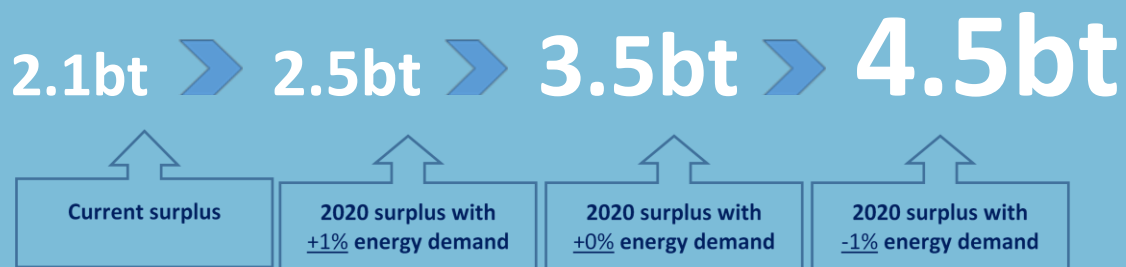


Forecasting the EU ETS to 2020

For the first time, Sandbag – alongside its “Annual State of the ETS” – launches a complementary report, “Forecasting the EU ETS to 2020”.

Sandbag projects a 4.5 billion tonne surplus by 2020 – this is more than double the current 2.1bt surplus. This is far in excess of the European Commission’s 2020 forecast of 2.6bt, and illustrates how severely the EU ETS is in need of reform.

The major difference from Sandbag’s forecast to forecasts by other analysts is its bearish outlook for emissions growth – in particular, due to the assumption of electricity consumption falling 1%/year. This is a critical assumption, as this graphic shows:



This document is open for peer review to 14-Nov-2014. Sandbag makes as transparent as possible all assumptions and methodology. If you wish to discuss any aspect of this document, please contact us at dave@sandbag.org.uk.

The document is split into 2 parts:

Part 1: Forecast EU ETS Balance to 2020

Sandbag forecasts an EU ETS surplus of 4.5 billion tonnes by 2020.

This assumes energy demand falling at 1%/year; if energy demand rises 1%/year then the surplus is only 2.5bt.

The surplus is forecast to fall only 0.2bt from end-2013 to end-2016, despite backloading.

Falling electricity consumption and growth in renewable generation means power emissions fall by 5.6%/year from 2013 to 2020.

Sandbag forecast that by 2020, emissions will be a massive 21% below the legal cap – even using a zero carbon price – which shows the scale of task in making the ETS useful again.

Part 2: Forecast Consumption to 2020

Sandbag forecasts EU electricity consumption will fall by 10% this decade.

This is due to perfect storm of

- A new generation of cheap super-efficient electrical products now available.
- Rapid uptake of these, due to easing of barriers such as price, availability, energy awareness, and funding.
- Increasing electricity prices encouraging a switch to more efficient products.
- Reducing “need” for new electrical products due to plateauing penetration of the most electric-intensive products, and low new-build of houses, offices and shops.

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](#).

Sandbag Climate Campaign is a not-for-profit enterprise and is registered as a Community Interest Company under UK Company Law. Co. No. 671444

EU Transparency Number: 94944179052-82

About this report

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Part 1: Forecasting the EU ETS Balance to 2020

Forecast Summary

Sandbag forecasts an EU ETS surplus of 4.5 billion tonnes by 2020.

Sandbag forecasts energy demand falling at 1%/year. This assumption is critical, and Sandbag believes most other analysts are not forecasting such large falls. Part 2 of this document is dedicated to explaining why Sandbag sees electricity consumption falling.

Sandbag has provided some scenarios to demonstrate the importance of this belief:

- -1%/year energy demand = 4.5bt surplus (-1.0% elec demand, -1.7% industrial emissions)
- 0%/year energy demand = 3.5bt surplus (0% elec demand, 0% industrial emissions)
- +1%/year energy demand = 2.5bt surplus (+1.0% elec demand, +1% industrial emissions)

Part of the reason why the surplus has yet to grow is not only the official backloading decision, but also a secondary backloading effect caused by unused allocations being auctioned in 2020. This means 2020 supply will be almost twice the 2014 supply. Despite this, the surplus is still forecast to fall only 0.2bt from 2013 to 2016, despite this double backloading effect.

Sandbag forecast that by 2020, emissions will be a massive 21% below the legal cap – even using a zero carbon price (see figure 1). This shows the scale of task in making the ETS useful again.

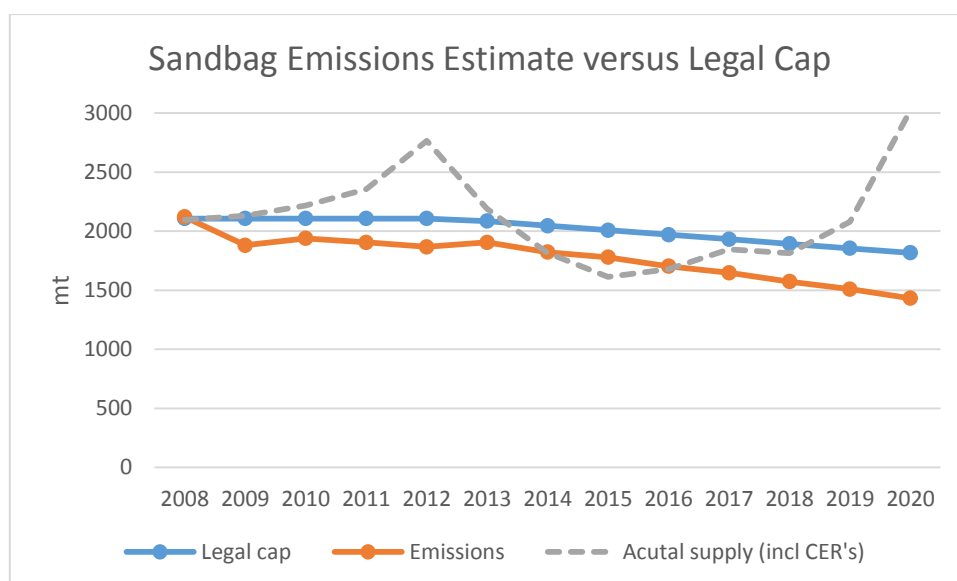


Figure 1: Emissions versus Legal Cap

Sandbag show the following table to give as much visibility as possible to the assumptions they are using. Figure 2 shows a breakdown of the major assumptions.

