce much lower promotion costs than a large scale implementation of PV or offshore wind.

38 Depending on other wholesale price drivers e.g. gas and coal prices, power plant scarcity, interconnectivity, etc.

39 Duration of payments for RES-E depends on Member State and promotions scheme. Typical duration are 10 to 20 years. The recently installed 15GW of PV in Germany will receive promotion beyond the year 2030.

Figure 20. Comparing RES-E costs with wholesale prices[40]



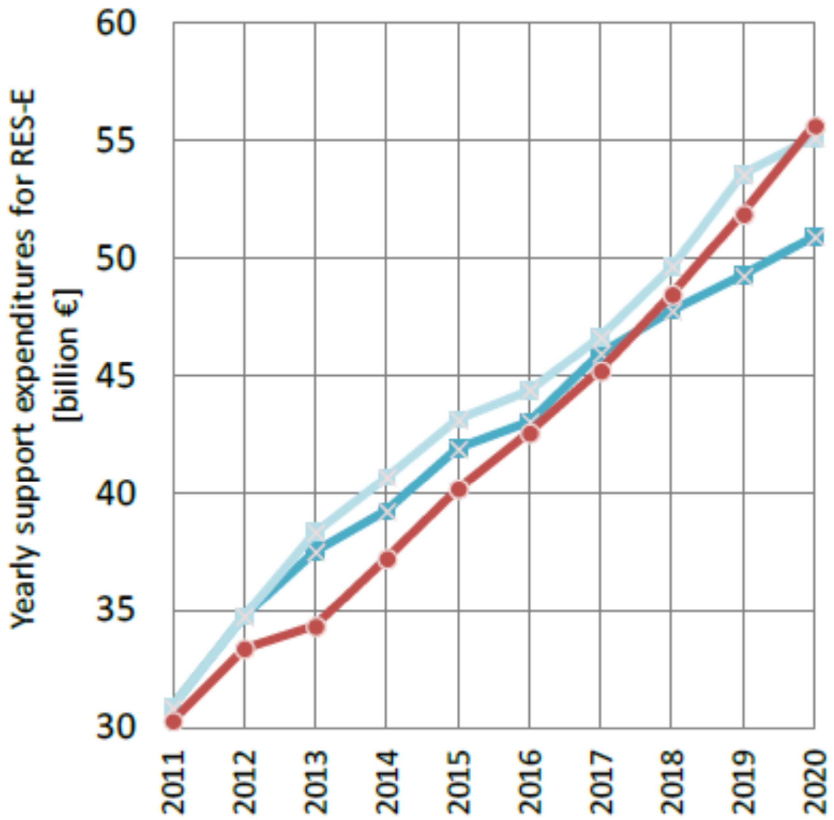
Source: Frontier

In the electricity sector an overall RES-E share of 34% is expected for the year 2020 in order to reach the 20-20-20 target. With further growth of supported RES-E power generation up to a share of 34% in 2020, the corresponding net support (revenues of RES-E investors minus the market value of the power on the wholesale market) is expected to increase to more than 50 bn. EUR/a by 2020[41].

40 RES-E costs and learning curves are taken from BMU Study "Leitszenario" 2012, power price forecast based on Frontier, including an increase in carbon costs. We show both the Base power price as well as revenues for Wind power assuming that they would only obtain 75% of base price due to their in-feed profile characteristics.

41 Resch, G./Ragwitz, M. "Beyond 2020"– presentation held on IEWT conference in Vienna(2013).

Figure 21. RES-E promotion[42] in the EU by 2020 (based on EEG Wien, Fraunhofer Institute 2013[43])



Source: Frontier based on EEG Wien/Fraunhofer ISI (2012)

The magnitude and implication of RES-E support can be further illustrated by the following numbers:

- In 2011, net support for RES-E was about 37 bn. EUR/a – this means
  - net support per MWh of RES-E generated was on average over all technologies and countries about 114 EUR/MWh[44]; and
  - costs to be paid by average final electricity consumption over all Member States and customer groups was about 13 EUR/MWh[45].

42 The different colours in the graph show the impact of various RES-E promotion schemes on promotion costs.

43 It is important to mention that the authors of the study are in general in favour of RES-E support – so the overall promotion numbers might be a rather optimistic estimate compared to other studies.

44 This does not include any additional support from priority access, exemptions for RES-E from grid costs nor the fact that RES-E does not pay imbalance charges in many Member States. At the same time the so called "merit-order effect" (the effect that subsidized RES-E lowers the wholesale prices for electricity) has not been taken into account either.

- In 2020, the overall budget for new RES-E[46] support will increase further:
  - net support per MWh of new RES-E will on average over all technologies and countries be about 30 to 50 EUR/MWh[47];
  - costs to be paid by average final consumption over all Member States will be about 16 EUR/MWh[48].

Even with an anticipation of optimistic learning effects and increasing wholesale prices the authors expect that most RES-E will continue to receive support until 2020. The growing RES-E volumes result in growing support budgets and higher burden for consumers - despite expected learning effects.

The exact level of overall net support required is difficult to estimate since key assumptions like wholesale price levels, learning curves for RES-E, demand scenarios and details of RES support schemes play a key role. Different studies[49] estimate the net present value of RES-E net support expenditures in Europe for the period 2006 to 2020 to add up to 150 to 260 bn. EUR.[50] It is worth noting that this number

- is a net present value – which means that expenditures are already discounted;
- does only include expenditures for RES-E built between 2006 and 2020 – any "legacy" from RES-E being built earlier (and requiring support in the next years) would need to be added; and
- does not include any additional promotion required to maintain the corresponding sub-targets for RES-H or RES-T[51] - so the total costs of RES promotion across sectors will be even higher.

