sandbag

Europe's failure to tackle coal

Risks for the EU low-carbon transition

July 2014

About Sandbag

Sandbag is a UK based not-for-profit research and campaigning organisation focused on the issue of emissions trading. If emissions trading can be implemented correctly, it has the potential to help affordably deliver the deep cuts in carbon emissions the world requires to prevent the worst impacts of climate change.

Through rigorous but accessible analysis we make emissions trading more transparent and understandable to a wider audience. In particular, we hope to shed light on the challenges the EU Emissions Trading System (ETS) faces in becoming a truly effective system for cutting emissions and to advocate the solutions that can help it to work better.

The International Centre for Climate Governance ranks Sandbag in the top twenty climate think tanks in the world.

We are grateful to the **European Climate Foundation** for helping to fund this work.

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Executive Summary

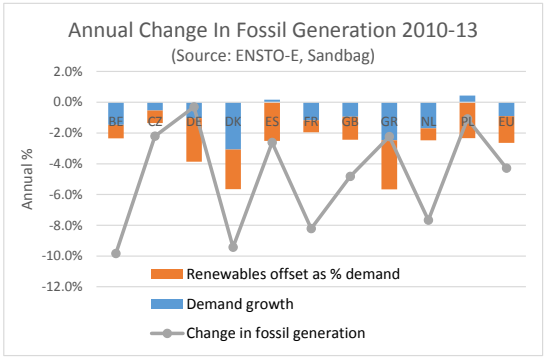
THE PROBLEM:

Coal emissions rose 6% from 2010-13, despite massive investment in renewables and electricity demand falling.

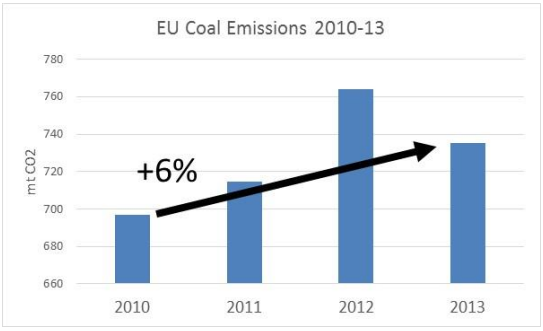
In 2013, coal emissions alone contributed to 18% of total EU CO2 emissions, which is as much as all road transport.

If the EU climate policy can't stop coal, then it is not credible.

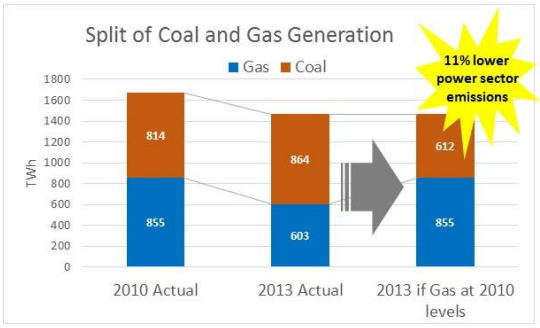
Fossil generation fell by 4.3% per year from 2010 to 2013 due to falling electricity demand and rising renewables.



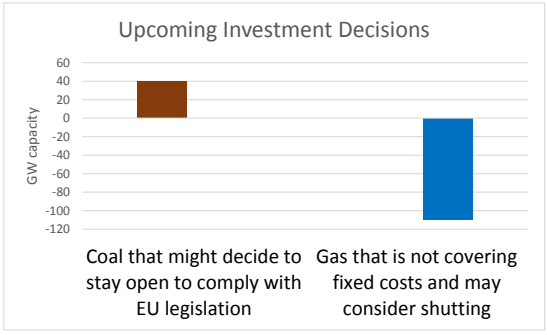
However, this just reduced gas emissions. Coal emissions actually increased by 6% over from 2010 to 2013.



This has created a "missed opportunity" to reduce power sector emissions by 11%.



It is also impacting upcoming investment and risks making "Coal's comeback" semi-permanent.



EU CO_2 emissions from coal in the power sector have increased by 6% since 2010 and now represent 18% of EU's total CO_2 emissions.

- Germany, UK and Poland are responsible for 66% of coal based emissions, and also responsible for the entire 6% EU increase since 2010.
- Overall, power sector emissions fell by 7% from 2010 to 2013, but would have fallen by 18% if gas had been cheaper than coal. Sandbag sees this as a "missed opportunity" to reduce emissions by an additional 11%.
- Carbon intensity for the power sector across the EU has fallen slightly overall as a result of renewables and energy efficiency improvements but not as steeply as might have been the case if gas had replaced coal.

European air quality legislation might result in many coal closures, but cheaper non-GHG scrubbing technology and new electricity capacity markets could work against this.

- The Large Combustion Plant Directive (LCPD) reduced coal emissions by 5% in 2008-13 as some stations have already shut. A further reduction of 3% is expected from 2013 to 16.
- The impact of the Industrial Emissions Directive in 2016 is not yet calculable since many flexibilities have been granted to plant owners. However:
    - Virtually no coal power stations have announced closure due to IED.
    - Cheaper compliance techniques mean it is increasingly likely many can stay open.
    - 40GW out of the total 150GW is still undecided; of this 30GW is in UK and Poland.
    - Capacity markets (already planned in UK) risk distorting the closure decision in favour of investing in refurbishment.
    - There is a real, preventable threat that many coal power stations will invest to stay open, which creates a high-carbon lock-in into the 2030's

If coal generation remains cheap, coal emissions will fall only 3% from 2013 to 2016.

- However, from 2016 to 2020, coal emissions will begin to fall faster. This is because from 2016 gas generation may have reduced to such a level that coal begins to be displaced by renewables for the first time.
- Fuel-switching will be an increasingly important feature of the EU power sector because increasing intermittent renewables leads to a lower utilisation factor on fossil capacity. And this means there is more spare capacity to switch from coal to gas, and vice versa.
- Therefore, the emissions saved in a "cheap gas" scenario compared to a "cheap coal" increase, as the potential for fuel switching increases. Emissions saved will increase from 11% of power sector emissions now, to 28% by 2020.

The increased fuel-switching potential has two important implications:

- The carbon price will become increasingly important in determining emissions.
- Getting the correct generation mix now is essential to future emissions – i.e. saying goodbye to old coal capacity now, and making sure large amounts of gas capacity don't close.

The most important policy lever at an EU level is the ETS the caps of which must be tightened to deliver a more meaningful carbon price. Additional options include:

- The introduction of supplementary carbon taxes to boost the carbon price
- The introduction of carbon intensity targets for the power sector
- Emissions performance standards on existing power stations
- Tighter environmental regulations on non-carbon pollution
- Reintroduction of mandatory efficiency targets for generating plant
- An age based phase-out policy
- A new Carbon Capture and Storage (CCS) policy targeted at countries with a higher than average carbon intensity

To be on course for longer term emissions reductions achieved at least cost, policy changes at Member States level and EU level are necessary to drive unabated coal off the system both in the short and longer term. This is a key credibility test for EU climate and energy policy. We hope that Member States and the newly configured European Parliament and Commission will take these findings to heart and agree an effective 2030 policy package.

We recommend:

- **Urgent reform of the ETS through cancellation of surplus allowances and the early introduction of a market stability reserve coupled with aggressive increases to the Linear Reduction Factor.**
- The introduction of mandatory power sector carbon intensity reporting and monitoring at an EU level coupled with a new steadily declining emissions performance standard for suppliers of electricity in the EU.
- A new round of grant funding for CCS projects specifically targeted at countries with a higher-than-average dependence on coal in the power sector.
- A clear state aid policy that states that capacity market payments should align with EU climate policy and take efficiency and carbon intensity into account.

Section 1:
Introduction

About this report

This Sandbag report is the culmination of months of research and analysis, to increase understanding and transparency of European power stations, what has been happening recently and what is likely to happen in the future.

Specifically, we created a unique free database, containing details of every power station in Europe – including historic emissions, MW capacity, fuel type, parent company, LCPD status. It covers 13 countries, which in total cover 92% of EU power station CO2 emissions.

We then undertook coupled research and analysis of investment scenarios for individual power stations, to build a bottom-up picture of what emissions and carbon intensity could be in the future.

Previously Sandbag's emissions analysis has been across the entire power sector, in this report, for the first time, Sandbag can reveal EU power sector emissions in more detail, and in particular take a close look at emissions from coal generation.

European policy-makers are not currently paying much attention to CO_2 emissions from coal and gas – and therefore the carbon intensity of the power sector. The policy focus has instead been on renewables and energy efficiency. Despite big advances in these technologies, at the same time, low carbon and coal prices coupled with high gas prices have precipitated a roll back to coal. Many commentators are saying that the recent increase in coal generation is temporary, and the outlook is for CO_2 emissions from coal to rapidly fall.

"European coal fever will prove temporary"
International Energy Agency's 5-year coal outlook, December 2013[1]

"European coal & lignite CO2 emissions will more than halve by 2030"
Bloomberg New Energy Finance, "2030 Outlook", Jul 2014[2]

"Coal is not making a comeback in Germany"
"Status of Coal in Germany's energy transition", Heinrich Boell Foundation, June 2014[3]

"In all scenarios, most UK coal plant is closed by 2023"
National Grid Future Energy scenarios, July 2014[4].

Could all these predictions be wrong?!

Sandbag started asking key questions, which we begin to answer in this report:

- How much have CO2 emissions from coal been rising and why?
- What has happened to gas capacity?
- Is it possible emissions and carbon intensity in the power sector could continue at the current high levels?
- If yes, why, what would this mean, and what policies could be put in place to ensure that this does not happen?

Predicting the future is of course impossible and in energy policy it has proved consistently difficult to get it right. The EU is currently debating a package of climate and energy policy measures that will guide developments from 2020-2030. It is therefore an important time to take stock, assess what has happened under the last 2020 package and consider carefully the policy parameters that will be needed in the next decade.

This report provides valuable insights into recent trends in the European power sector and looks in detail at some of the factors determining what they might be in the future. We hope that Member States and the newly configured European Parliament and Commission will take its findings to heart and agree an effective 2030 policy package.

[1] http://www.iea.org/newsroomandevents/pressreleases/2013/december/name,45994,en.html
[2] http://bnef.folioshack.com/document/v71ve0nkrs8e0/15lzp6
[3] http://boell.org/web/index-German-Coal-Conundrum.html
[4] http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/

Section 2:
Analysis of EU power sector, 2010-13

Key findings

EU CO2 emissions from coal in the power sector have increased by 6% since 2010 and now represent 18% of EU's total CO2 emissions.

Germany, UK and Poland are responsible for 66% of coal based emissions, and also responsible for the entire 6% EU increase since 2010.

Overall, power sector emissions fell by 7% between 2010-2013, but would have fallen by 18% if gas had been cheaper than coal. Sandbag sees this as a "missed opportunity" to reduce emissions by an additional 11%.

Carbon intensity across the EU has fallen slightly overall as a result of renewables and energy efficiency improvements but not as steeply as might have been the case if gas had replaced coal.

Overall trend 2010-13:

Total emissions within the EU Emissions Trading Scheme have fallen 2% from 2010 to 2013 (figure 1).

Industrial emission increased by 3% as the economic picked up from the depths of the recession.

Power sector emissions fell by 7% from 2010 to 2013. This is because falling demand and increasing renewables reduced overall generation from conventional sources by a massive 200TWh.