	Supply				Demand					Balance			
	Phase 2	Phase 3	CER	Total Supply	Power emissions	Change	Industrial emissions	Change	Aviation EtC	Total emissions	Change	Annual balance	Cumulative Balance
	mt	mt	mt	mt	mt	%	mt	%	mt	mt	%		mt
2008	2,011	0	84	2,094	1,336		784		0	2,120		-25	-25
2009	2,049	0	81	2,130	1,227	-8%	653	-17%	0	1,880	-11%	250	225
2010	2,081	0	137	2,218	1,250	2%	689	6%	0	1,939	3%	279	504
2011	2,101	0	254	2,355	1,225	-2%	679	-1%	0	1,905	-2%	450	955
2012	2,140	120	504	2,764	1,219	0%	648	-5%	0	1,867	-2%	896	1,851
2013	30	2,027	133	2,190	1,156	-5%	748	15%	0	1,904	2%	286	2,137
2014	0	1,616	200	1,816	1,081	-6%	741	-0.9%	0	1,822	-4%	-7	2,130
2015	0	1,578	35	1,613	1,053	-3%	726	-2.1%	0	1,778	-2%	-165	1,965
2016	0	1,644	35	1,679	992	-6%	711	-2.1%	0	1,703	-4%	-24	1,941
2017	0	1,811	35	1,845	952	-4%	696	-2.1%	0	1,648	-3%	198	2,138
2018	0	1,777	35	1,812	889	-7%	684	-1.7%	0	1,573	-5%	239	2,377
2019	0	2,044	35	2,079	836	-6%	673	-1.7%	0	1,509	-4%	570	2,947
2020	0	2,986	35	3,021	771	-8%	662	-1.7%	0	1,432	-5%	1,588	4,536
2008-2020	10,412	15,603	1,600										

Figure 2: EU ETS balance to 2020

Supply

- CER's: 1600mt of entitlements used.
- Phase 2 Supply: All but 188mt of the legal cap comes to market
- Phase 3 Supply: All the legal cap comes to market by 2020

Demand

- Industrial emissions: Falling at 1.7% average per year from 2013 to 2020
 - o This is based on falling production of energy-intensive materials, and on accelerating energy efficiency.
- Power sector emissions: Falling at 5.6% average per year from 2013 to 2020
 - o This is based on electricity consumption falling 1%/year. This assumption is analysed at length in Part 2 of this report.
 - o [Power sector assumptions](#), which includes Renewables built to meet 2020 EC targets, and assumes a 1% fall in fossil generation leads to a 1% fall in power sector emissions.
- The aviation sector requires zero allowances from the EU ETS.

Section 1: CER usage

Sandbag assume 1600mt of CER entitlements are used by 2020.

Entitlements are published by installations, which total 1483mt. However, entitlements for closed installations are not published, meaning the actual entitlements are higher. Sandbag believes the total is about 1600mt.

There is a slight price incentive that means 2014 usage of CER's will be quite high, because only more-expensive CER's can be used after 2014 when the criteria for EU ETS compliance tightens. Sandbag estimates 200mt CER's will be used for compliance in the EU ETS in 2014, falling to 35mt/year thereafter.

Section 2: Phase 2 supply

Sandbag assumes all but 118mt of legal cap in Phase 2 will come to market.

Sandbag uses [European Environment Data](#) for allocations and auctions, which show 10412mt of Phase 2 permits have so far come to market, 118mt less than the total 10530mt legal cap. This is shown in figure 3.

Since there is a the [2013 deadline](#) for auctioning Phase 2 permits has expired, Sandbag concludes the 118mt will not come to market.

Phase 2 Supply

mt	Allocations	Auctions	Total Supply	Legal Cap	Diff of supply to legal cap
2008	1,958	53	2,011	2,106	-95
2009	1,970	79	2,049	2,106	-57
2010	1,989	92	2,081	2,106	-25
2011	2,008	93	2,101	2,106	-5
2012	2,045	95	2,140	2,106	34
2013		30	30		30
2014			0		0
2015			0		0
2016			0		0
2017			0		0
2018			0		0
2019			0		0
2020			0		0
2008-2020	9,970	442	10,412	10,530	-118

Figure 3: Phase 2 supply

Section 3: Phase 3 supply

Sandbag assumes all legal cap in Phase 3 will come to market.

The [EC states](#) the legal cap for stationary installations as 15,603mt from 2013 to 2020. The ETS Directive also [states](#) from 2013 all cap not allocated **must be auctioned** (this was not true for Phase 2). Therefore, all the legal cap of 15,603mt must come to market for phase 3.

It is then just a question of timing. Figure 4 shows Sandbag's annual breakdown:

Phase 3 Supply

mt	Allocations	Auctions	Power allocations (Article 10c)	NER (excl NER300)	Remaining cap to market	Total Supply	Legal Cap	Back-loading	Diff of supply to legal cap+BL
2008						0			0
2009						0			0
2010						0			0
2011						0			0
2012		120				120			120
2013	1,004	1,016		7		2,027	2,084		-57
2014	846	628	130	12	0	1,616	2,046	-393	-37
2015	819	628	115	17	0	1,578	2,008	-306	-123
2016	793	730	98	22	0	1,644	1,970	-201	-125
2017	769	934	81	27	0	1,811	1,931	-0	-120
2018	745	937	63	32	0	1,777	1,893	0	-116
2019	722	1,243	42	37	0	2,044	1,855	300	-111
2020	699	1,570	0	326	391	2,986	1,816	600	569
2008-2020	6,397	7,807	528	480	391	15,603	15,603	0	0

Figure 4: Phase 3 supply

Note: There is a double back-loading effect from unallocated EUA's that will be auctioned in 2020. This acts as a secretive back-loading, adding to the existing back-loading. Sandbag estimates 2020 supply will be almost double 2014 supply, disguising the scale of the surplus today.