Given the fact that German consumers in 2013 are expected to pay about 18 bn. EUR/a for an expected RES-E generation in Germany of 134 TWh/a – resulting

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45 In practice, there are wide variations between cost burden between Member States and consumer groups which we do not analyse in detail in this study (compare **Figure 19**).

46 New means that this is only for additional RES-E in that period – does not include any legacy from previously installed RES-E.

47 This does not include any additional support from priority access, exemptions for RES-E from grid costs nor the fact that RES-E does not pay imbalance charges in many Member States. At the same time the so called "merit-order effect" (the effect that subsidized RES-E lowers the wholesale prices for electricity) has not been taken into account either.

48 In practice, there are wide variations between cost burden between Member States and consumer groups which we do not analyse in detail in this study.

49 For an overview of those studies see Resch et al. http://www.reshaping-res-policy.eu/downloads/final%20conference/8_RE-SHAPING_future-consequences_Resch.pdf

50 Net present value 2006 means that all future cost have been expressed in EUR(2006) and are discounted so that later expenditures are less costly than early expenditures.

51 Resch et al. expect a net support over all RES (not only RES-E) of about 44 EUR/MWh if the 20% RES target will be met by 2020.

in an expenditure of more than 130 EUR/MWh[52] RES-E generated - these estimates for future EU wide RES-E costs seem to be low.

In 2013, German net support for German RES-E alone will already be around 11 bn. EUR/a[53] (gross payments were about 18 bn. EUR/a).

Even in 2020 most RES-E investment in Europe will still require support. On average a net subsidy of about 30 to 50 EUR/MWh of generated green electricity is required which corresponds roughly to today's wholesale market price for electricity[54].

4.4 Impact of other policies on energy costs

The EU ETS and support for RES-E are currently the main policies that impact the cost of electricity to industry in Europe. However, the following policies may also apply upward pressure on energy prices in the coming decade:

- policies to promote energy efficiency;
- industrial emission directive; and
- policies to promote use of biogas other than for electricity generation.

The recent CEER study[55] of support mechanisms noted that the majority of national energy efficiency support schemes are financed through pass through of suppliers' costs to end users. An example would be the Energy Companies Obligation on suppliers in Great Britain to reduce carbon emissions and provide support to low income households. However the scale of funding is generally more modest than that required for RES-E. Nevertheless, support for cogeneration in Germany, for example, is funded through an environmental levy on electricity customers and this has similar industrial customers as the RES-E levy.

Natural gas prices have not been adversely affected by EU energy and climate change policies. Indeed, the policy of market liberalisation has provided the foundation for gas trading and spot markets which have put downward pressure on traditional gas import contracts linked to movements in oil prices. In countries which have actively promoted biogas, notably Germany, most gas is

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52 Applying a wholesale price of about 50 EUR/MWh this means that net support for RES-E in Germany is in a range of 80 EUR/MWh generated RES-E.

53 See EEG Mittelfristprognose: Entwicklungen 2013 bis 2017

54 Ragwitz estimates a net premium of 30 to 50 EUR/MWh required for new RES-E to be installed between 2010 and 2020 in order to reach RES-E targets http://api.ning.com/files/L10LECFyIdfq8L-SzB02AD2ysF6EClF*OHuO9KJYMuMKjbfM0eY3obtgmjC1a2hyEbl1peGPMdxPEbP34ePhHCwyQaZGP7dS/Ragwitz_lecture_1.pptRagwitz.pdf

55 Council of European Energy Regulators (CEER) – "Status Review of Renewable and Energy Efficiency Support Schemes in Europe", 2013

used for electricity generation where it is eligible for a Feed-in-Tariff but the balance is injected into the gas grid and the additional costs are reflected in network charges. If the scale of biogas injection were to grow significantly, this could begin to exert upward pressure on the delivered cost of gas.

4.5 Summary of factors which influence energy prices

This chapter has focussed on how EU energy and climate change policies can increase energy prices paid by industry in different Member States. These effects can distort the level playing field for European industry compared to global competitors. For this reason, there are measures in place which aim to compensate or to protect industry in respect of costs which lead to carbon leakage or a loss of competitiveness[56].