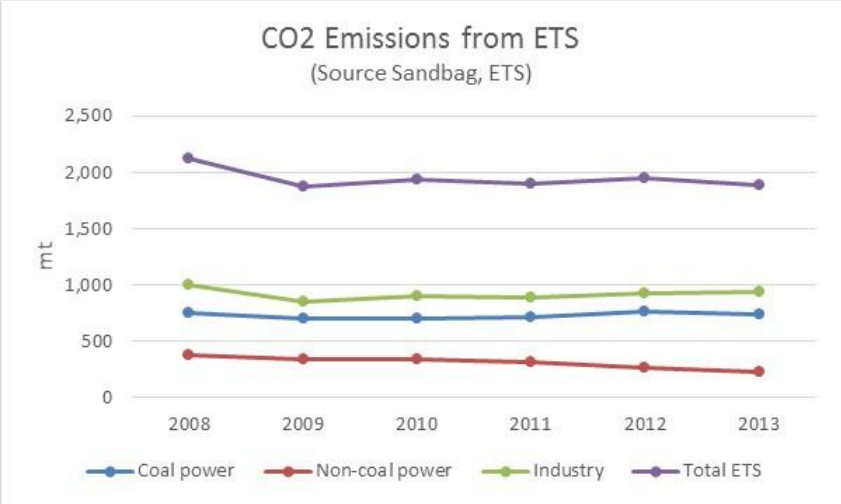


Figure 1 Carbon emissions on the EU Emissions Trading Scheme

However, because gas generation became more expensive than coal generation, coal generation over this period actually increased. Figure 2a shows that gas generation fell by a massive 250TWh across the EU, however, coal generation increased by 50TWh.

This shift from gas generation to coal generation increased CO2 from coal power stations by 6% from 2010 to 2013. In the same period that gas power emissions fell by 34%.

If a higher carbon price had ensured falling demand and renewables growth had resulted in coal generation declining, instead of gas generation, then EU power sector emissions would have fallen by 18% instead of 7%, across 2010-13 (figure 2b).

Sandbag sees this as a missed opportunity to reduce power sector emissions by 11%.

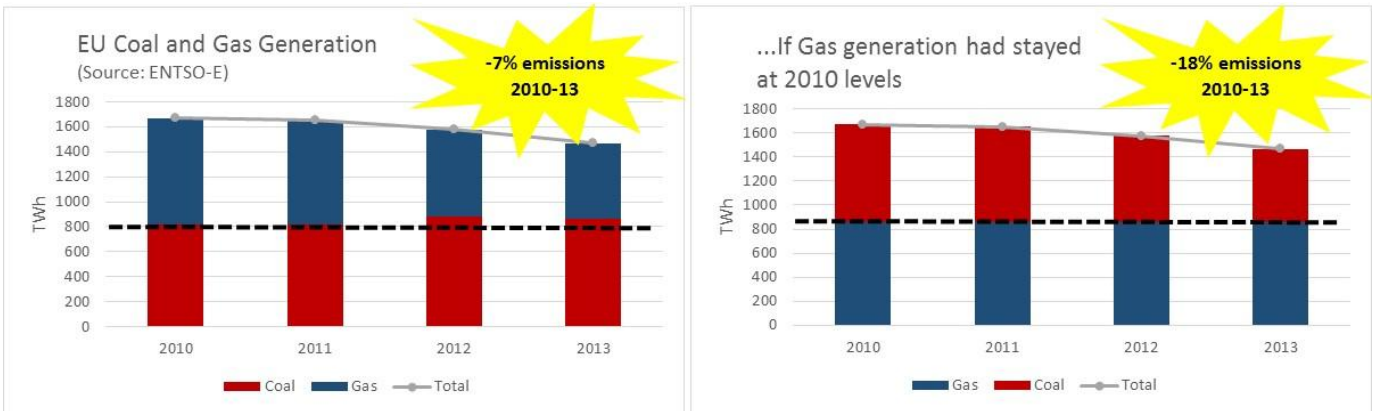


Figure 2 EU coal and gas generation; (a) actual and (b) hypothetical

Falling fossil generation

Before analysing coal emissions specifically, it's important to understand the broader picture of the power sector.

In almost every major country in the EU, electricity demand fell 2010-13, and renewables rose substantially. On average, demand fell 0.9%/year, and renewables came online equal to 1.5% of demand (figure 3). This created a 2.4%/year average fall in generation needed from conventional sources.

Since nuclear and hydro were mostly constant, this led to an amazing **4.3%/year reduction in fossil fuel generation** across the entire EU in 2010-13.

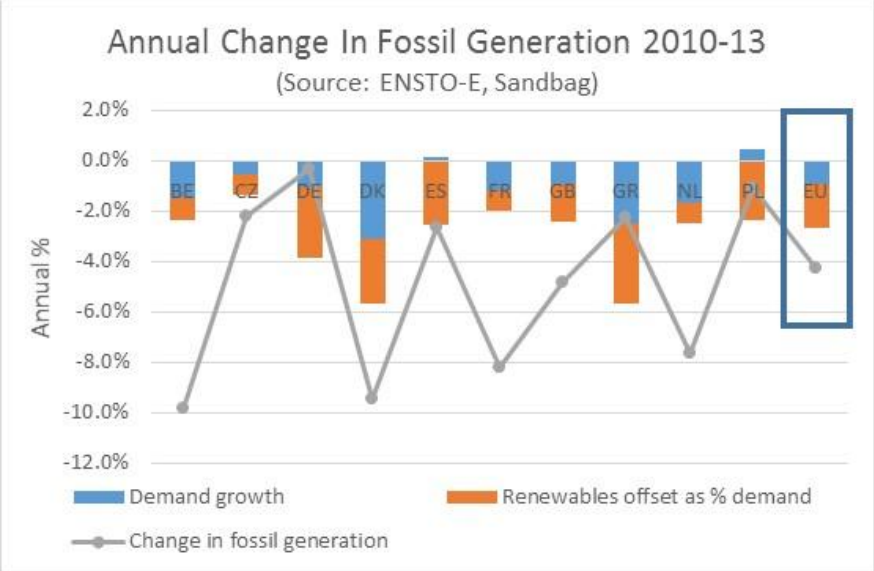


Figure 3 Annual change in fossil fuel generation 2010-2013

The only exception is Germany (see figure 4), where fossil generation fell by only 0.3%/year. Renewables growth was almost completely offset by falling nuclear generation from Germany's nuclear phase-out programme (+45TWh renewables , -41TWh nuclear, from 2010 to 2013). Also, a 16TWh increase in exports kept fossil generation high.

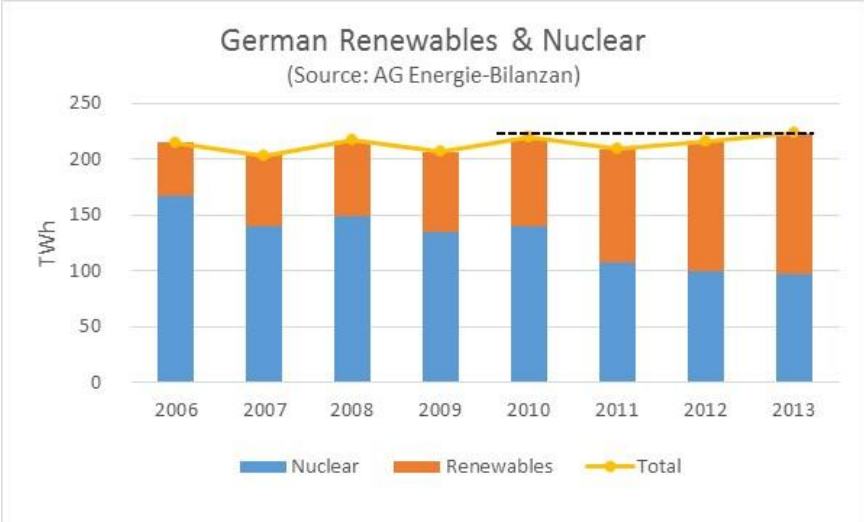


Figure 4 Power generation by renewables & nuclear in Germany

Analysis of coal emissions 2010-13

Sandbag found that in 2013, coal power stations were responsible CO2 emissions of

- 77% of the European power sector
- 39% of all emissions from the Emissions Trading Scheme (*figure 5a*)
- 18% of all Europe's CO2 emissions[5].

Also, 66% of coal power stations emissions were from just 3 countries (*figure 5b*).

- 36% from Germany
- 15% from UK
- 15% from Poland

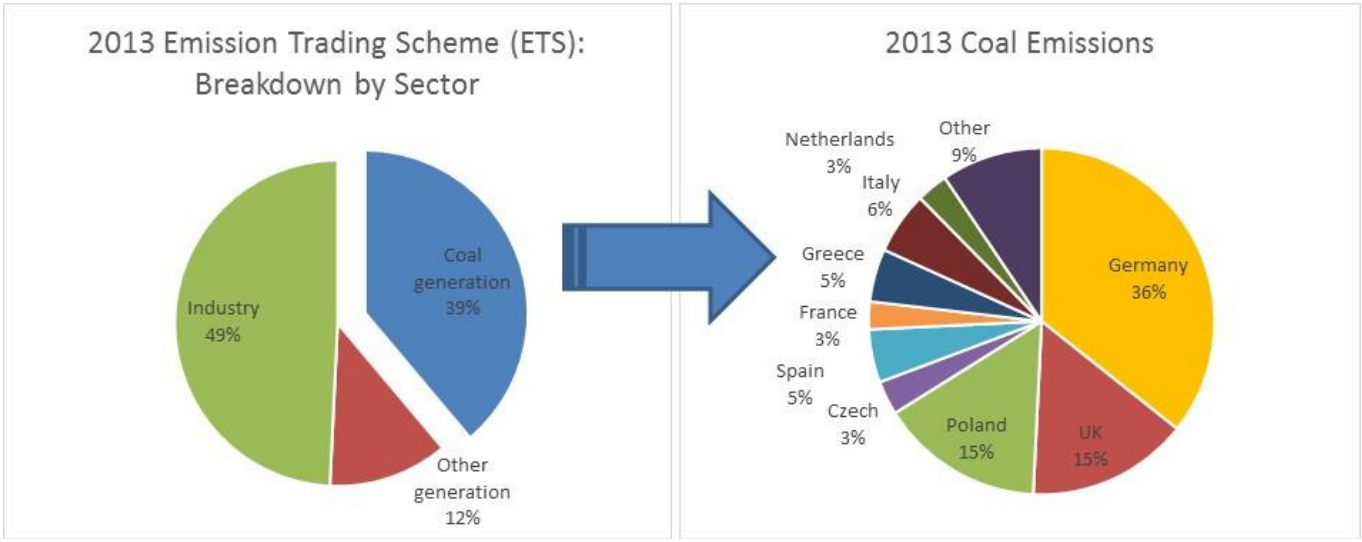


Figure 5 (a) EU ETS sectorial emissions, and (b) coal emissions by country

Sandbag found that coal power station CO2 emissions jumped 6% from 2010 to 2013 (figure 6). This was caused almost entirely by fuel switching away from gas generation to coal generation, as high gas prices, low carbon prices and low coal prices combined to push coal up the merit order.

This is despite a 4% fall in 2013 coal emissions, which was due to the closure of LCPD coal power stations (which had ran out of permitted running hours) and Spain getting a wetter year which reduced need for coal generation. Fuel-switching in 2013 was actually even larger than in 2012.