Sandbag builds up the individual components as follows:

- Sandbag uses [European Environment Data](#) for allocations and auctions
- "Power allocations from Article 10c" are taken from this [document](#) (Column 1 minus Column 2 under question "How many allowances will be auctioned in individual years up to 2020?"). These are only taken for 2014 onwards, since the 2013 allocations are already allocated.
- "New Entrant Reserve". The NER300 is assumed as 120mt in 2012, 180mt in 2013. This leaves 480mt, which is mostly [yet to be allocated](#); Sandbag expects this to be back-loaded.

The column "Remaining Cap to Market" is the difference required to bring the total supply up to match the Phase 3 legal cap of 15603mt. This works to 391mt of allocations, which have not been allocated. This is comprised:

- [Partial cessations](#) contributing 35mt in 2013; Sandbag estimates 52mt in 2014.
- [Article 10c under-allocations](#), which contributed 12mt in 2013.
- Other [unallocated permits](#), which in 2013 amount to 5mt.

Since most of this will never be allocated, it will be forced to market as auctions, which most-likely will not be until 2020.

Section 4: Forecast growth of Industry's ETS emissions

Sandbag forecasts industrial emissions falling by 0.9% in 2014, 2.0% to 2018, 1.6% to 2020.

Key themes are –

- Continued fall in production of energy-intensive materials in line with historic levels
- Accelerated energy efficiency measures of 0.5%-1.0% per year. Mandatory energy audits and other policy measures are expected to make a substantial difference.
- Non-CO2 pollutants which entered the Emissions Trading Scheme in 2013 are forecast to fall quickly due to cheap abatement until 2018.
- Sandbag does not assume a substantial pick-up in construction, which is important because of its large influence on the cement and steel demand.

Figure 5 shows a full sectorial breakdown:

<i>Sector (%=of total, mt=2013 actual emission)</i>	2001-2013 production* (%/year CAGR**)	2010-2012 actual emissions*** (%/year CAGR)	2014 emissions Sandbag forecast	2015-2030 emissions Sandbag forecast
Iron and Steel (25%, 184mt)	-0.9%	-1.8%	+2%	-1%
Oil and Gas (22%, 163mt)	-5.9% oil -3.8% gas	-2.1%	-2%	-2%
Cement (19%, 140mt)	-3.0%	-3.7%	-1%	-3%
Paper (4%, 27mt)	-0.1%	-4.2%	-4%	-4%
Glass (3%, 19mt)	-0.4%	-1.1%	-1%	-1%
Non-CO2 pollutants (11%, 79mt)	-	-	-5%	-5% to 2018 -1% after
Other (16%, 135mt)		-3.7%	-1%	-1%
TOTAL INDUSTRY (100%, 748mt)		-3.1%	-0.9%	-2.0% to 2018 -1.6% after

Figure 5: Sandbag forecast of industrial emissions, by sector

* Production data from industry associations (Iron and Steel from World Steel Association; Oil and Gas from Eurostat; Cement from Cembureau; Paper from CEPI; Glass from GAE).

** CAGR = Compound annual growth rate

*** From European Union Transaction Log (EUTL)

Section 5: Power Sector emission assumptions

Sandbag splits EU ETS into industrial emissions and power emissions. Total 2013 emissions were 1904mt, of which Sandbag split as 748mt as industrial emissions and 1156mt as power emissions¹.

Sandbag employs a very simple technique for forecasting power sector emissions – to calculate the fall in fossil generation, then apply the % fall of fossil generation to % fall in power sector emissions.

Year-on-year change					
Consumption	Nuclear & hydro	Renewables	Fossil	Fossil generation	
TWh	TWh	TWh	TWh	%	
2010	3246	1351	247	1623	
2011	3183	1281	296	1604	-64
2012	3196	1301	365	1530	13
2013	3156	1315	416	1420	-40
2014	3093	1298	467	1327	-63
2015	3093	1282	518	1293	0
2016	3062	1274	569	1219	-31
2017	3031	1242	620	1169	-31
2018	3001	1238	671	1091	-30
2019	2971	1222	722	1026	-30
2020	2941	1221	773	947	-30
					-19
					69
					-110
					51
					-92
					-35
					-74
					-50
					-77
					-65
					-80
					-6%
					-3%
					-6%
					-4%
					-7%
					-6%
					-8%

Figure 6: EU28 Generation mix to 2020

The % fall in fossil generation (in orange, in Figure 6) uses 2013 Eurostat data, then adjusts for:

- Consumption falling 1.0%/year as described in [Section 5](#).
- Nuclear phase-outs of 94TWh/year across Germany, France and UK.
- Renewables growth of 51TWh/year to meet EC 2020 targets.
- Coal remains mostly more expensive than gas.

Fossil generation fell 200TWh from 2010 to 2013, and Sandbag forecasts it will fall a further 473TWh by 2020. This works to 5.6%/year average fall in power sector emissions.

Sandbag then apply this 5.6%/year fall is then applied to power sector emissions (see table on the front page). This means 473TWh fall leads to a 385mt fall in power sector emissions, which is an intensity of 0.81 tonnes/MWh for the fall in fossil generation.

Sandbag believes that the fall in fossil generation would be met with 60% gas generation and 40% coal generation. This is because coal generation remains cheaper than gas, so gas generation will continue falling first, but in certain countries, at certain times of year, gas generation is already near-zero, so coal will also need to fall as well, and also UK coal is more expensive because of carbon tax.

Although 60:40 coal:gas ratio implies a carbon intensity of 0.60t/MWh (based on standard 0.4t/MWh for gas and 0.9t/MWh for coal), compared to the 0.81t/MWh, the difference is explained by

- Least efficient generators reducing their generation
- Small improvement in underlying power station fleet efficiency (esp from new coal in NL/GE).

¹ "Power" installations include CHP and auto-generators, and are identified by (a) having NACE codes 35.00, 35.10, 35.11, 35.12, 35.13, 35.14 & 35.30, or (b) in "Combustion" sector with no free Phase 3 allocation but with emissions 2013; all other installations are classified as "industrial".

- Reduction in emissions from heat-only installations, which are mostly lignite or coal.