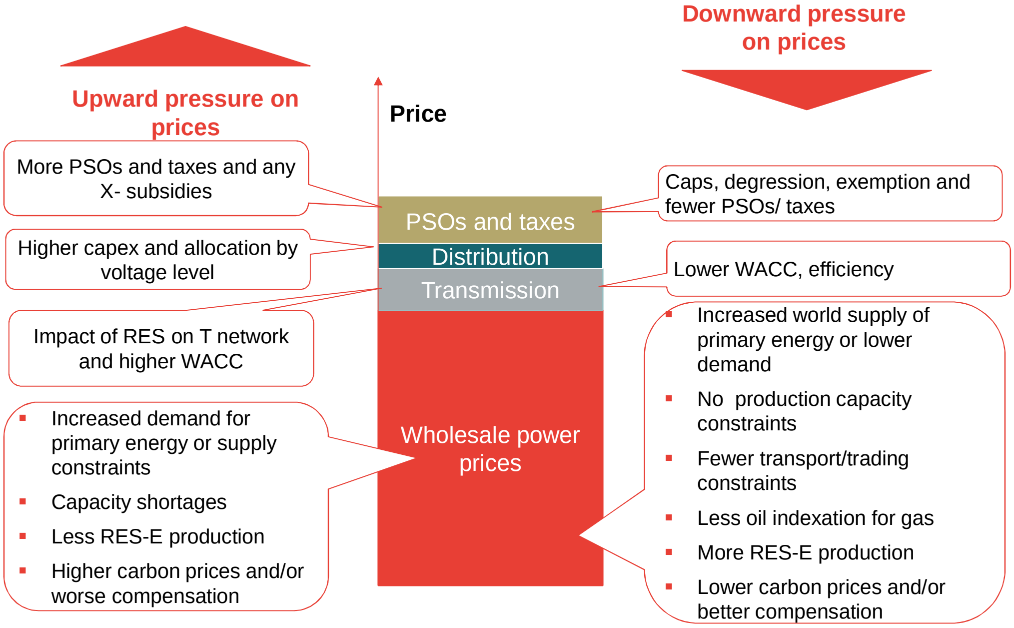
It is important to stress that EU energy and climate policies are only one set of factors that determine energy prices paid by industry. Supply and demand for energy and the underlying costs of the capacity needed to produce and transport energy remain dominant factors.

Figure 22 summarises the drivers - upward and downward - pressures on electricity prices. In this diagram, PSO stands for Public Supply Obligations which include environmental levies and WACC[57] stands for the Weighted Average Cost of Capital.

56 Compensation mechanisms are discussed in the course of the project but detailed analysis is beyond the scope of this report.

57 WACC is a measure for capital costs of a company. It reflects the average capital costs including costs for debt and the interest on equity. Both interest rate for debt as well as equity interest are influenced by the risk of a project and economic situation of the specific company. Investors define a "hurdle rate" – a minimum expected interest they expect to receive on their equity before investing in a project.

Figure 22. Summary of upward and downward pressures on electricity prices[58]



Source: Frontier Economics

58 The figure is a schematic explanation – the size of the boxes does not represent necessarily the size of the price impact. Depending on grid connection level grid cost can have a larger (low voltage connection) or smaller share (high voltage connection) of the retail price. Also relative importance of price components can vary between Member States.

5 Comparison of industrial energy prices in Europe and the United States

In this chapter, we look at distortions to the level playing field for global competition. Since the US is the most similar industrial competitor to Europe we focus on energy price differences for industry between Europe and the US.

We now:

- compare industry price levels in EEA countries vs. the US; and
- analyse the main drivers of price differences between Europe and the US.

5.1 Comparison of industrial energy prices in Europe vs US

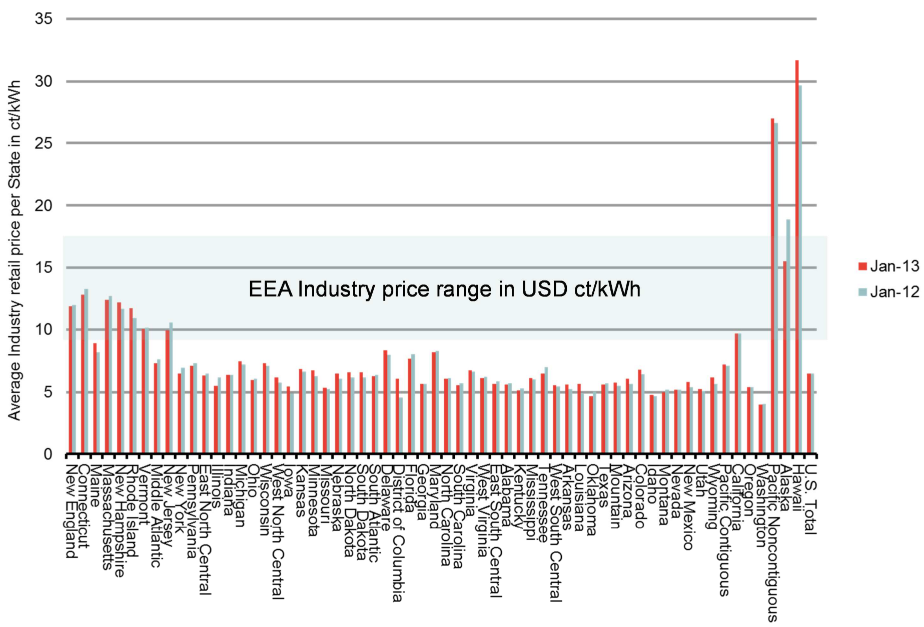
5.1.1 Retail electricity prices for industry

As explained in **Chapter 4**, industrial energy prices in Europe fall in a range from 7 to 13 €ct/kWh (corresponding to about 9 to 17 USct/kWh) – depending on the country and size of customer (see **Figure 14**).

A similar variation of industrial energy retail prices can be found within the US. Industrial energy prices vary between 6 USct/kWh in industrial regions and up to 30 USct/kWh in remote locations such as Hawaii or Alaska. Prices shown include taxes and levies (except for VAT as this is not paid by industry).

It becomes obvious that a comparison on industry energy prices between Europe and the US is not easily possible – both retail prices in Europe as well as industry retail prices in the US vary significantly between (Member) States. While acknowledging large differences and variations between retail prices for industrial customers within each continent, it is fair to state that industry prices for the US industry are on average much lower than in Europe.