[5] Using EC assumption that the ETS represents 45% of total EU emissions http://ec.europa.eu/clima/policies/ets/index_en.htm

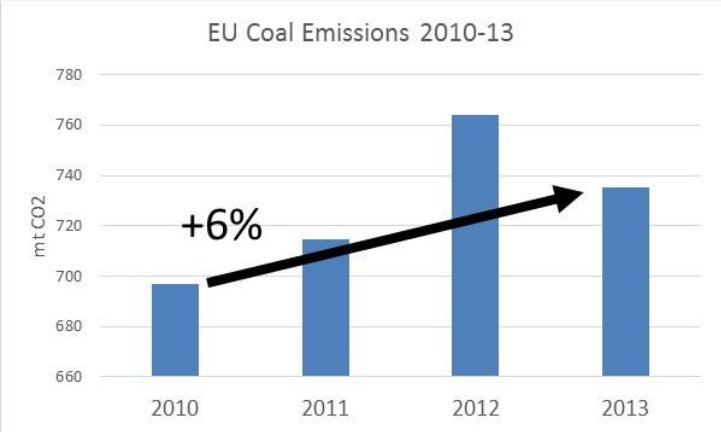


Figure 6 Growth in EU Coal Emissions, 2010-2013

The 6% rise in total coal emissions was entirely caused by the 3 biggest emitters – Germany, UK and Poland (figure 7). Germany increased by 7%, UK increased by 19% and Poland increased by 2%.

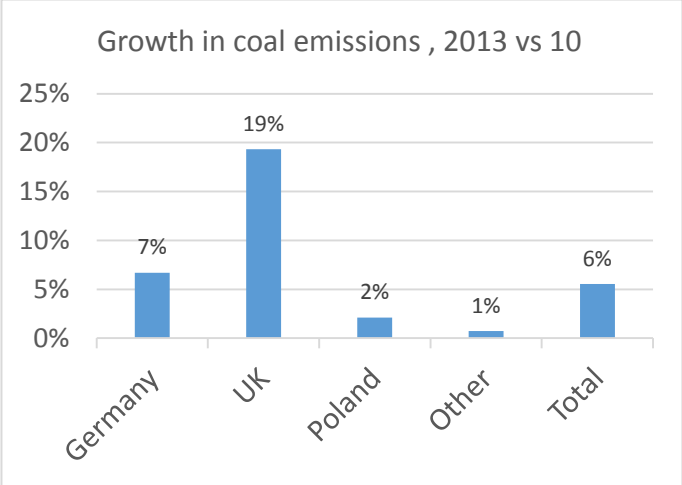


Figure 7 Growth in coal emissions by country, 2010-2013

The fuel-switch happened in Germany, UK and Spain (Figure 8). The coal-gas price differential, including carbon, increased in 2012 and hit its highest point in 2013. As at 2013, there was no further fuel-switching possible because coal was consistently cheaper than gas through the year.

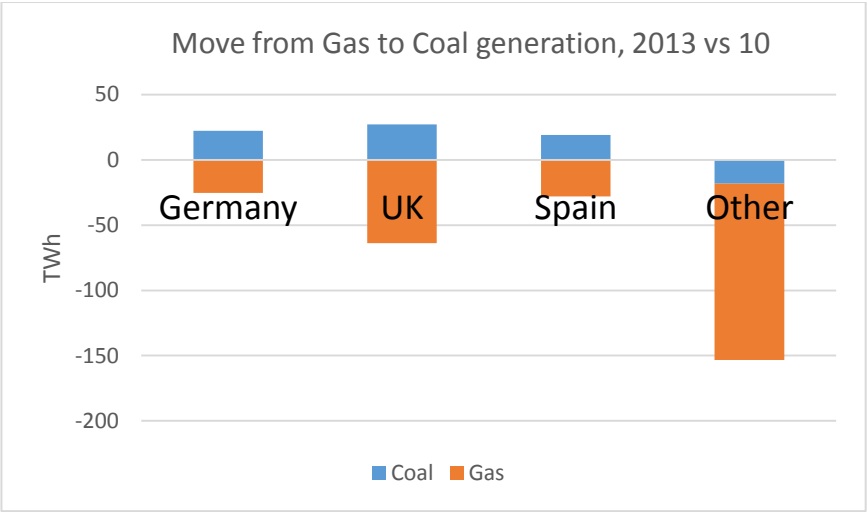


Figure 8 Switching from gas to coal generation, 2010-2013

German fuel-switching happened not only with domestic gas, but German coal generation also offset gas generation in bordering countries. Figure 9 shows border countries increasing their imports and reducing their gas generation.

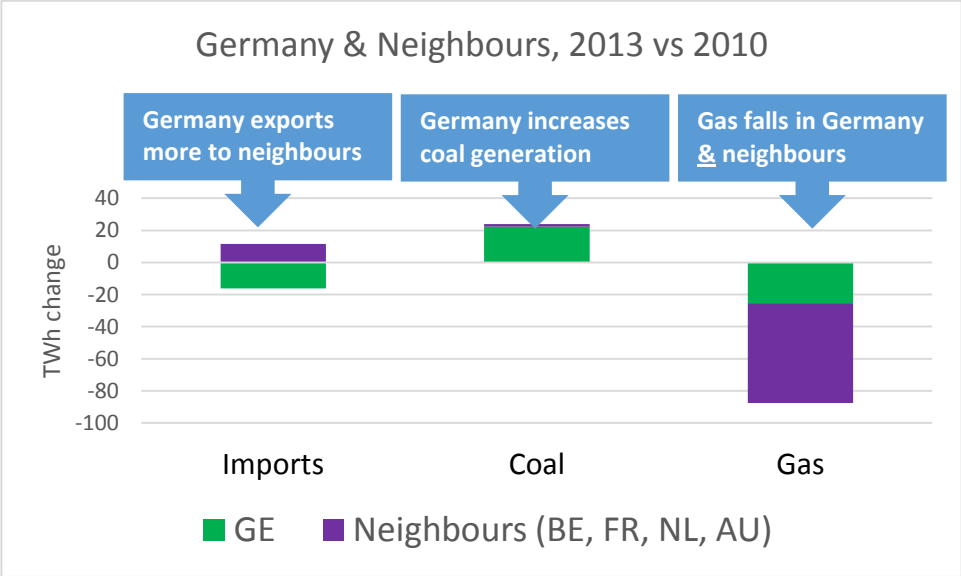


Figure 9 Changes to generation in Germany and neighbouring countries, 2010-2013

The huge reductions in gas generation and modest increases in coal generation means that coal's emissions, as a % of power sector emissions, increased hugely from 67% to 76% (figure 10).

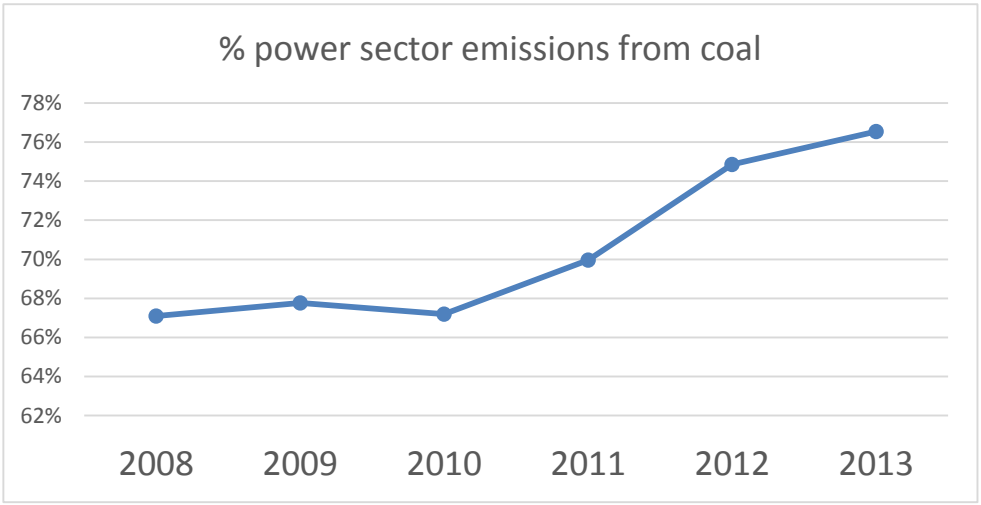


Figure 10 Percentage change in power sector coal emissions, 2008-2013

Deep-dive of Coal Emissions: UK, Germany, Poland

UK

UK coal emissions jumped 19% from 2010 to 2013. Figure 11 splits coal emissions down, and there are 3 trends.

1. *LCPD-constrained plant* had a huge surge in 2012, before collapsing in 2013 as the coal power stations reached the end of their permitted running hours. All UK LCPD coal power stations were closed by March-2014.
2. *Drax* is the 5th single largest emitter in the EU. However, its trend is downwards as it steps up biomass burn. By 2016, it plans to have half its generation from biomass.
3. *Other.* This constitutes 20GW of unconstrained coal power stations, which increased their burns hugely in 2012 due to fuel-switching. This peaked in 2013, as the coal-gas price differential hit its highest levels, increasing emissions even more.

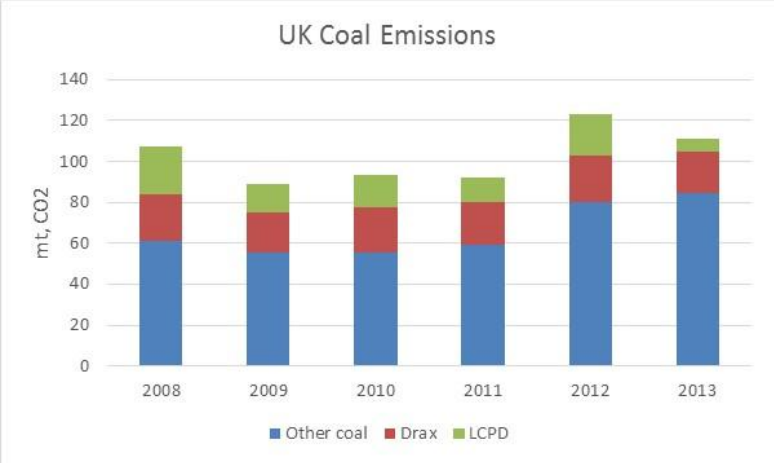


Figure 11 UK coal emissions, 2008-2013

Germany

Coal emissions rose by 7% from 2010-13 (figure 12). This was caused by new lignite capacity coming online, and fuel-switching increasing generation from hard coal.

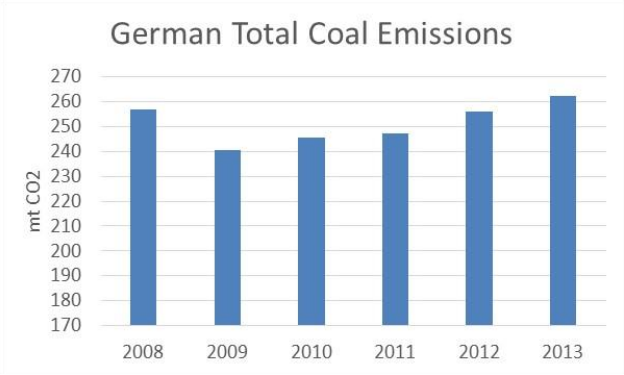


Figure 12 Germany coal emissions, 2008-2013

Lignite emissions fell from 2008 to 2010, and then rose in 2012 (figure 13a) due to new capacity. Neurath (2.2GW) came online in 2012, but the old units that it replaced at Frimmersdorf had shut 1-2 years earlier,

creating a temporary dip in emissions. In addition, Boxberg, another new lignite power station came online in 2012, pushing up emissions further. The new stations increased total lignite efficiency from 1.06 tonnes CO2 per MWh in 2008 to 1.02 in 2013. Despite this, emissions are higher in 2013 than in 2008.

Hard coal emissions increased in 2012 and 2013 as gas price rose, and German coal began to offset gas generation at home, and in bordering countries (figure 13b).