Part 2: Forecasting Electricity Consumption to 2020

Contents

1. [Forecast Summary](#)
2. [Implications of Forecast](#)
3. [Analysis of Recent Trends](#)
4. [European Commission's Energy Efficiency Directive](#)
5. [External forecasts by appliance](#)
6. [Detailed Sandbag Forecast](#)

1. Forecast Summary

Sandbag forecast electricity consumption will fall 1.0% from 2013 to 2020. The analysis in this reports suggests that a 1.5%/year may even be possible.

Sandbag began a thorough analysis of electricity consumption when they realised that other analysts were only extrapolating historical trends, and ignoring recent evidence of a new generation of cheap, super-efficient electrical products, and their fast integration into modern life.

Sandbag forecast that EU28 electricity consumption in 2014 will be at its lowest level since 2003, effective having wiped out all the gains of the last 10 years (see figure 7). Importantly, the relationship between economic growth and electricity consumption is no longer as strong as it was - from 2000 to 2005, 1% increase in real GDP growth mirrored exactly a 1% increase in electricity consumption; however since 2005, real GDP has grown 7% and electricity consumption has fallen by 3%. Much of this divergence occurred in 2013 and 2014.

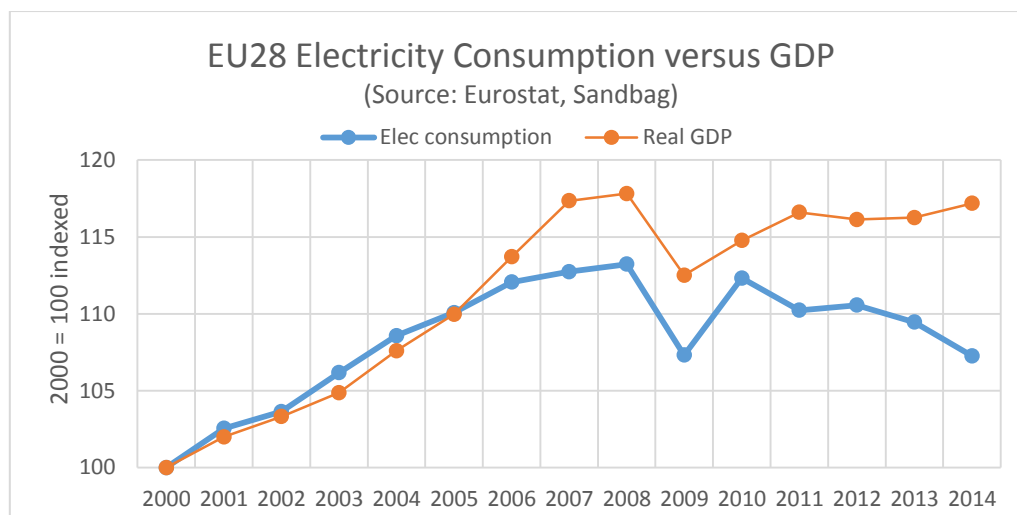


Figure 7: EU28 electricity consumption 2000 to 2014

Sandbag believes electricity consumption will continue to fall because of a perfect storm of factors:

- **A new generation of cheap super-efficient electrical products are now available.**
 - The European Commission’s Ecodesign project estimates its improvements to efficiency of products will reduce business-as-usual electricity consumption by a massive 600TWh/year by 2020 (20% of today’s consumption). Ecodesign covers virtually every electric-powered item from TV’s to electric motors to hairdryers.
 - The energy efficiency improvements of specific products is not just 10% or 20%, but quite often over 50%. TV, lighting, computer and refrigeration appliances have all experienced recent general improvements in energy efficiency of over 50%.
 - Much, but not all, of this is related to the European Energy Efficiency (EE) Directive. LED technology is one main breakthrough technology causing this change, but this is not just about breakthroughs; rapid innovation in all areas has led to this.
- **Reduced barriers to buying energy efficient products should mean a rapid uptake –**
 - Increasingly these are being priced on a par with more energy-hungry products
 - Increasingly they replace the availability of more energy-hungry products in shops.
 - Awareness of their cost savings is increasing because of labelling and smart meters.
 - Energy audits will help speed their uptake further. An energy audit gives a specific action plan to install product X and save €Y (just heating and AC investment alone could [potentially](#) reduce total EU electricity consumption by 5%).
 - Grants or low-interest loans are increasingly available for capex on EE upgrades.
- **Rising electricity prices gives more incentive to upgrade**
 - EU end-user electricity prices have risen from 2007 to 2014 by 29% for residential consumers and 28% for industrial consumers (Eurostat). They are likely to continue rising as renewables tariffs rise.
- **Plateauing “need” after the last decade of growth**
 - The last decade saw huge rises in the penetration of many high electricity intensive electrical items such as air-conditioning, # of TV’s, set-top & Wi-Fi boxes, computers & data centres, etc. This “need” is plateauing now penetration of existing households and offices is already so high.
 - The number of new houses, offices and shops increased dramatically last decade, and has now dramatically slumped, reducing the “need” for new electrical products (construction levels in 2013 were a massive 42% below the peak levels of 2007, according to Eurostat).

Even if economic growth does pick up Sandbag anticipates electricity consumption to fall. This is because Sandbag believe electricity consumption from new items is so low because they are much more efficient than historically, and that this will always be outweighed by the fall in electricity consumption caused by replacing old items with new more-efficient items.

What's more, electricity consumption is falling faster every year. The falls from 2014 to 2020 are likely to be much larger than observed so far. For example

- By 2012, only half the Ecodesign measures had been implemented, and the ones that had been implemented were all new and take time to impact.
- The first energy audits are not compulsory until end-2015 for large companies, and will take even longer to reach smaller companies. Implementation of their action plans will mean large-scale results will not be obvious until 2016.
- Building regulations are getting gradually stricter year-by-year.
- The roll-out of smart metering is yet to start in most countries.
- Financing for energy efficiency from the European Commission is doubling only from 2014, and national schemes will be even slower to implement.

2. Implications of the forecast

In December-2013, the European Commission updated its electricity forecast in its “Trends to 2050” document². The European Commission forecast electricity consumption rising by 0.2%/year from 2010 to 2020. This is described as the EC Reference Case, which feeds into a variety of policy documents.