Figure 23. Comparison of US industrial retail power prices with the European industrial power price range[59]

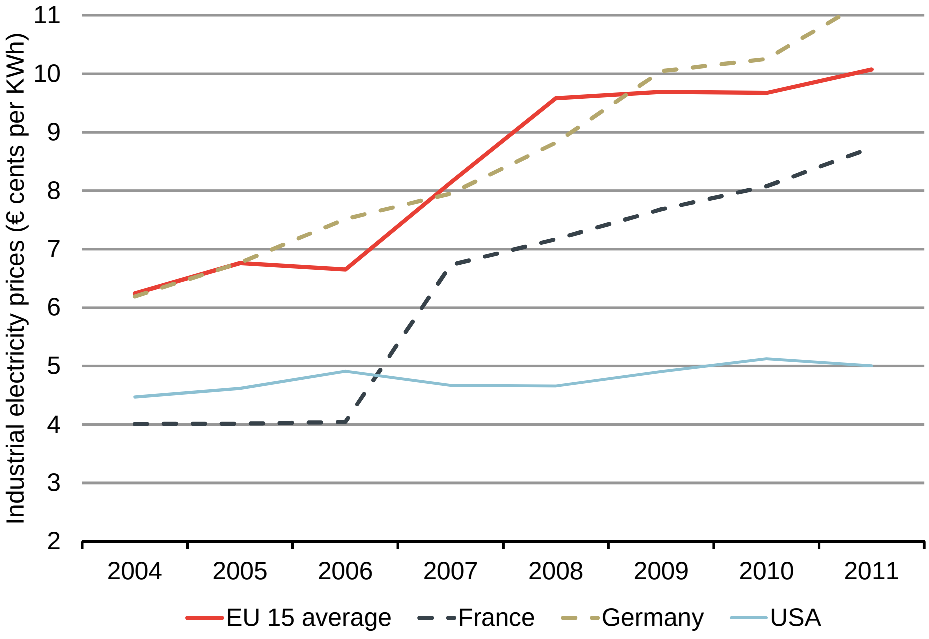


Source: Frontier based on EIA (2013)

Taking historic developments into account, it is evident that this energy price disadvantage for the EEA industry has become larger in recent years. **Figure 24** below compares the trend in annual electricity prices for all industrial customers in the EU and the US (and France and Germany) between 2004 and 2011.

59 US prices are annual average prices year-to date – e.g. Jan 2013 represents annual average prices from January 2012 to January 2013. We have applied an exchange rate of 1,3 USD/EUR to convert European retail prices in this graph.

Figure 24. Trends in industrial electricity prices in EU and USA



Source: International Energy Agency publication (IEA), energy prices and taxes (derived from DECC, 2013)

The strong increase in French industry prices in 2006/2007 is mainly driven by regulatory changes in France when regulated tariffs were removed resulting in prices being linked to wholesale market prices. In 2011, average US industry power price was about half of average European price (as said price variations between individual Member States and US States as well between consumer groups or currency exchange rates can change ratio).

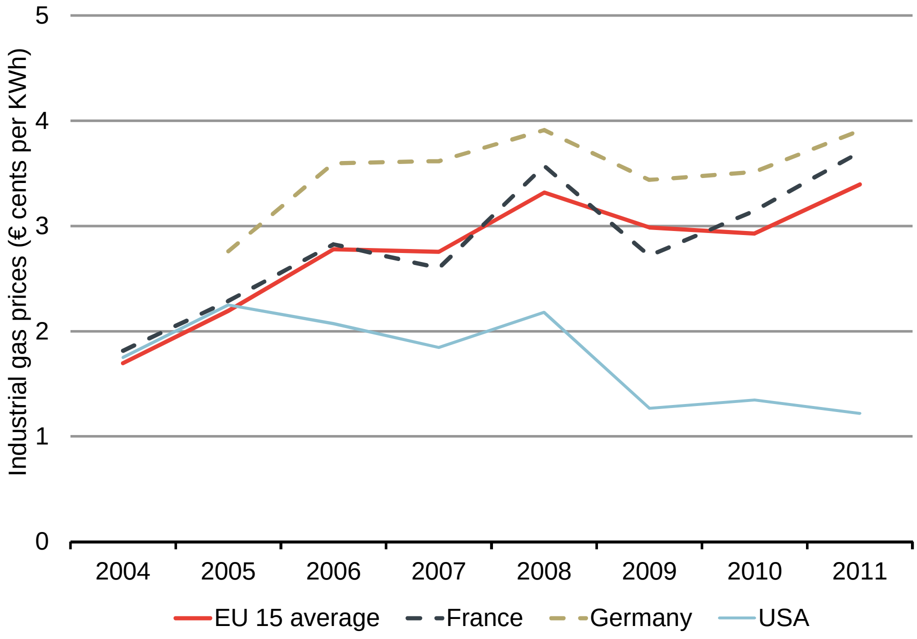
5.1.2 Retail gas prices for industry

Figure 25 below compares the trend in annual gas prices for all industrial customers in the EU and the US (and France and Germany) between 2004 and 2011. The main factors responsible for the divergence are likely to be:

- the stronger price linkage in Europe of rising crude oil prices and natural gas due to the way many import contracts are structured but with some moderation from spot gas prices towards the end of the period; and
- the discovery and production of shale gas in the US, in combination with the constraints on gas exports to world markets. In consequence gas prices in the USA have declined.

We look into the underlying retail prices drivers in the next chapter further. In this chapter, we analyse primary energy prices (e.g. coal and natural gas) as well as wholesale prices for electricity.