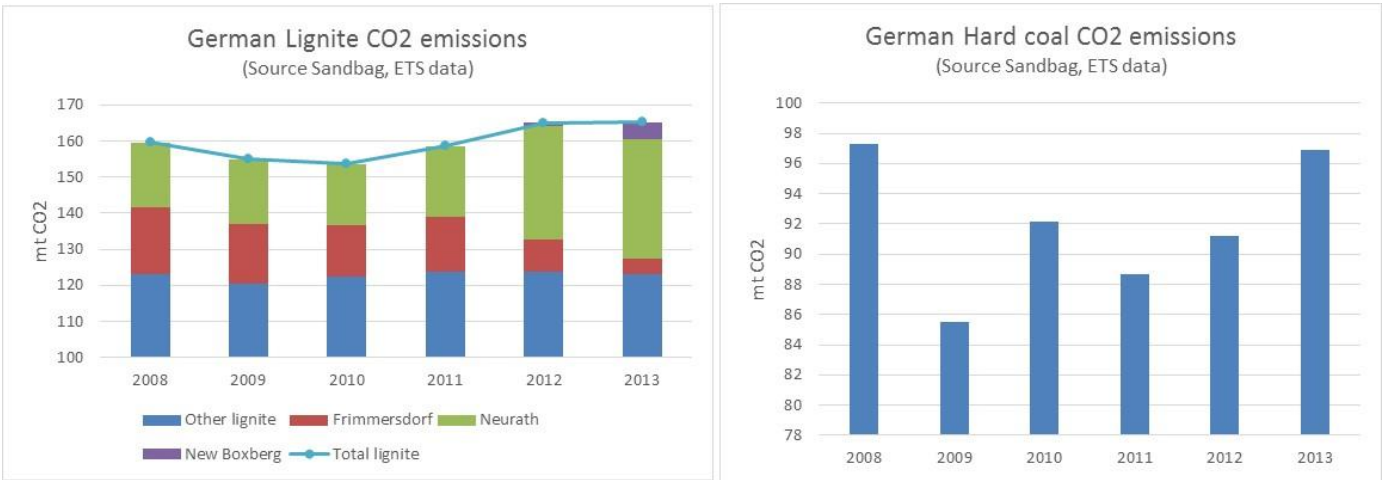


Figure 13 German (a) Lignite emissions and (b) Hard Coal emissions

So with the additional lignite capacity, and with the extra hard coal generation displacing gas generation, total German coal emissions rose in 2013 to their highest level since the ETS begun.

Poland

Polish coal emissions are remarkably flat because virtually all generation is from coal, border flows are small, and very slowly increasing demand is offset by a small growth in wind and biomass growth.

Belchatow Unit 13 came online, increasing Belchatow's emissions, and reinforcing its position as #1 polluter in the whole of Europe (figure 14). However, since total Polish generation is unchanged, this new efficient unit (41%) is – at the moment – offsetting less efficient production in Poland, leading to slight emissions reductions.

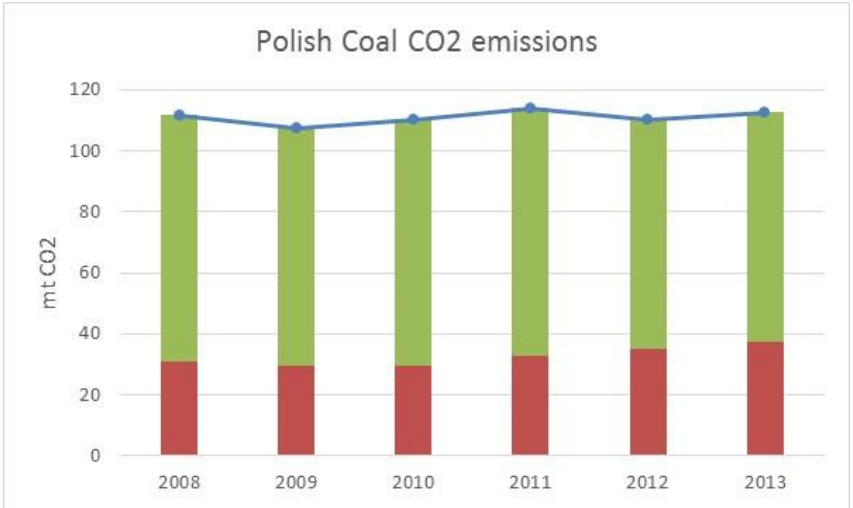


Figure 14 Polish CO2 emissions

Recent trends in carbon intensity

The carbon intensity (CO2 produced per kilowatt hour) is not a metric much focused on in EU energy policy, however, using our power sector database, Sandbag has calculated the carbon intensity of power in each country of the EU[6].

Overall, EU carbon intensity fell slightly from 2010 to 2013, from 0.33t/MWh to 0.31t/MWh. Increasing renewables and falling demand both led to large drops in fossil generation, which counteracted an increase in coal generation.

Poland, Germany and UK – the 3 countries with the highest coal emissions – also, as might be expected, have the highest carbon intensity.

Germany: German carbon intensity is second only to Poland. German carbon intensity actually rose in 2010-13 from 0.49t/MWh to 0.51t/MWh, as coal/gas switching pushed up carbon intensity (+22TWh coal, -36TWh gas).

UK: UK carbon intensity in 2013 was at 2010 levels. It spiked in 2012, but fell back in 2013 as some coal power stations had to close under the Large Combustions Plant Directive. Increased renewables (+15TWh) helped to offset the large shift from gas to coal (+27TWh coal, -70TWh gas).

Poland: Poland carbon intensity fell from 0.91 to 2010 to 0.87 in 2013, as the introduction of renewables began. Renewables increased from 2TWh to 12TWh – in 2013 there was 6TWh each of wind and biomass.

Carbon Intensity of Power Sector, tonnes/MWh					
(Source, Sandbag, ENTSO-E, ETS data)					
	2010	2011	2012	2013	*% Elec from coal, 2013*
Poland	0.91	0.89	0.88	0.87	*88%*
Germany	0.49	0.50	0.50	0.51	*48%*
UK	0.48	0.45	0.51	0.47	*43%*
Denmark	0.51	0.45	0.41	0.44	*42%*
Netherlands	0.39	0.39	0.42	0.44	*27%*
Ireland	0.40	0.39	0.43	0.39	*27%*
Czech Republic	0.48	0.47	0.42	0.39	*47%*
Romania	0.43	0.49	0.48	0.36	*30%*
Hungary	0.36	0.34	0.34	0.34	*24%*
Italy	0.38	0.36	0.35	0.31	*16%*
Slovenia	0.33	0.33	0.34	0.31	*32%*
EU	**0.33**	**0.33**	**0.33**	**0.31**	***28%***
Malta	0.28	0.31	0.35	0.30	*23%*
Portugal	0.25	0.30	0.36	0.26	*23%*
Spain	0.22	0.28	0.28	0.22	*15%*
Belgium	0.20	0.18	0.18	0.17	*3%*
Finland	0.22	0.18	0.13	0.16	*16%*
Slovakia	0.14	0.14	0.13	0.11	*10%*
Austria	0.15	0.16	0.11	0.09	*7%*
France	0.05	0.04	0.05	0.04	*4%*
Norway	0.01	0.00	0.00	0.00	*0%*
Sweden	0.00	0.00	0.00	0.00	*1%*

[6] This is done by dividing the CO2 emissions from ETS electricity installations, by TWh ENTSO-E generation. (Note: Sandbag has mapped specifically "electricity" installations using mainly EC's NACE code definition, and not used the conventional "Combustion" definition as 30% of "Combustion" emissions do not relate to power stations).

DEEP-DIVE: What carbon price is needed for fuel-switching to happen?

Fuel-switching is a 3-way formula based on gas, coal and carbon price.

Gas price has been declining through 2014, and as at July-2014, **some fuel-switching back to gas is currently taking place**. Dutch gas price (TTF) has fallen from €26/MWh across most of 2013 to around €16 (see graph below). The equivalent movements in coal and carbon price have been small by comparison.

There is over a €20/tonne range at which different degrees of fuel switching takes place. At the current €16/MWh gas price – with $75/tonne coal price and €6/tonne carbon price – it starts to become economic to replace the least efficient coal power stations with generation from efficient gas power stations. However, this is only happening in small volumes; carbon price needs to be at €18/tonne for large fuel-switching to happen now. For next summer, €18/tonne needs to be €48/tonne, because gas price is substantially higher at €23/MWh.

The UK has a carbon tax, which adds £9/tonne this year, doubles to £18/tonne from Apr-2015 to Mar-2020. **This means that from May to July 2014, there has been substantial fuel switching already.**

In conclusion, there is no "one" carbon price needed for fuel-switching – volatile gas prices in particular, mean the carbon price for fuel-switching can swing dramatically. Also, there is a €20/tonne range at which switching happens, and the UK happens much earlier due to an £18/tonne carbon tax.

As at July-2014, a €6/tonne is only resulting in small amounts of fuel-switching in mainland Europe; an €18/tonne would mean large amounts of fuel-switching happen.

Spot Dutch Gas Price Aug-11 to Jul-14

Section 3:
Impact of EU air quality legislation on coal power stations

Key findings

European air quality legislation might result in many coal closures, but cheaper non-GHG scrubbing technology and new electricity capacity markets could work against this.

The Large Combustion Plant Directive (LCPD) reduced coal emissions by 5% in 2008-13, as some stations have already shut. A further reduction of 3% in expected between 2013-16.

The impact of the Industrial Emissions Directive which begins in 2016 is not yet calculable since many flexibilities have been granted to plant owners. However:

- Virtually no coal power stations have announced closure due to IED.
- Cheaper compliance techniques mean it is increasingly likely many can stay open.
- 40GW out of a 150GW is still undecided; 30GW is in UK and Poland.
- Capacity markets (already planned in UK) risk distorting the decision in favour of investing in refurbishment.
- There is a real, preventable threat many coal power stations will invest to stay open, creating a high-carbon lock-in into the 2030's

Introduction

There are 2 pieces of EC legislation relating to air quality standards impacting coal.

- **The LCPD** – Large Combustion Plant Directive primarily restricts sulphur dioxide (SO2) from 2008.
- **The IED** – Industrial Emissions Directive primarily restricts nitrous oxides (NOx) from 1st Jan 2016.

The LCPD

The LCPD gave power stations a choice to (a) comply by installing flue gas desulphurisation, or (b) opt-out and limit generation 2008-2015, closing by Dec-2015. This led to about 35GW of power station closures across Europe, but much of this was low-load factor plant, and often back-up oil plant.

In order to work out what remaining impact the LCPD will have on coal emissions going forward Sandbag have calculated the amount of allowable generation remaining for opted out plant for each country using EC data[7], which runs up to Dec-2012. Since opted out plant is constrained to a total generation by 2015, it is also possible to calculate how much potential generation is left until 2015.

Sandbag finds that 90% of the possible LCPD generation had been made by 2012. Therefore from 2013 onwards, LCPD opted-out plant will make only a small contribution as they run out of hours.

Sandbag has mapped LCPD compliance to individual power stations, and therefore can track emissions from LCPD power stations, and then make assumptions on how they will use their remaining hours until 2015 (see figure 15).

Sandbag estimates that opted out LCPD power stations reduced their total emissions from 2008 to 2013 by 5%. However, total coal emission from 2008-2013 fell by only 3%, meaning remaining coal power stations increased their emissions.

LCPD opted-out power stations continued to contribute 3% of coal emissions in 2013. They must stop generating by 2016, but we cannot be sure that this necessarily ensures a drop in total EU coal emissions.