By 2020, that means there is a massive 10% difference in forecast European electricity consumption between EC Reference Case and Sandbag’s forecast (see figure 8).

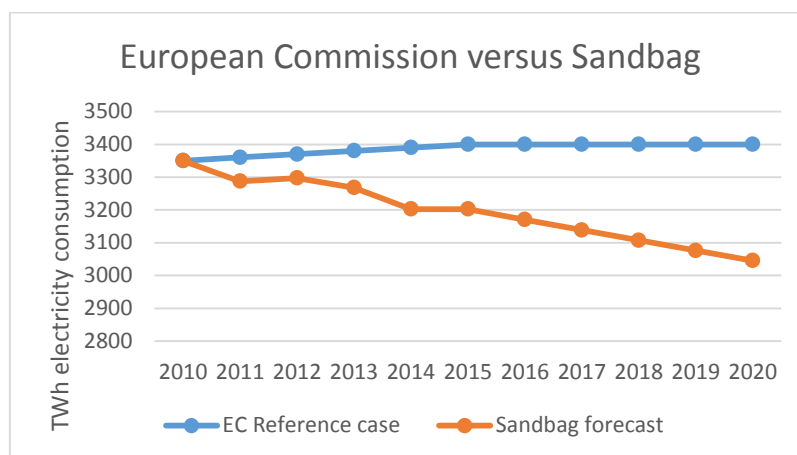


Figure 8: Comparing Electricity Consumption forecasts

The implications for this for policy-makers are large –

- **There needs to be more urgency to reform the Emission Trading Scheme**
 - The EC predicts a 2.6b tonne EU ETS surplus by 2020. But using the Sandbag electricity consumption growth, electricity use would be cumulatively 1900TWh less 2013-2020.
 - This would increase the surplus to 3.2b if the reduction came 100% from gas, or 4.3b if 100% from coal generation – either way, a massive difference to the EC prediction.
- **European Commission GHG targets for 2020 and 2030 are unambitious**
 - It is quite likely that a 40% GHG target for 2030, as currently proposed by the EC, would be met under “Business as Usual” (after taking into account renewables and EE).
 - This means the Emissions Trading Scheme would continue to run a large surplus past 2030, meaning the EUA carbon price would fall towards zero, leading to no abatement.
- **An opportunity exists to permanently shut coal power stations**
 - If electricity consumption continues falling, then there are more idle power stations. This presents an opportunity for national and European policy-makers to shut coal.
- **Are capacity markets really needed to encourage new capacity if consumption is falling?**
- A global agreement signed in Paris needs to take into account that electricity consumption growth historically has been consistently over-estimated in most countries. With the current environment of hugely increasingly efficient appliances, other countries risk making the same mistake as the EU, which is to sign up to targets that they will meet under business-as-usual.

² Page 35 http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf

3. Analysis of recent trends

Electricity consumption growth has been slowing (see Figure 9). Growth has been slowing from before the recession, and the trend shows electricity consumption is now actually

Electricity consumption fell 0.8%/year from 2010 to 2013, compared to a rise of 1.2%/year from 2000 to 2010 – a massive swing of 2%/year.

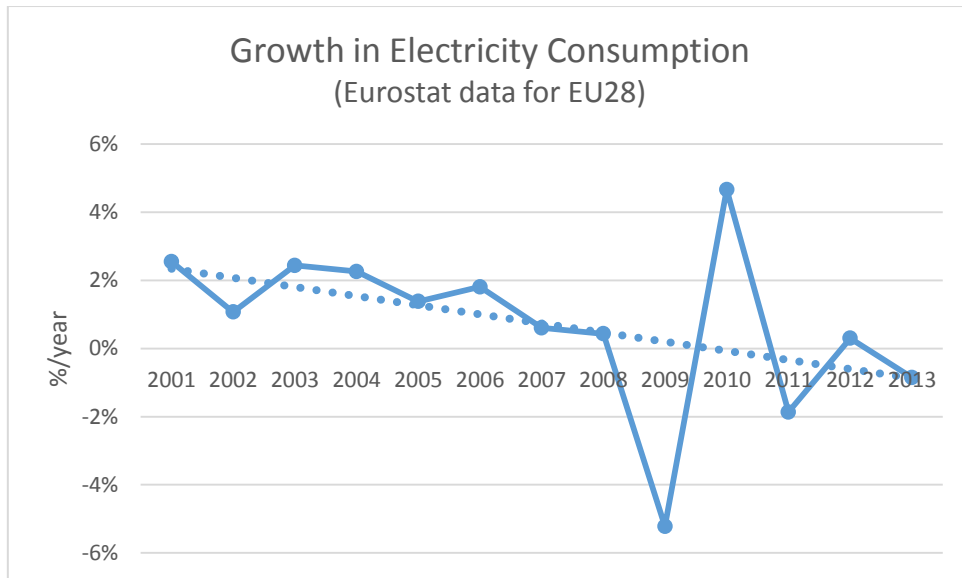


Figure 9: Growth in EU28 Electricity Consumption

Based on actuals data available as at September-2014, Sandbag anticipate a 2014 fall of 2%, further confirming this downwards trajectory. Although much of this was weather-related, the figures for falls in 2014 are huge. For Jan-Aug, the year-on-year falls by country are estimated at 4.2% for Germany, 5.7% for UK, 8.4% for France, and 3.3% for Italy, based mostly on TSO consumption data.

The most striking trend of 2010-2013 is that electricity consumption in virtually all countries has fallen (see figure 10). Generally, the countries with the biggest increases in the last decade also had the largest falls in the last 3 years.