Figure 25. Trends in industrial gas prices in EU and USA



Source: International Energy Agency publication (IEA), energy prices and taxes (derived from DECC)

We note that the prices in **Figure 24** and **Figure 25** above relate to the average electricity/gas price for all industrial customers in the EU. The methodology for calculating these average prices varies in some countries. In the majority of cases, it refers to the average electricity/gas price for all industrial customers, weighted by physical quantities consumed (across individual standard bands).[60] [61]

However, in reality, larger industrial customers benefit from lower energy prices than smaller industrial customers. There are also significant differences between countries.

5.2 Main drivers for price differences between Europe and the US

We now provide further analysis of the underlying drivers of the diverging price between the US and Europe. In our view, the main factors which explain these trends are:

60 In some cases, the electricity price refers to the band with the largest energy consumption (medium customers: 2,000 - 19,999 MWh per annum). Further information available in IEA Energy Prices and Taxes Country Notes.

61 Prices reported in national currency/MWh in the IEA data have been converted to Euro cents/KWh using annual average exchange rates derived by DECC.

- **Endowment of natural resources:** Low cost coal accounts for a majority of electricity generation in the US. The recent emergence of shale gas without sufficient infrastructure for exports has lowered gas prices significantly, leading to an increase in gas-fired power generation and putting downward pressure on coal prices. In contrast, Europe has to import an increasing proportion of its primary energy and is much more exposed to upward pressure on world energy prices caused by rising energy use in Asia;

- **Carbon pricing and liberalized electricity markets**: The EU ETS was first introduced in 2005 in Europe. Although there was free allocation of a limited supply of EUAs, these had an opportunity cost and were reflected in the price of unregulated electricity. EUA prices were much higher than present prices during some periods. The sharp rise in electricity prices in France shown in **Figure 24** appears to be closely correlated to market liberalization. In contrast the USA has no national system of carbon pricing and the longest standing regional initiative in the North East has always had carbon prices of under $5 per tonne; and

- **Renewables support**: While both Europe and the USA have adopted incentives for renewable electricity production, penetration of subsidised RES-E is significantly greater in Europe where it was encouraged by the 2001 EU renewables directive. This is especially true of Germany. Europe more often uses feed in tariffs which can encourage higher cost technologies. The level of support for RES-E in the US varies significantly from state to state but the most common form of support is a quota obligation (known as the Renewable Portfolio Standard in the US) and the impact on customers is offset by a federal production tax credit[62]. There are no renewable targets at federal level.

It is not possible to say exactly how much of the divergence is due to each factor but the increasing divergence in the period when Europe first introduced the ETS and expanded renewable generation suggests that EU policies are likely to have been a significant factor. In order to identify the areas explaining the price differences, we analyse selected main drivers of industrial energy prices in the following:

  - Prices for primary energy source (gas, coal);
  - Prices for carbon allowances;

[62] The federal renewable electricity production tax credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. Originally enacted in 1992, the PTC has been renewed and expanded numerous times, most recently by the American Recovery and Reinvestment Act of 2009 (H.R. 1 Div. B, Section 1101 & 1102) in February 2009 (often referred to as "ARRA") and the American Taxpayer Relief Act of 2012 (H.R. 6, Sec. 407) in January 2013. http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F

- Energy wholesale prices – reflecting generation costs for power plants.

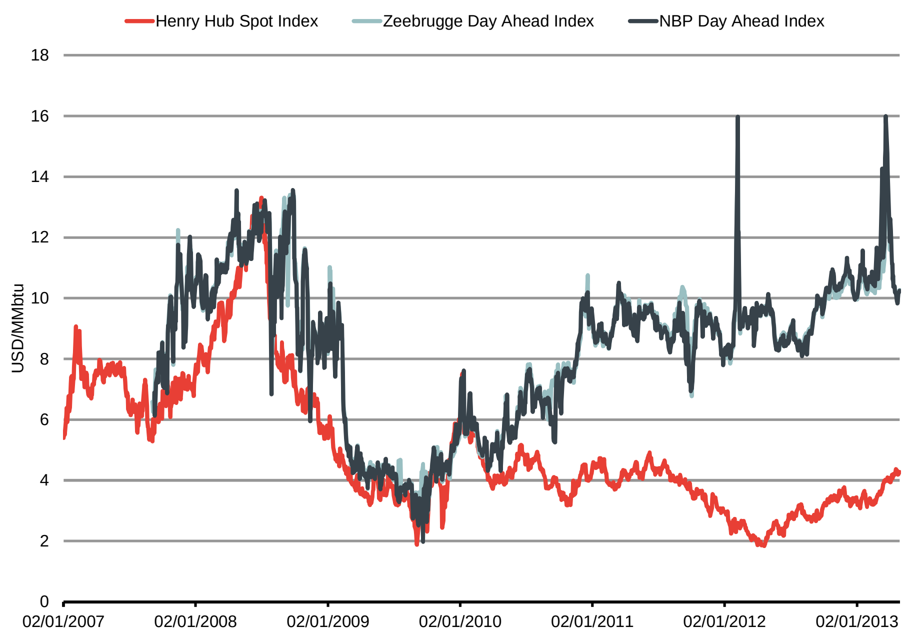
The difference between industrial energy prices and wholesale market prices can be explained by grid cost, taxes and levies.

5.2.1 Prices for primary energy sources

Analysis of the costs of primary energy sources (gas and coal) already shows a large price difference between US and Europe.