[7] http://forum.eionet.europa.eu/x_reporting-guidelines/library/lcp_reporting/opted_out_plants/opted-out-plants-1-january-2013

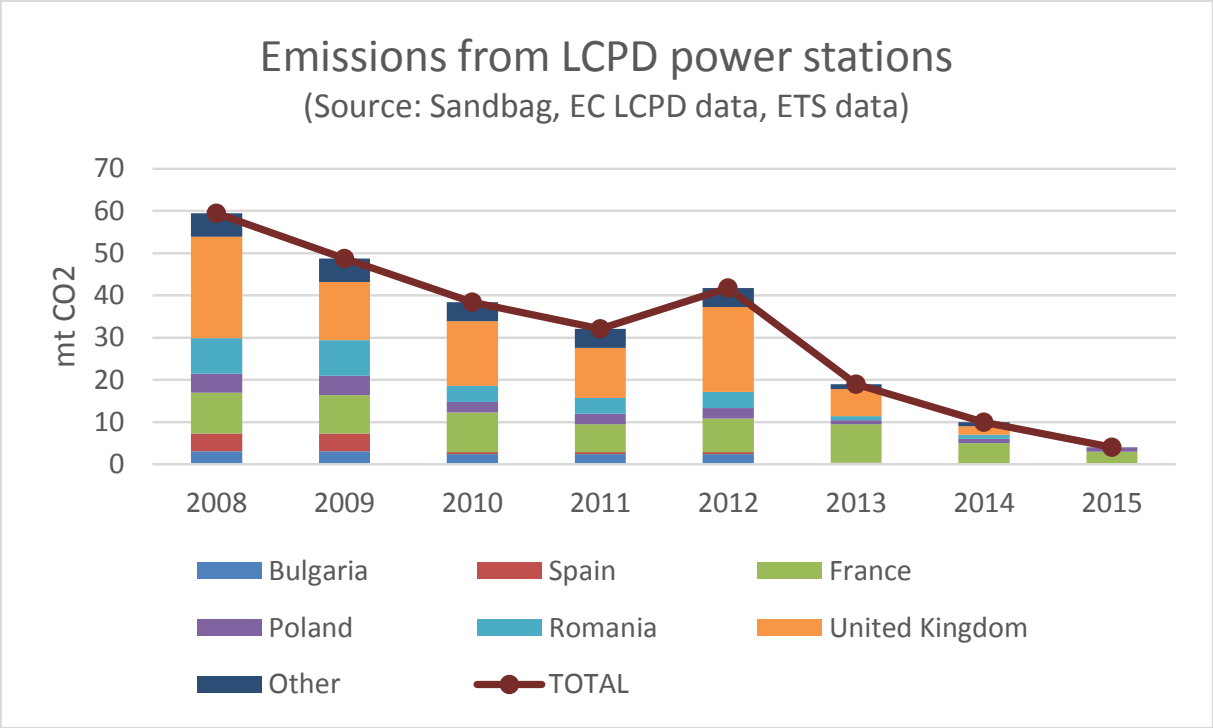


Figure 15 Emissions from LCPD opt-out coal power stations

The IED

The intention of IED was to require all power stations to install selective catalytic reduction (SCR) on all coal power stations by 2016, which reduces NOx levels by about 90%. Power stations that chose not to do this had to run limited hours and close by 2023.

However, two things mean this won't happen as envisaged:

First, many flexibilities were negotiated by industry and implementation has effectively been delayed by 4½ years. The EC introduced the concept of a "transition plan" for key countries, where full compliance is delayed until mid-2020.

Second, cheaper NOx abatement techniques have since become available, allowing a wide range of compliance options. These do not abate NOx by the same levels, but they enable power stations to comply more cheaply and still operate high load factors.

The IED limit imposed on NOx emissions is relatively high – a limit of 200mg/Ncm, when 80mg is possible if SCR is fitted. The EC is currently trying to reduce the limit to 80mg for a future date, but this decision is subject to aggressive lobbying by utilities and may not be introduced for many years.

The net effect of how the IED is now being complied with means more coal power stations will be able to remain open at relatively high load factors. Far fewer coal stations are likely to close than might have been first anticipated.

DEEP-DIVE on IED

IED Background

- European Commission's Industrial Emissions Directive[8].
- It covers all major industrial facilities, but most stringent emissions are for **SO2, NOx and dust**.
- It does not only impact coal - many less efficient CCGT are also impacted.
- IED is effective 01.01.2016. However, for power stations built before 2003, national governments can agree a Transitional National Plan (TNP).

Options for Power Stations

Transitional National Plans exist for most countries. This gives power stations until December-2015 before they need to make a decision.

At this point, they can:

1. **Opt-in to the "Transitional National Plan" (TNP).**
   - Between 2016-2020, the power station has a reducing, tradable bubble of NOx. Applied at a plant level the bubble would allow load factors of around 40% per plant, however, it is expected some stations that have early compliance will trade to enable other unabated stations to run at higher factors than this.
   - At June-2020, the full 200mg limit applies, so the power station must either be 100% IED-compliant, or it can continue operating if it runs less than 1500 hours/year.
   - Therefore, this route does not force IED compliance necessarily.
2. **Opt-in to "Limited Lifetime Derogation" (LLD)**.
   - Restricted to 17,500 hours from 2016-23; must close by Dec-2023.
   - No need to reduce NOx emission rates past Dec-15 levels.
   - Appears stations can change their minds and opt back in to the TNP until Dec-15.

Therefore, if the station enters TNP in Dec-2015, it still does not need to comply, so **the actual decision on compliance can be made as late as probably 2018**.

Investment options for Power Stations

The European Commission intended that IED would necessitate a technology called SCR to be installed at all complying power stations. However, other cheaper options are increasingly available-

- A recent report commissioned by the UK Government shows hybrid SCR/SNCR would achieve compliance 20-30% cheaper than SCR[9].
- It is also increasingly possible that SNCR, which by itself is far cheaper than SCR, could also now enable compliance to the 200mg/Ncm[10].
- Because the NOx limits apply at a whole station – stations with multiple units can comply on one unit and use this to enable another non-compliant unit to run.
- A station could also comply if it is part-run on biomass. This is thought to be Drax's strategy, that biomass dilutes station NOx below station limits.
- CEZ[11] and PGE[12] also state that they can achieve IED compliance at some stations with only cheaper conventional methods, without need for SCR or SNCR.

[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF
[9] https://www.gov.uk/government/publications/coal-and-gas-assumptions
[10] http://noxcare.com/en-us/Images/ICR%20FEB%20PetroMiljoHR%20LOW.pdf
[11] http://www.arena-international.com/Journals/2014/03/05/r/v/j/CEZ-Zizka-IPS-Munich.pdf

Who will comply, who will close?

Sandbag has researched plant-by-plant data through EU countries, to see how owners plan to deal with IED. In the majority of countries, most of the coal power stations have plans to become IED compliant, or are already. The two undecided countries with major coal assets are the UK and Poland.

	GW*	TNP	Status of IED compliance
Germany	46	N	BDEW estimates only 4.3GW is not IED compliant[13], running on limited hours from 2016. However, this could be even lower – the 2009 ordnance[14] forced all plant to comply at similar levels to IED.
Poland	25	Y	Out of 25GW of coal plant, the system operator say only 6.6GW to will shut 2012-2020, which includes LCPD which had to close already[15].
Great Britain	20	Y	Only 6GW of 20GW is expected to be definitely IED compliant. A massive 14GW is as yet undecided. See deep-dive below.
Italy	11		Enel says all 8.7GW of coal plants are already IED-compliant[16]. Remaining 2.3GW is not clear.
Spain	10	Y	3.5GW is or planning to be compliant. 6.2GW is uncertain.
Czech Republic	7	Y	All plant investing to become compliant. CEZ is planning for all its 7GW coal plant to be compliant[17], and each plant is at various stages of financing / investment. Subsidies issue?
Netherlands	5	N	All plant is compliant, although 2.5GW of old coal plant is shutting by 2017 as part of a Government agreement[18]. This leaves only 2GW of old coal running past 2017, although new 4GW online in 2014-15.
Romania	5		3GW will be open after LCPD shut-downs, mostly lignite which is not currently compliant. Not clear on IED plans.
Greece	4		Seemingly mostly complying. PPC own all 4.4GW of lignite, and they indicated back in 2010 that they would invest to make sure almost all complied with IED[19].
France	2	N	Only EDF's 1.2GW Cordemais will comply. All other 4.7GW of coal plant will shut by 2016 (mostly LCPD opt-out).
Austria		N	Austria expected 100% compliance[20].

*GW = Gigawatts of open coal power stations in 2014, excluding LCPD opt-out.

Deep-dive on UK IED compliance

UK IED compliance

The largest uncertainty of any country is the UK. Only 6GW of 20GW of coal plant in the UK is currently expected to be definitely compliant with IED (see table below). No power stations have stated that they

[12] Page 9: http://www.gkpge.pl/media/pdf/raport_srodowiskowy_en.pdf

[13] https://www.bdew.de/internet.nsf/id/A4D4CB545BE8063DC1257BF30028C62B/$file/Anlage_1_Energie_Info_BDEW_Kraftwerksliste_2013_kommentiert_Presse.pdf

[14] http://www.bmub.bund.de/en/service/publications/downloads/details/artikel/thirteenth-ordinance-on-the-implementation-of-the-federal-immission-control-actordinance-on-large-combustion-plants-and-gas-turbine-plants-13-bims/

[15] http://issuu.com/polishmarket/docs/ca__o_____maj_2013/67

[16] "Enel's Italian plants safe from IED", Argus Media, 22-Jan-2014

[17] http://www.arena-international.com/Journals/2014/03/05/r/v/j/CEZ-Zizka-IPS-Munich.pdf

[18] https://www.acm.nl/en/download/publication/?id=12082

[19] http://www.dei.gr/Images/TSADARI.pdf

[20] http://www.argusmedia.com/Power/~/media/CE1CCE67FB4C4101A7D176BAB6863F9B.ashx

will not be compliant, and most plant are hedging their bets by having opted into both the LLD and the TNP.

The plans of 14GW of power stations are currently not clear. The chances of much of this becoming IED-compliant have increased dramatically in the last year with 2 changes: the UK's unilateral carbon price floor being frozen, and the introduction of a capacity market mechanism. The carbon price floor was reduced in Apr-14[21], making coal generation more profitable in the period 2017-2020. Although the floor price was not changed post-2020, it has set the precedent that it can be, and increased the expectation that it will be.

The introduction of a new UK Capacity Mechanism which begins in Dec-14 with auctions for capacity in 2018, has two features in which coal plant can get funded for IED compliance.

First, it can apply as a "new station" to get a 15-year capacity payment – potentially to invest £500m to get £1b in capacity payments, which could be attractive to any coal power station looking to extend its life.

- A 2GW coal power station would qualify for "new-build" if it spend >£500m (the threshold is £250/KW). Ratcliffe – a 2GW station – spent £800m on a "re-life" through 2010-2013, which included SCR (see Box).
- If the station undercut anticipated new-build CCGT price by 25%, to bid £33/kW, this would equate £1b of capacity payments over 15 years.

Second, it can apply as a "refurbished station" to get a 3-year capacity payment. If the station does not get accepted for this, it would still be eligible for the standard capacity payment on a 1 year contract, so there is nothing to lose in applying. This extra funding would certainly help swing anyone with a marginal decision. The investment needed is £125/KW, which is intentionally just below the £150/KW expected costs for SCR. However, could potentially do SNCR (or SCR/SNCR) for cheaper, and invest to reach the £125/KW threshold by useful making additional investment, in for example, efficiency improvements.