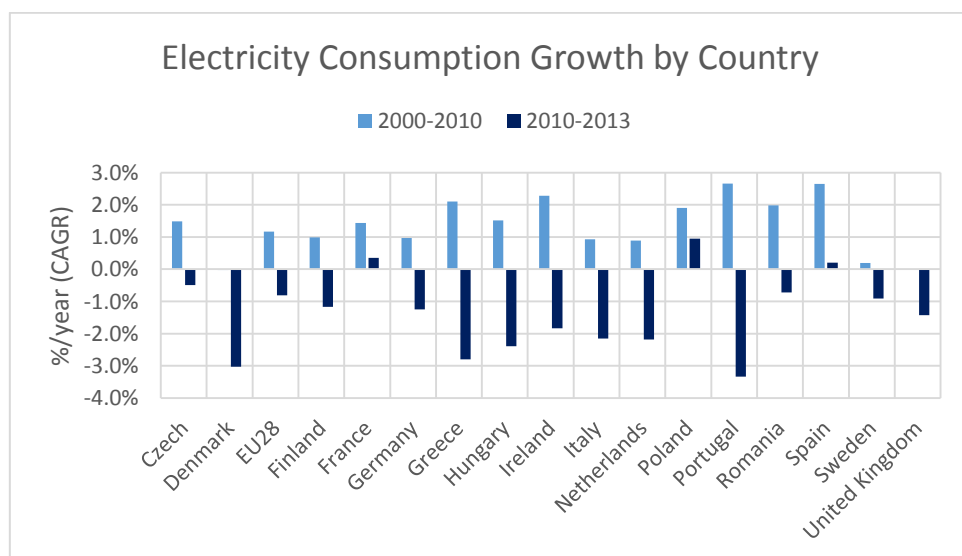


Figure 10: Electricity Consumption Growth by Country

All sectors have recorded a fall in electricity consumption, which is in stark contrast to 2000-2010 when residential and services recorded consistently large gains (see figure 11).

The only reason why electricity consumption has risen in the last decade was because of increased consumption in the residential and service sectors, and electricity consumption in these sectors is now falling.

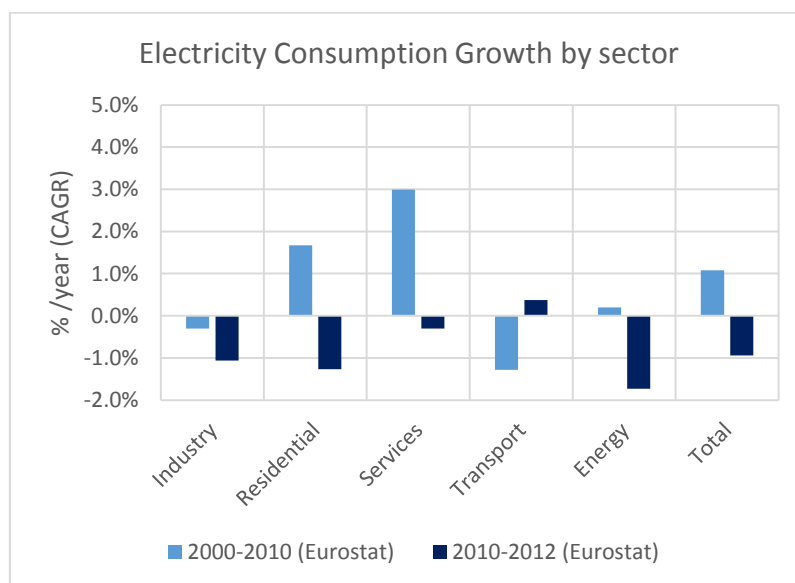


Figure 11: Electricity Consumption Growth by Sector

Note: Historic consumption data analysed is not impacted by growth in Embedded Renewables

There is a good confidence that the electricity consumption trends in this report are not impacted by the growth in embedded renewables.

Member States must report a consistent dataset to Eurostat. Generation includes categories for all renewable types, and there is also a sub-category for embedded generation of each type of renewables (“auto-producers”). Consumption = sum[All Generation sub-categories] minus Net Imports. Therefore consumption is designed to exclude all impacts of growth in embedded renewables. Sandbag performed a country-by-country analysis of each renewables type, and although it is impossible to know if this includes all embedded renewables, it appears all countries have been consistently reporting embedded renewable generation separately from consumption.

What’s more, Member States use Eurostat data to [report their progress of renewable generation](#) relative to their targets, therefore Member States have further incentive to ensure all embedded generation is pulled out separately from consumption.

4. European Commission's Energy Efficiency Directive

The EC wants to reduce end-use energy consumption by 20% by 2020. Whilst this is expected to fall proportionally more on non-electricity energy use, the European Commission is still extending its tentacles into virtually all aspects of electricity consumption, and will undoubtedly have a very positive impact on reducing EU electricity consumption.

Specific measures relating to electricity are:

Product efficiency through "Ecodesign". The [European Commission says](#) "By 2020 full implementation of the EU product efficiency legislation would be one of the most important contributions to the EU energy efficiency target. The Ecodesign Directive alone would yield yearly savings of up to 600TWh of electricity" – 20% of current electricity consumption. Although the 600TWh is in against a rising BAU, still the implication on reducing consumption is huge. [Ecofys](#) give further details of the scheme. [By 2012](#), only half the measures had been implemented, so it can be assumed by 2013, the reductions in electricity consumption still have much room to accelerate further.

Smart meters. The European Commission estimate that 72%³ of European households will have a smart meter by 2020, of which only 23% of these were installed by mid-2014 (mostly in Finland, Italy and Sweden). Initial results from various countries show electricity savings averaging 3% per household.

Energy audits. All large companies (>250 employees, >€50m turnover) must undergo an energy audit every 4 years, with the first before Dec-2015. All governments must also develop programmes to "encourage SME's to undergo energy audits and the subsequent implementation of the recommendations from these audits". This will accelerate reductions in electricity consumption from 2015. The audits are especially expected to lead to investment in better electric heating, air conditioning and ventilation systems, which alone could reduce *total* EU electricity consumption by 5%, according to a 2014 [EC-funded project](#).

Building regulations. Building regulations through the last 5 years have got much more rigorous, and are a sliding step to the EC's mandate that all new buildings to be nearly zero-energy by 2020⁴, increasing its importance through to 2020.

European Financing. €23bn is expected to be available through the Cohesion Fund for sustainable energy from 2014 to 2020, compared to €9bn from 2007 to 2013⁵. €5bn of the €9bn from 2007-2013 was allocated directly to energy efficiency, although there is no stated guidance on the split from 2014. The impact of this should accelerate from 2014 as the funding increases.