Figure 26 shows the average daily wholesale prices for gas in the US (represented by Henry Hub) and the National Balancing Point in UK. Since 2010, a large price difference can be observed which is to a large extent driven by the shale gas development in the US. In the year 2011, gas prices in the US were on average about 5-6 USD/MMbtu lower than in the UK – this corresponds to a price difference of about 15 to 20 USD/MWh_th.

Figure 26. Wholesale gas price differences between Europe and the US in USD/MMbtu[63]



Source: Frontier based on Bloomberg (2013)

Coal prices in the US are also lower than in Europe – however, the differences are much smaller than for gas. In addition, delivered coal prices in both Europe and the US largely depend on the location of a coal plant or an industry facility (plants running on imported coal close the sea have much lower costs than facilities requiring the coal to be transported by train or further shipping).

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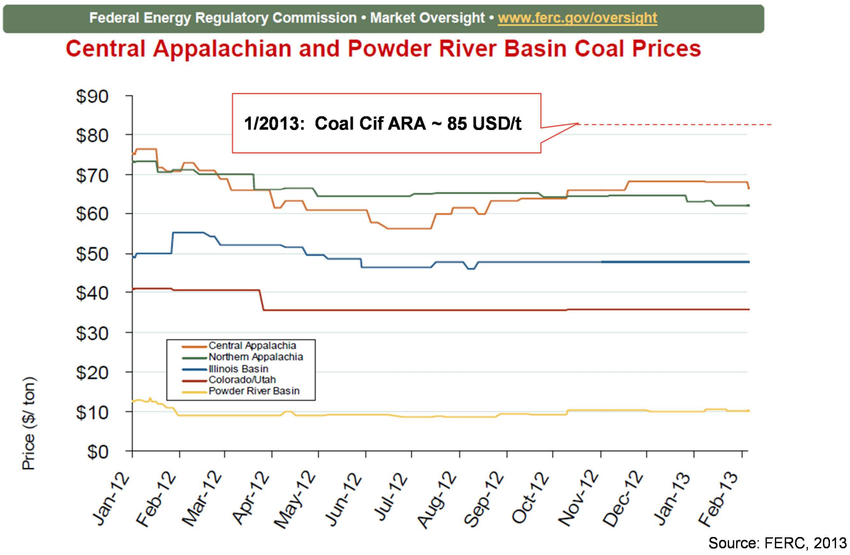
63 In order to convert prices from USD/MMbtu to USD/MWh_th we need to divide by 0.2931 – 4 USD/MMbtu corresponds to about 13,5 USD/MWh_th (or about 10,5 EUR/MWh_th)

Figure 27. Coal prices in the US and in Europe (cif ARA[64])



Source: Frontier based on FERC and EEX (2013)

Due to transport costs, coal prices within the US vary significantly from one region to another. However, coal prices are in general lower than in Europe, where the ARA index (Amsterdam-Rotterdam-Antwerpen) represents the lower end of costs of imported coal[65]. The price advantage of the US is in a range of 15 to 25 USD/t which corresponds to about 2 to 3 USD/MWh_th.

5.2.2 Prices for carbon allowances

While in Europe the EU ETS sends a uniform price signal to power producers and emitters within the EU ETS, the situation in the US and Canada varies significantly by region. There is certainly no level playing field regarding the pricing of carbon emissions. Thus,

- EU had a carbon price of about 7 USD/t in 2012 although it has been as high as 30 USD/t in the past;
- California (and Canadian states) have a carbon price of 15 USD/t;
- RGGI[66] regions (e.g. NY, Massachusetts) have a price of 3 USD/t; and
- the majority of US States have no carbon prices at all.

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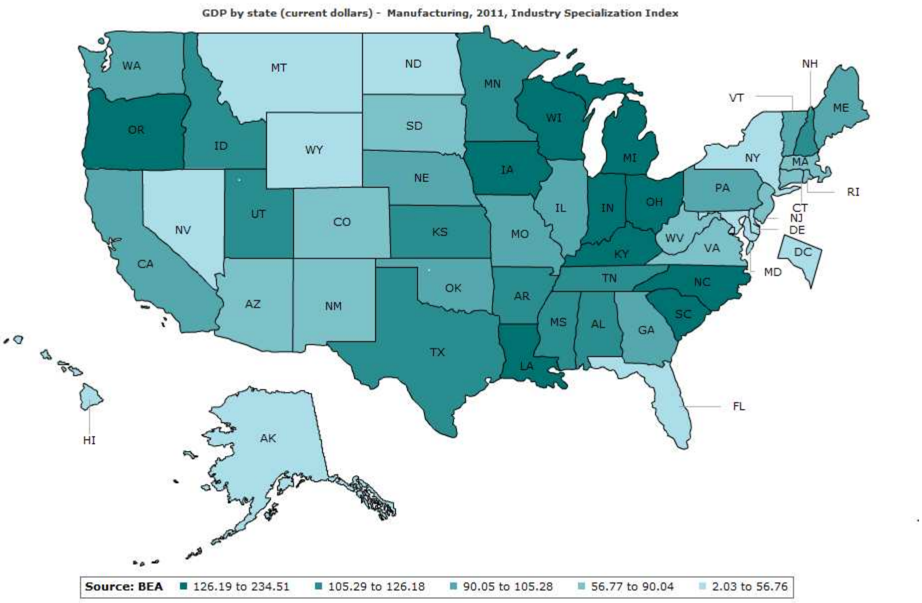
64 Prices are given in USD/t for imported coal delivered to Amsterdam-Rotterdam-Antwerpen area, incl. charge, insurance, freight

65 This simple comparison does not reflect variations in the quality of coal.

66 Regional Greenhouse Gas Initiative States; RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector.

Figure 28. Industry specialisation index per US State, 2011[67]



Source: Frontier based on BEA

Industry allocation within the US is only partly driven by carbon prices – it is also driven by historical developments, general energy prices (e.g. gas and coal prices) and other policy measures. **Figure 28** shows the so called manufacturing specialisation index for each US State. Even though California is a very strong economic area, its manufacturing industry is only on an "average" level compared to other States[68]. Oregon and East Coast States rely heavily on their manufacturing industry (dark green).