	MW	Comments	Opted into LLD[22]	Opted into first TNP[23]
Eggborough	2000	Future not clear. Lobbying Prime Minister for CFD's to convert to biomass[24].	Y	Y
Longannet	2400	Future not clear. Connection charges probably too high, but Scottish politicking could means it stays open.	Y?	Y
Rugeley	1000	Future not clear. Withdrawn plans for biomass conversion.	N	N
Aberthaw	1500	Future not clear. Initial investments in NOx reductions have begun, but no commitment yet to comply with IED.	Y	Y
Fiddlers	2000	Likely to become compliant, although not committed. Investment begun a while back for partial SCR.	N	Y
Ferrybridge,	1000	Unlikely to become compliant. However, SSE have not yet confirmed.	Y	Y
Ratcliffe,	2000	Already invested to be compliant.	N	Y
Drax	3800	Expected to be compliant without investment, as will be at least 50% biomass-fired by 2016[25].	N	N
West Burton and Cottam	4000	Future not clear. EDF delays building UK nuclear are increasing chances of conversion.	Y	Y

[21] https://www.gov.uk/government/publications/carbon-price-floor-reform
[22] http://www.defra.gov.uk/industrial-emissions/files/LCP-limited-life-list-for-publication-FINAL.pdf
[23] https://www.gov.uk/government/publications/details-of-uk-transitional-national-plan
[24] http://www.yorkpress.co.uk/news/11278507.display/?ref=twtrec...
[25] http://www.platts.com/latest-news/electric-power/london/uk-power-generator-drax-aims-to-hit-50-biomass-26724461

Therefore, the reduced carbon price floor and introduction of the capacity market, alongside the possibility of using SNCR alone to allow IED compliance, means that much of the 14GW of coal plant that is currently undecided on IED compliance, could actually end up complying.

Poland IED compliance

Poland is using its expertise to argue for exemptions and delays, rather than getting on with the job in hand of upgrading their coal power stations[26]. Poland's initial Transitional National Plan was confusing, including some power stations that were compliant, and some power stations that were due to close.

PGE says only 6.6GW of 25GW capacity is expected to close from 2012 to 2020[27].

However, it is not known how definite this is, or how remaining power stations plan to comply. PGE's own plans[28] for their 11GW of coal is to less than halve NOx emissions versus 2010, using only primary NOx reduction methods and SNCR. This does not seem to be enough to guarantee IED compliance.

If the EU carbon price were higher, it would make little economic sense to refurbish these old, very inefficient units. However, Polish companies, assisted by their Government, may be banking on the current low carbon price remaining low.

Also, Poland is considering a capacity mechanism similar to the UK. A slimmed down reserve market went live in Jan-2014, which had a fund of €100m to pay to old coal power stations. Polish power stations are undoubtedly waiting to see if they will get paid to refurbish, in the same way that UK power stations are.

IED conclusions

Through this analysis, amazingly Sandbag has identified only one major power station that has announced they are definitely closing due to the restrictions of the IED. That is Emile Huchet in France. The remaining announced closures are small, old 50-150MW units, which were likely to shut in any case.

Sandbag estimates 40GW, out of 150GW of existing coal capacity are yet to make an investment decision. They may not need to make a firm investment decision until as late as 2018.

With compliance becoming cheaper as existing techniques become more established, and cheaper techniques become more viable, there is an increasing risk that much of the 40GW may choose to invest rather than close.

What's more, 30GW of this are in the UK and Poland, where new capacity markets are making investing much more attractive, making UK and Poland even more vulnerable to a large lock-in of coal generation into the 2030's.

In terms of influencing these investment decisions it is a terrible time to have a sustained low carbon price.

[26] http://bankwatch.org/our-work/projects/coal-fired-power-plants-poland
[27] http://issuu.com/polishmarket/docs/ca__o_____maj_2013/67
[28] Page 9: http://www.gkpge.pl/media/pdf/raport_srodowiskowy_en.pdf

Section 4:
Modelling future coal emissions

Key findings

If coal generation remains cheap, coal emission will fall only 3% from 2013 to 2016.

- By 2020, this should accelerate to 19% reduction in coal generation, because from 2016 gas generation has reduced to such a level that coal begins to be displaced by renewables for the first time.
- Fuel-switching will be an increasingly important feature of the EU power sector because increasing intermittent renewables leads to a lower utilisation factor on fossil capacity, which means there is more spare capacity to switch from coal to gas, and vice versa.
- The difference between a "cheap coal" and "cheap gas" scenario will increase from 11% of power sector emissions now, to 28% by 2020.

The increased fuel-switching has two important implications:

- The carbon price will become increasingly important in determining emissions, because the possibility of fuel-switching increases.
- Getting the correct generation mix now is essential to future emissions – i.e. limited coal capacity, and making sure gas capacity doesn't reduce.

Modelling the future for coal

In this section we look at what the future could be for coal in the EU going forward.

We assume:
- Renewables growth in line with the average last 3 years – i.e. 57TWh/year.
- Demand falls at the same rate as in 2010-2013 (0.9% for EU average).
- Nuclear phase-out in countries already announced.
- Coal capacity unchanged by the IED.
- Gas capacity closures do not happen.
- Coal generation is not constrained in the run-up to IED (i.e. through the 2016-2020 transition phase), because of bubble can be traded between units.

Fossil fuel generation fell by 4.3%/year across the EU from 2010 to 2013 due to falling demand and increasing renewables. We assume this trend of falling fossil fuel generation continues from 2014 to 2020 at broadly the same MWh rate, but in % terms, it increases to 6%/year fall.

In order to assess the future role of coal Sandbag's country-by-country modelling then attempts to model real-world constraints to get the correct breakdown of remaining coal and gas generation. Important considerations were given to:
- Changes to electricity exports
- Changes to coal capacity from announced closures and new-build in GE/NL.
- Quantifying how much gas generation is able to fall. Specifically –
    - There is not perfect interconnection, so countries like UK, Italy and Netherlands will need to continue to have some gas generation;
    - There are some hours where there is not enough coal capacity to meet demand (especially in cold, windless winter days);
    - Some gas generation is not flexible due to heat off-take contracts.

We then modelled two scenarios, one where coal generation remains cheaper than gas, and one where gas generation becomes cheaper than coal like in 2010. Figure 16 shows the model results in TWh at an EU level.

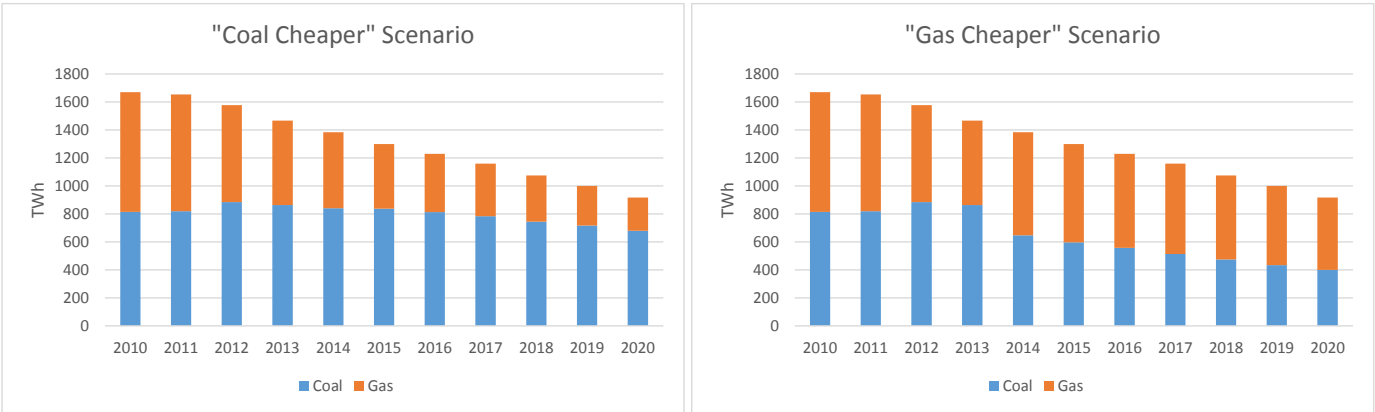


Figure 16 Scenarios of coal and gas generation

Conclusions of Modelling

The above analysis draws two important conclusions.

1. Coal emissions remain stubbornly high, if coal generation is cheaper than gas.

Sandbag modelling shows that coal generation will fall only 3% from 2013 to 2016, if coal generation remains cheap (figure 17). This does accelerate from 2016 when gas generation has reduced to such a level that coal begins to be displaced by renewables and by 2020, coal generation will have reduced by 19%.

Germany - Falls in coal are slight to 2016, as new coal capacity and interconnector capacity increase exports, at the expense of gas generation abroad. However, this trend reverses from 2017, when increasing renewables in neighbouring countries mean they no longer need German exports of coal generation.

UK – Closure of LCPD power stations and also Drax partial conversion to biomass reduces UK's coal emissions by 9% by 2016. However, there is so much gas left to displace in the UK, and coal only falls by 13% by 2020.

Poland – Increasing wind and biomass will gradually impact coal emissions – down 4% in 2016 and 12% by 2020.

Spain and Italy – Between 2013 and 2016, coal emissions are unchanged, as there is still so much gas generation to displace. Only at the end of the decade do coal emissions really fall.

Netherlands – Coal emissions will increase substantially as new power commission in 2013. This will reduce in 2017 when the phase-out of old coal has finished, but it still leaves 2020 emissions 28% higher than 2013.

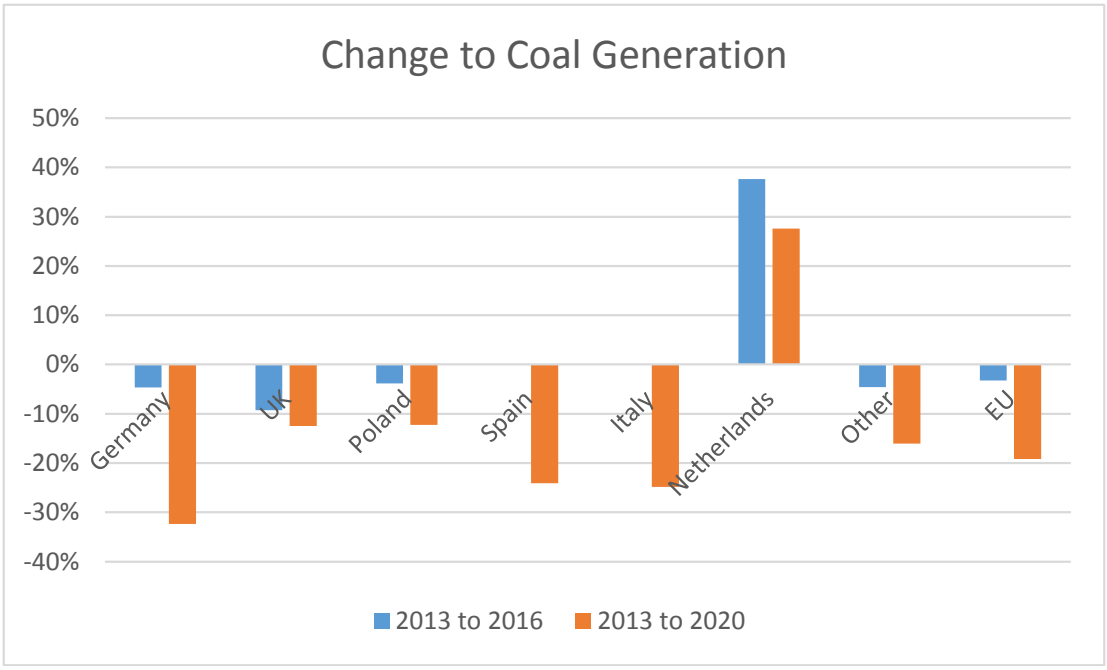


Figure 17 Modelled changes to coal generation

3. Switching potential increases through time – making it more important to close coal and keep gas capacity open.

Fuel-switching will be an increasingly important feature of the EU power sector. This is because as intermittent renewables comes into the generation mix, fossil capacity will decline only marginally as it will be needed on cold, dark, windless days, and therefore the utilisation of power stations will continue to fall. This lower utilisation factor means there is more spare capacity to switch from coal to gas, and vice versa.