Co-generation. Industrial facilities that use lots of heat are being encouraged to set up self-generation, producing electricity alongside the heat that they need, so in effect lowering their electricity consumption.

³ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0356&from=EN>

⁴ http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm

⁵ http://ec.europa.eu/energy/efficiency/financing/financing_en.htm

5. External forecasts by appliance

Sandbag has taken external sources of electricity consumption by specific end-use, and built up a graph of the summary data (see figure 12). The data sources, and explanations on “normalising” the data to fit the graph are explained in the table below.

The results are dramatic, with electricity consumption clearly on a downward trajectory to 2020. A very simplistic average (un-weighted) of the components pictured show electricity consumption at +2.5%/year in 2001-2013, and -1.5%/year in 2013-2020 – i.e. **a massive 4%/year swing down from last decade to this decade.**

The impact will come from a combination of all products falling, and in some cases quite dramatically. Specifically, most TV’s sold are now ultra-efficient LED, lighting is seeing great advances as incandescent bulbs are phased out and LED’s increase in popularity, refrigeration efficiency has more than doubled in recent years.

The change to “A+” or better rated products has occurred very recently. For example, in the UK fridges sold with “A+” or better efficiency increased from 18% of total sales in 2011 to 89% in 2013, with similar results for washing machines and TV’s. Because household appliances are replaced regularly, so this guarantees falls through this decade (1 in 8 TV’s replaced every year, 1 in 10 washing machines and 1 in 12 fridges [in the UK](#)).

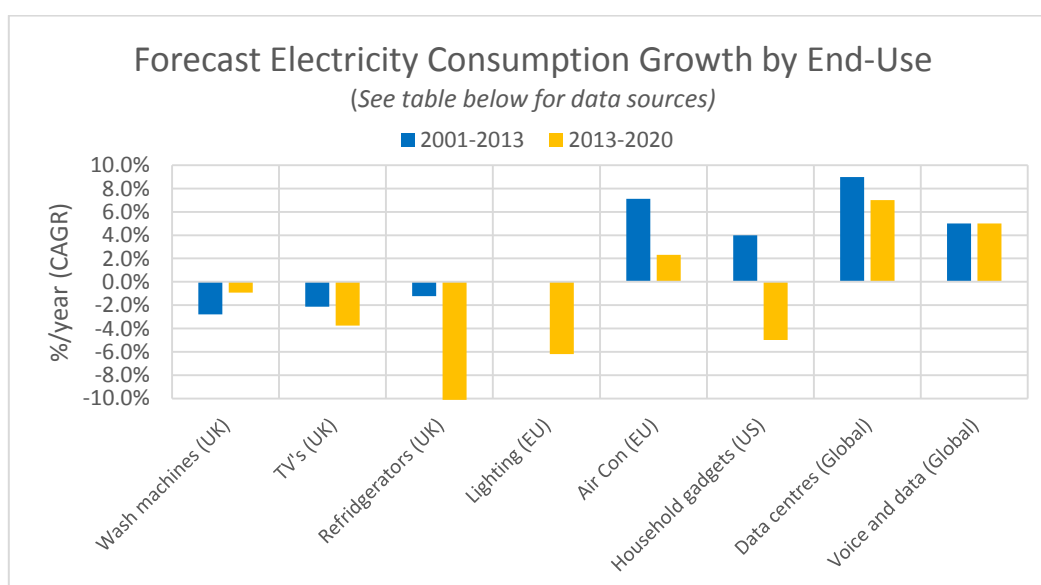


Figure 12: Forecast Electricity Consumption Growth by End-Use

Sector	Source	Relevant statistic, changes per year (% CAGR)
Washing Machine	DECC report for UK , forecast average household electricity use for average national efficiency of washing machines, past and projected.	2001-2013 -3% 2013-2020 -1% 2020-2030 -1%
TV's	Same source as Washing Machine	2001-2013 -2% 2013-2020 -4% 2020-2030 -1%
Fridges	Same source as Washing Machine. DECC say % of fridges bought that were rated “A+” or better rose from 18% in 2011 to 89% in 2013. Also, DECC estimate about 8% of total fridges are replaced every year; and for TV’s and washing machines 10% are replaced every year, resulting in a rapid reduction in overall energy use.	2001-2013 -1% 2013-2020 -10% 2020-2030 -2%

Lighting	2007 EC Impact Assessment on lighting energy efficiency plan. Assumes scenario of most EE, reducing 112TWh in 2007 to 49TWh in 2020.	2007-2020 -6%
Air conditioning	2010 EC Impact Assessment on air conditioning efficiency plan.	2005-2013 +7% 2013-2030 +2%
Household gadgets	A report by Fraunhofer USA on household gadgets. Includes drop from TV's already mentioned, but also includes desktop PC's, smartphones, etc. Note Sandbag has applied the drop quite liberally (see right), but believes this would approximately mirror the general EU trend over these periods.	2006-2010 +4% (but applied to 2001-2013) 2010-2013 -5% (but applied to 2013 to 2020)
Data centres	A report by Global e-Sustainability Initiative estimates global electricity consumption for the internet, although for Europe the growth rates are likely higher before 2013, and lower after 2013, because of growth in Asia from 2013, and therefore underestimate the Europe impact.	2002-2011 8.6% 2011-2020 7.1%
Voice and data networks	See "Data centres" above.	2002-2011 4.7% 2011-2020 4.6%

6. Detailed Sandbag Forecast

Sandbag forecasts EU28 electricity consumption falling by 1.0%/year from 2013 to 2020 (figure 6).