It is worth noting that even within the US there are a few regions which pay rather high prices for emissions (California) as well as States where emitters pay less or nothing (the RGGI states and many states in the mid-West). However, California is unusual – most states fall into second category.

5.2.3 Wholesale prices for electricity

Assuming typical conversion efficiencies of existing gas plants (~50%) and coal plants (~40%) the differences in the price of primary energy sources shown above translate into power price differences of about 30 USD/MWh for gas plants and 5 USD/MWh for coal plants.

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67 http://www.bea.gov/iTable/iTable.cfm?reqid=99&step=1#reqid=99&step=11&isuri=1&9905=112&9907=2011&9901=1200&9902=1&9903=200&9904=NAICS&9934=5&9993=ISI&9990=99&9995=Blue&9935=-1&9936=-1

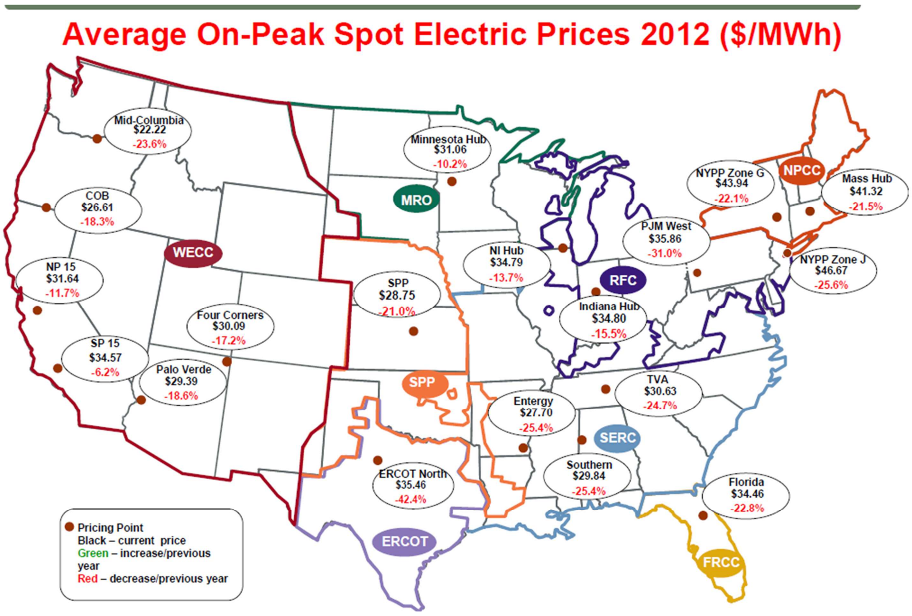
68 It is also worth to note that manufacturing includes non-energy intense manufacturing as well.

Looking at electricity wholesale price data we can indeed see that wholesale power prices in Europe are indeed often much higher than in most US states.

In the year 2012, electricity wholesale prices in the US vary between 25 USD/MWh and 45 USD/MWh. Prices in East Coast States are often a bit higher than at the West Coast – again driven by shale gas usage.

For the year 2013, similar electricity prices are expected for the US (PJM West Forwards Base are around 40 USD/MWh for 2013).

Figure 29. Wholesale electricity prices in US (peak prices) for 2012

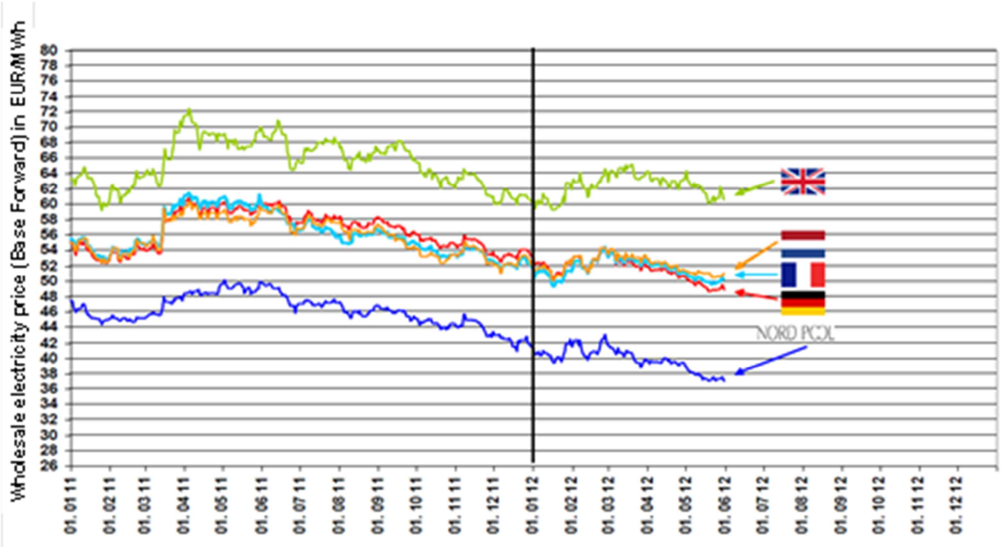


Source: Frontier based on FERC (2013)

At the same time, European wholesale prices are in a range between 50 USD/MWh (Nordpool) and 85 USD/MWh (UK). European continental wholesale prices (the Central West or CWE region) were around 65 USD/MWh (about 50 EUR/MWh).