Figure 18 shows the difference between a "cheap coal" and "cheap gas" scenario will increase from 11% of power sector emissions now, to 28% by 2020.

This has two important implications.

First, the carbon price will become increasingly important in determining emissions, because the possibility of fuel-switching increases.

Second, getting the correct generation mix now is essential to future emissions – i.e. limited coal capacity, and making sure gas capacity doesn't reduce.

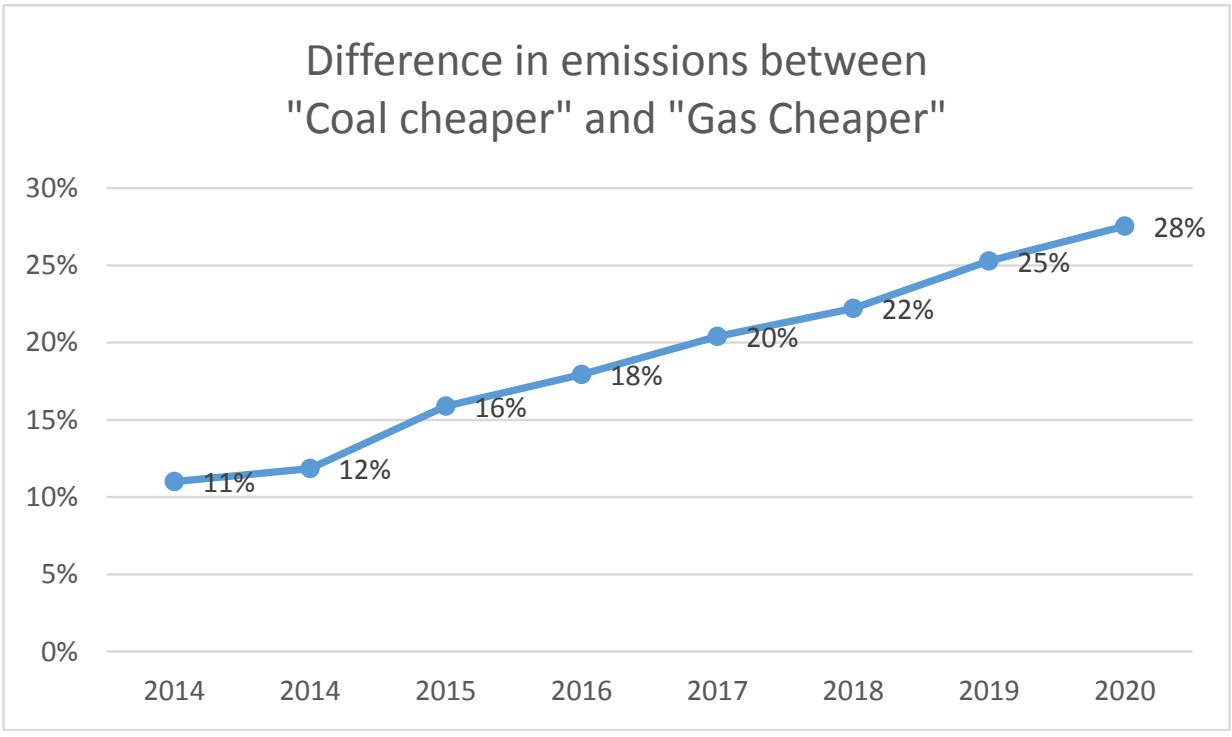


Figure 18 Emissions savings possible

Carbon intensity

Carbon intensity in 2013 for the EU power sector was 0.31tonnes/MWh. If in 2020 coal is cheaper, this is modelled to fall slightly to 0.28. If gas is cheaper, then this would fall to 0.22t/MWh.

Fuel-Switching post-2020

A low carbon price now is impacting the chances of fuel switching in the future. As we stated in the beginning of this report, between 2010-13 gas generation in the EU fell by massive 250TWh across the EU. This has a resulted in closures of gas stations:

- 51GW of gas power stations have been shut, according to the utility lobbying group, "The Margritte Group"[29].
- 20GW of gas power stations were announced for closure just in 2012-13, just by 10 companies, according to an Oxford University study in Jan-14[30].
- 110GW of gas power stations are unprofitable and at risk of closure according to IHS CERA in November-2012[31].

Coal capacity closures, however, have been far more limited. The only closures have been those previously been mandated to shut – either under the LCPD, or as part of the new RWE's Neurath lignite power station, or mandated under a Dutch government energy policy agreement with industry.

The large long-term impact from the current period of cheap coal generation, resulting in gas closures, is that there will be a reduced potential for a switch back to gas generation than there has been previously, keeping future emissions higher than they would have been otherwise.

In addition, as detailed below, many remaining coal stations, particularly in the UK and Poland, face a choice of whether to invest in refurbishments to comply with forthcoming air quality restrictions under the Industrial Emissions Directive. Significant investments into old coal capacity will reduce the overall efficiency of the EU's power sector and would mean a high proportion of coal in the mix well in to the 2020's.

[29] http://uk.reuters.com/article/2013/10/11/utilities-renewables-ceos-idUKL6N0I11UF20131011
[30] http://www.smithschool.ox.ac.uk/research/stranded-assets/Stranded%20Generation%20Assets%20-%20Working%20Paper%20-%20Final%20Version.pdf
[31] http://www.ihs.com/products/cera/energy-report.aspx?id=1065973362

DEEP-DIVE of German interconnection

In 2013, Germany exported a record 34TWh of electricity.

However, there is a lot of spare capacity that could mean exports increase significantly, as German demand falls, renewables increases and new efficient coal power stations come online.

In 2013 there was capacity made available by TSO's to export an additional 80TWh over and above the 34TWh record exports, so German exports in theory could have reached up to 114TWh (figure 19a). By 2017, there is a minimum of 20TWh additional of available capacity, giving **export capacity of 134TWh in 2017.**

The 3 new developments are

1. Assume 12TWh from a new Netherlands-Germany interconnector, due 2016.
2. Assume 6TWh extra export capacity to France. A move to a "Flow Based Mechanism" in Nov-14 will increase capacity from Germany to France/Netherlands. In 2013, according to official test runs, it would have resulted in additional exports from Germany of 6TWh. However, it may be that this increases even more – in some periods in the test runs, it increased German exports by a staggering 5GW! (figure 19b).
3. Assume 4WTh from Polish developments. "Phase shifting transformers" will, the Polish TSO (PGE) says, will allow them to increase capacity (NTC) by 4TWh (500MW). However, the border is much larger than that, and as the German North-South grid gets reinforced in 2016, this may allow even larger flows.

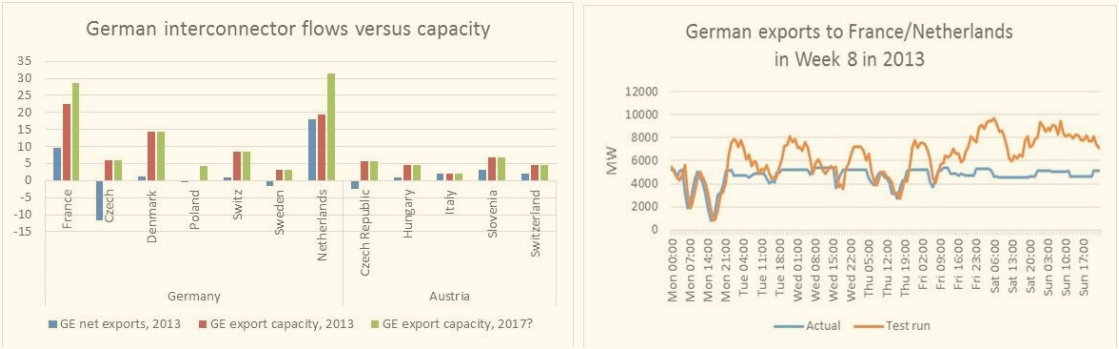


Figure 19 (a) Theoretical interconnector capacity, (b) Test run results

This German model of using interconnection to even out high renewables is not under threat in the long-term. From 2017 onwards, when neighbouring increase their own renewables – whose generation coincides generally with German renewables – Germany will find it much harder to export. What's more, the other countries will face the same problem – i.e. that they cannot rely on interconnection to even out all the renewables intermittency.

Section 5:
Policy options and Recommendations

Key Recommendations

Urgent reform of the ETS through cancellation of surplus allowances and the early introduction of a market stability reserve coupled with aggressive increases to the Linear Reduction Factor.

The introduction of mandatory power sector carbon intensity reporting and monitoring at an EU level coupled with a new steadily declining emissions performance standard for suppliers of electricity in the EU.

A new round of grant funding for CCS projects specifically targeted at countries with a higher-than-average dependence on coal in the power sector.

A clear state aid policy that states that capacity market payments should align with EU climate policy and take efficiency and carbon intensity.

Policy Implications

It is clear that to date EU energy policy has not prioritised securing reductions in the carbon intensity of our power sector. Far from being the flagship climate policy in the EU, the ETS has played a secondary role to the Renewables Directive in terms of driving investment decisions. A sustained low carbon price has allowed a considerable increase in coal emissions and caused a significant volume of cleaner gas plant to go off-line. This has meant that while renewables and demand reduction have delivered emissions cuts, these have been to gas generation, not coal generation. Worse, this risks becoming semi-permanent as gas power stations close and coal investment increases.

If nothing changes, our analysis indicates coal emissions could stay stubbornly high. Increases in renewables and demand reduction in the period between now and 2020 will begin to encroach on coal, but with no binding renewables targets on Member States continuing after 2020, this trend could slow significantly, allowing coal to remain at high levels at the expense of cleaner gas.

This would also impact transport emissions – policy to encourage transport electrification is less tenable if coal generation stays high.

In summary: Current EU energy policy is problematic in two respects: a massive potential for low cost emissions reductions is being squandered now in favour of more expensive options, and there is a risk of short term investment decisions locking in coal infrastructure for many years to come, locking out gas generation.

Policy options going forward
Solving this problem could be achieved through energy policy decisions taken in the three member states it chiefly affects – i.e. Germany, UK and Poland – however, in order to facilitate these changes EU climate policy also needs to change.

At an EU level the most important policy lever is the ETS the caps of which must be tightened to deliver a more meaningful carbon price.

If this is not achieved soon alternative approaches include:

- **The introduction of supplementary carbon taxes to boost the carbon price**
    - This option has already been implemented in the UK and Holland
    - In the UK a carbon price floor was introduced on an aggressively increasing line. However, it was subsequently frozen, and will be £18/tonne from 2015 to 2020. This has undermined the future trajectory which was originally planned to be to £70/tonne by 2030.
    - In Holland, there is a tax on coal generation of €16/tonne of coal. This was then used to negotiate a phase-out of 2.5GW of old coal – so the 2.5GW of old coal will shut by 2017, and tax will disappear in 2016.

- **The introduction of carbon intensity targets**
    - The UK's Committee on Climate Change which advises on the least cost pathway to meeting its legally binding carbon reduction target in 2050, recommended that a decarbonisation target be adopted in the UK and legislation was passed last year for one to be set in 2016.

- Similar power sector decarbonisation targets could be introduced in other EU countries and these targets should be presented as an alternative to focusing on non-binding renewables targets at a Member state level.