Figure 30 shows the forward base prices for different European Member States

Figure 30. Base prices in EUR/MWh – delivery 2013 for different European countries



Source: RWE (2012)

Summing up we can conclude:

- **European electricity wholesale prices are about 40 to 70% higher than in the US.**
- **Primary energy prices for coal and gas are a main driver for this price advantage.**
- **Industry retail prices are typically lower in the US than in Europe – however, it has to be acknowledged that large price differences already occur between individual (Member) States in Europe and inside the US.**

6 Conclusions

Our analysis of current policy framework has demonstrated that:

- **Current EU energy and climate policy design is inconsistent and inefficient** – At EU level, three important climate policy targets (the so called 20-20-20 targets) have been defined for 2020. The current policy framework setting is critical since it induces
  - an imbalance of policy objectives – The fact, that all of the defined 20-20-20 targets are logically linked to environmental sustainability, excluding the objectives of competitiveness and security of supply, tends to induce an imbalance of policy measures towards environmental sustainability;
  - failure to coordinate targets – The 20-20-20 targets are not coordinated: It would be a coincidence if the 20% emission reduction was met with exactly 20% RES (renewable energies) share and an energy efficiency improvement of 20%. In fact, todays situation shows that the EU is on track (or even ahead) for achieving the 20% emission reduction target while at the same time the energy efficiency targets may be missed;
  - inconsistency of instruments – By promoting renewable power generation (RES-E) in combination with a volume cap on CO_2 emissions (EU ETS), **no extra tonne of emissions is avoided**. Instead,
    - overall carbon avoidance costs are increased by building expensive RES-E technologies, while at the same time..
    - other low cost avoidance options within the conventional power generation or industrial sectors are not used since those market participants only receive the weak EU ETS price signal diluted by the impact of RES-E promotion.
- **High cost impact of RES promotion** – The additional cost burden from financing RES-E promotion is the main cost driver for society. The net support (payments to RES-E above wholesale prices for the delivered electricity) is expected to increase to about 50 bn. EUR/a in 2020. This number does not include additional costs arising from strong RES-E growth such as
  - additional costs in the conventional power plant park which is operated in a less efficient way; or

  - the costs of required grid extensions[69].

- **Internal European energy market is distorted** – National legislation and policies applied by Member States result in distortions of the internal energy market. While different national energy mixes (and prices) can be explained by differences in the resource base or demand, national policies also play a crucial role: National energy taxes, promotion schemes, exemption rules and grid regulation may all distort the internal energy market.

- **Energy prices for European industry are a competitive disadvantage compared to US competitors** – While acknowledging large differences between retail prices for industrial customers inside Europe and the US (and regarding the size of industrial customers), it can be stated that industrial energy prices in the US are on average significantly lower than in Europe. There are indications that especially lower prices for gas and coal are the main drivers for this cost advantage. Therefore, the US industry already has a "head start" on global markets – this means that any additional cost burden on the European industry should be avoided if competitiveness is to be ensured.

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69 The so called "merit order effect" is also not included. The merit order effect of RES-E refers to the impact of RES-E in-feed which tends to lower electricity wholesale prices at the power exchange. So RES-E in-fed tends to reduce the wholesale prices in some hours but increases total cost of electricity supply.

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Annexe – Further details about the Energy Efficiency Directive

Member States derive their national targets for energy efficiency improvements based on

- GDP forecasts;
- Energy saving potentials;
- the national energy mix;
- export import balance.

Most relevant aspects of the EED are

- In the long run, Member States shall develop a long term perspective for the building sector.
- In the shorter term, public buildings are required to improve their energy efficiency by 3%/a. Public sector has to procure energy efficient goods and services.
- Energy audits for companies, individual metering, transparency of energy use, cost efficient CHP generation as well as district heating or cooling are also supported.
- From 2014 onwards, Energy distributors and retailers shall be put under obligation schemes (e.g. Tradable White Certificates). In this cap-and trade scheme energy savings of 1.5% per year shall be achieved. Member States can opt out of this scheme and install alternative schemes.

Ecodesign Directive

In addition to the EED, the so called Ecodesign Directive was adopted in 2005 and amended in 2009. It aims at improving energy efficiency in the EU by setting minimum standards for energy related products looking at the whole product life cycle. National authorities are in charge to verify compliance ("CE" marking). Products covered are for example refrigerators, freezers, driers, dishwashers, washing machines, TVs, electric motors, water boilers, water pumps, air fans, etc. Further products shall be added to the list in the coming years (e.g. air conditioning, industrial ovens, etc.).

Energy Performance Building Directive

The Energy Performance Building Directive has been adopted in 2010 and aims at energy efficiency improvements in the building sector. It adresses both, existing building stock as well as new buildings. Today, about 40% of total energy consumption in Europe is related to buildings (mainly heating and cooling).

The directive sets mid-term objectives for all new buildings, aiming at close to zero energy consumption for new buildings by 2020. Member States can choose how to define the national building requirements.

Annexe – Further Details on the Energy Efficiency Directive

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