- **Emissions performance standards on existing plant**
  - In Canada and the US emissions performance standards which require emissions from plant to stay within a regulated limit on CO_2 have been introduced at a state level and apply to new and existing generating plant.
  - In the UK an EPS on new plant was also recently introduced as a backstop policy. To solve the coal problem in the UK an EPS could be extended to existing plant and introduced in both Germany and Poland.
  - An EU-wide EPS could also be considered for suppliers of electricity, requiring them to steadily decarbonise their electricity purchasing until at an EU level a target carbon intensity is reached. This has the advantage of being similar in approach to the relatively successful EU attempts to decrease emissions in transport through the application of emissions standards to vehicle sales. EU suppliers are already required to gather and publish their carbon intensity on an annual basis though little attention appears to being paid to the results**.**

- **Tighter environmental regulations on non-carbon pollution**
  - The idea that non CO2 emissions limits will constrain coal has been challenged by the arrival of cheaper abatement options and lots of flexibilities in the regulations. However, newer tougher limits could still be set from 2020 and could include a tight standard on mercury, which is a known persistent pollutant. Engineering advances may, however, still mean that this proves an indirect and ultimately unsuccessful way of limiting coal generation.

- **Reintroduction of mandatory efficiency targets for generating plant**
  - The EU is keen to improve its resource efficiency and is still debating the setting of an energy efficiency target as part of the 2030 climate and energy package. Any efficiency target would be easier to meet if the efficiency of electricity were improved where it is at low levels today. Efficiency improvement requirements were in place under the Integrated Pollution Prevention and Control Directive but were removed on introduction of the ETS. If urgent reform to the ETS is not forthcoming it may be time to revisit them.

- **An age based phase out policy**
  - In Canada their EPS regulations are triggered by a plant reaching more than 50 years of operation. The age of plant is used by market analysts as a rule of thumb for how long plant may continue to operate however there is no a priori reason why old plant cannot continue to operate for very many years if they receive capital investment and good maintenance. An age based limit would assist market analysis by taking out some of the guess work involved in how long companies plan to sweat assets that have been amortised many years previously.

- **A new CCS policy targeted at countries with a higher than average carbon intensity**
  - For countries without the capacity to fuel switch, deployment of CCS offers a way of reducing carbon intensity. However, the EU's CCS policy has so far failed to deliver any projects in countries such as Poland, which arguably needs CCS the most. A new more targeted CCS support policy at EU level could be introduced to address this.

Conversely certain policies at a MS level can exacerbate the problem:

- **Capacity market payments**
    - Exaggerated fears about the potential for the lights to go out because of the impact of varying renewable output and potential constraints due to emissions limits has lead some countries to introduce capacity payment schemes to reward plant for staying open and available at peak times. Depending on how these policies are designed they can act as a considerable subsidy to existing coal fired power stations at the expense of cleaner more efficient existing or new plant.
    - State aid rules on capacity mechanism payments represent a missed opportunity. In the initial draft of the new guidelines there was a proposal that capacity payments should reward lower carbon capacity providers ahead of hi carbon however this was significantly weakened
      in the final version making it more likely that member states will introduce support payments that distort the market in favour of old coal plant which though high carbon and inefficient can provide cheap back up. The arrival of capacity payments combined with a low carbon price could tip the balance in favour of continued capital expenditure into plant that would otherwise be expected to shut, squeezing out existing cleaner more efficient gas plant.

- **Seeking derogations for IED emissions standards**
    - The IED already has many flexibilities built in, but nonetheless plant operators who find it difficult to comply have persuaded Member states to request derogations from the regulations to assist them to remain operational. These derogations can further exacerbate the coal problem and create yet another layer of uncertainty when trying to assess the impact of regulations on closure of plant.

7. Conclusions and recommendations

This report provides new evidence to inform the discussion about the role of coal in the EUs power sector in recent years and into the future. Coal generation was much cheaper than gas generation in 2012 and 2013, and the co-incidence of this with a low carbon price represents a missed opportunity in terms of lower power sector emissions. There is also a significant risk that this loss of abatement potential becomes semi-permanent as gas power stations close and coal power station invest to stay open.

Many commentators, wrongly in our opinion, assume that this is a temporary phenomenon and that incoming regulations on non-GHG emissions and the existing climate policy framework will act as a dramatic break on coal in the near term.

Our analysis shows, if the ETS remains unchanged, pre-2020 coal will be reduced from high levels today but primarily because of the rise of renewables and continued reduction in demand, not because of carbon pricing or air quality regulations.

Next decade, with the absence of binding MS renewables targets and demand potentially growing again, without a higher carbon price coal emissions could remain stubbornly high as the capacity to switch back to gas is diminished by continued closures of gas plant and coal plant are encouraged to invest to stay on the system by capacity payments.

We conclude that the existing climate policy framework is currently deficient in providing the right signals at an important time when incumbents are facing investment decisions about both existing coal and gas.

In order to be on course for longer term emissions reductions, achieved at least cost, policy changes at MS and EU level therefore are necessary to drive unabated coal off the system both in the short and longer term. This is a key credibility test for EU climate and energy policy. We hope that Member States and the newly configured European Parliament and Commission will take its findings to heart and agree an effective 2030 policy package.

We recommend:

- Urgent reform of the ETS through cancellation of surplus allowances and the early introduction of a market stability reserve coupled with aggressive increases to the Linear Reduction Factor.
- The introduction of mandatory power sector carbon intensity reporting and monitoring at an EU level coupled with a new steadily declining emissions performance standard for suppliers of electricity in the EU. This would be in place of non-binding renewables targets,
- A new round of grant funding for CCS projects specifically targeted at countries with a higher-than-average dependence on coal in the power sector.
- A clear state aid policy that states that capacity market payments should align with EU climate policy and take efficiency and carbon intensity into account when awarding contracts and not reward the least efficient and most carbon intensive plant at the expense of other existing capacity.

Failing this, specific additional policies to constrain emissions from coal and support switching back to existing gas capacity in Germany, Poland and the UK may be needed to avoid lock in to high carbon investments. For example, in the UK reform of the capacity mechanism to avoid coal lock in and the setting of a decarbonisation target and the application of an EPS to existing plant. In Germany, a commitment to reducing carbon intensity and the phasing down of coal; and, in Poland, policies to encourage CCS and renewables post 2020.

Appendix 1. About the Sandbag database of power stations

For this project, Sandbag has undertaken an extensive research exercise so get as much knowledge about European power stations as possible – what their emissions are, from which fuel source, and how they comply with EU legislation.

As part of this project, we make data is freely available to other organisations.
Please email dave@sandbag.org.uk, if you would like access to it.

We have taken the EC's ETS emissions data by installation, and overlaid a variety of data on top, to get a full view of coal and lignite power stations across Europe. We have also included as much detail about gas and oil power stations, where this was available.

We have this complete for 13 countries, which covers 48% of total ETS emissions, and 92% of emissions from EU power station emissions. Of the installations in these countries, mapping of fuel type and capacity is complete for installations relating to 96% of emissions.

As an example of the data collected, here is Ireland:

Irish dataset				Details for coal/lignite compliance				Emissions, mt					
INSTALLATION NAME	Company	Fuel type	MW capa	LCPD opt-in?	IED compliant?	IED not compliant	IED unknown	2008	2009	2010	2011	2012	2013
ESB Moneypoint Generating Station	ESB Group	Coal	848	Y			848	4.0	3.1	3.5	3.7	4.7	3.9
ESB West Offaly Power	ESB Group	Lignite	137	Y			137	1.1	1.1	1.1	0.7	1.2	1.0
ESB Poolbeg Generating Station (CCGT)	ESB Group	Gas	463					1.1	1.0	1.1	0.8	1.0	1.0
Huntstown Power Station Phase 2 HPC2	Viridian Group	Gas	400					1.1	1.0	1.0	0.9	0.9	0.7
ESB Lough Ree Power	ESB Group	Lignite	91	Y			91	0.8	0.8	0.5	0.8	0.8	0.8
Whitegate Independent Power Plant	Bord na MÃ³na	Gas	445					0.0	0.0	0.3	0.9	0.8	0.7
Edenderry Power Plant	Bord na MÃ³na	Lignite	118	Y			118	0.9	0.8	0.7	0.8	0.7	0.6
Huntstown Power Station		Gas	342					0.9	0.9	0.7	0.6	0.3	0.1
ESB Aghada CCGT	ESB Group	Gas	270					0.0	0.0	0.6	0.4	0.3	0.5
ESB Aghada Thermal	ESB Group	Gas	690					0.5	0.7	0.6	0.2	0.1	0.1
ESB North Wall Generating Station	ESB Group	Gas	267					0.2	0.1	0.2	0.1	0.0	0.0
Great Island Generating Station	SSE	Oil	216					0.1	0.1	0.0	0.0	0.0	0.0
Tarbert Generating Station	SSE	Oil	590					0.9	0.5	0.2	0.1	0.0	0.0
ESB Marina Generating Station	ESB Group	Gas	85					0.3	0.2	0.1	0.0	0.0	0.0
Cushaling Power Limited		Unmapped						0.0	0.0	0.0	0.0	0.0	0.0
Tawnaghmore Generating Station	SSE	Oil	104					0.0	0.0	0.0	0.0	0.0	0.0
Rhode Generating Station	SSE	Oil	104					0.0	0.0	0.0	0.0	0.0	0.0
ESB Poolbeg Generating Station	ESB Group	Unmapped						0.0	0.0	0.0	0.0	0.0	0.0
ESB Poolbeg Generating Station (Unit 1)	ESB Group	Unmapped						0.1	0.1	0.0	0.0	0.0	0.0
ESB Poolbeg Generating Station (Unit 2)	ESB Group	Unmapped						0.0	0.1	0.0	0.0	0.0	0.0
ESB Poolbeg Generating Station (Unit 3)	ESB Group	Unmapped						0.0	0.0	0.0	0.0	0.0	0.0

Methodology

- Installation name & emissions
  - Sandbag took the full EU ETS installations, filtered for "Combustion", and with NACE code "Production of Electricity".
  - Robustness of the EU's NACE codes for "Production of Electricity" js generally very good. Two things to note: first, they exclude CHP units (as their main activity is making heat); second, manual adjustments needed to be made for Netherlands and Romanian data, which was incomplete.
  - **Sandbag found that, of the ETS "Combustion" data, power stations represent just 17% of installations, covering 75% of emissions.**
- Company name
  - Sandbag has a propriety database, mapping company names to individual installations. This covers installations representing 98% of power station emissions.
- Fuel type and MW capacity
  - This has been completed for 13 countries representing 92% of power station emissions.

- [Coverage will be 96% when complete for Spain/Italy]
- See table below for coverage and source data.

- LCPD compliance data is mapped from the European Commission records of opt-out plant[32].
- IED compliance data was researched from a variety of sources. The next section shows this in more detail.

Mapping quality for capacity and fuel type	*% coverage (by emissions)*	*Data source*
Bulgaria	89%	Internet research
Czech Republic	83%	Internet research
Germany	99%	From government (Bnetz)
Estonia	99%	Internet research
Spain	68%	
France	84%	From TSO (RTE)
UK	99%	From government (Dukes)
Greece	96%	From TSO (Admie)
Ireland	99%	From TSO (EIRgrid)
Italy	56%	Coal association website
Netherlands	99%	?
Poland	86%	Wikipedia, checked with internet research
Romania	99%	From TSO (Transelectrica)

[32] http://www.eea.europa.eu/data-and-maps/data/large-combustion-plants-lcp-opted-out-under-article-4-4-of-directive-2001-80-ec