Sector Analysis

Here is Sandbag's forecast by sector:

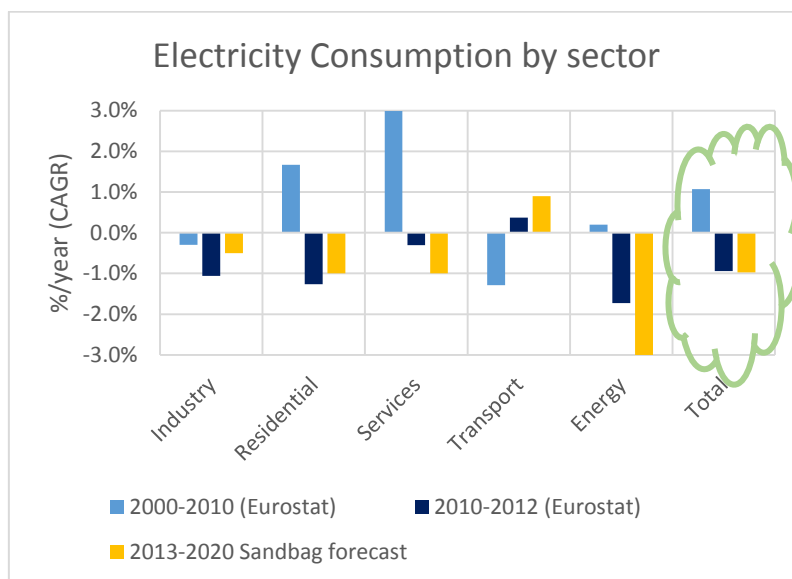


Figure 13: Forecast growth by sector

Sandbag forecast Residential and Service sectors will fall 1%/year

(Compared rises of 1.7% and 3.0% respectively last decade)

- Last decade, EU consumption rose 1.2%, but all that was from residential and service sectors. A crude average of independent forecasts studying specific products in Section 5 which relate to residential and service sectors, show that electricity consumption will fall 1.5% from 2013 to 2020, compared to a 2.5% increase from 2000 to 2013.
- Also, the annual number of new homes, shops and offices built has dramatically fallen, with the Eurostat construction index 42% below peak 2007 levels.
- Ecodesign policy is designed to cut electricity consumption by 20% against business-as-usual (BAU) by 2020. The main question is how this relates to absolute falls? At a simplistic level, it means electricity consumption growth is 2% below business-as-usual with Ecodesign. So an increase of 1.2% last decade would have been a 0.8% fall, had Ecodesign been implemented.
- It seems very likely that the penetration of ultra-energy efficiency products will explode. Pricing for A+ rated products are generally not at a premium, their lifetime cost saving are clearly labelled, they are on prominent display and less efficient models are being phased out. Energy awareness will get much better through energy audits and smart meters, and with electricity price already up 28% in 6 years, there is focus on how reduce bills.
- Economic growth seems irrelevant – more growth means consumers will replace products faster actually reducing electricity consumption, and new houses/offices/shops will be supplied with ultra-efficient products.
- There are 3 sub-sectors that will probably grow.

- *Internet*. As data and video-streaming explodes, the infrastructure needed to power this will increase. It is not clear how electricity needs will offset against huge expected efficiency improvements. One [estimate](#) shows growth falling only slightly this decade.
- *Air conditioning*. The penetration of air conditioning across the Europe is still quite low, and is expected to increase. However, much more efficient designs with much better control systems mean growth will be lower than last decade, and with replacement of existing systems, over electricity consumption may not even increase.
- *Heating electrification*. This report does not have line of sight of how much electrification of heating is going on. Sandbag assumes not much, but this could be a driver for change.

Given this, a 1% fall/year feels like a conservative estimate, and a 2%/year fall may even be possible.

Sandbag forecast the Industrial sector will fall 0.5%/year

(Compared with a 0.3%/year fall last decade)

- Assume energy efficiency continues to exceed weak increases in industrial production.
- Forced energy audits are especially expected to shift industry's focus from increasing production to reducing energy costs, and lower costs for low-energy investments and possible cheap loans for energy efficient investments mean that large efficiency gains are expected.

Given this, a 0.5% fall/year feels like a conservative estimate.

Transport: Transport use is small, but will increase with electric cars. The European Commission estimate 2TWh of electricity use for every 1m cars on the road. For context, they say even if all 223m passenger cars were electrified tomorrow, EU electricity consumption would "only" rise 15%. Sandbag assume quite low rates of vehicle electrification – 2m by 2020.

Energy: Electricity use in the energy sector is expected to fall 3%, which is slightly faster than the fall in fossil generation, with some improvements in energy efficiency, especially through investment in eastern European countries.

Country Analysis

Sandbag uses 2 key inputs to derive its electricity consumption growth forecast: impact of energy efficiency measures, and forecast GDP growth.

Energy Efficiency measures are being implemented nationally, with significantly different speeds of implementation and with significantly different levels of ambition. Sandbag takes the results of a 2012 [Energy Efficiency Watch](#) report, which interview 700 experts across all EU27 countries, to judge likely impact of energy efficiency by country. First, Sandbag takes "EE ambition" which is the % of experts who perceive the country's EE plan "quite ambitious or more". Second, Sandbag takes "EE speed" which is the % of experts who perceive the country's EE progress as "good or better".

Sandbag then takes the IMF's average 2014-15 [GDP forecast](#) from Apr-14.

The results are that eastern European countries will see no fall in electricity consumption, because their energy efficiency programmes are ambitious and behind schedule, and because their GDP growth is forecast as quite high. However, only Poland electricity consumption is forecast to actually increase, because of its poor energy efficiency plan and very high forecast economic growth.

In addition, these eastern European countries have lower electricity rates than other countries and are thought to have some heat electrification of heat, which will keep electricity consumption supported.

Country	EE ambition	EE speed	GDP growth 2014-15	Sandbag Electricity forecast
Denmark	72%	53%	1.6%	-2%
Finland	69%	81%	0.7%	-2%
Ireland	61%	61%	2.1%	-2%
Portugal	62%	52%	1.3%	-2%
Slovenia	68%	68%	0.6%	-2%
Austria	51%	33%	1.7%	-1%
France	50%	53%	1.0%	-1%
Germany	61%	38%	1.8%	-1%
Italy	12%	18%	0.7%	-1%
Netherlands	53%	18%	1.2%	-1%
Spain	43%	51%	1.4%	-1%
Sweden	59%	51%	2.7%	-1%
United Kingdom	51%	31%	2.9%	-1%
Czech	0%	9%	1.9%	0%
Estonia	29%	82%	2.8%	0%
Greece	32%	49%	1.7%	0%
Hungary	23%	17%	1.8%	0%
Romania	30%	27%	2.3%	0%
Slovakia	8%	8%	2.6%	0%
Poland	15%	23%	3.2%	1%

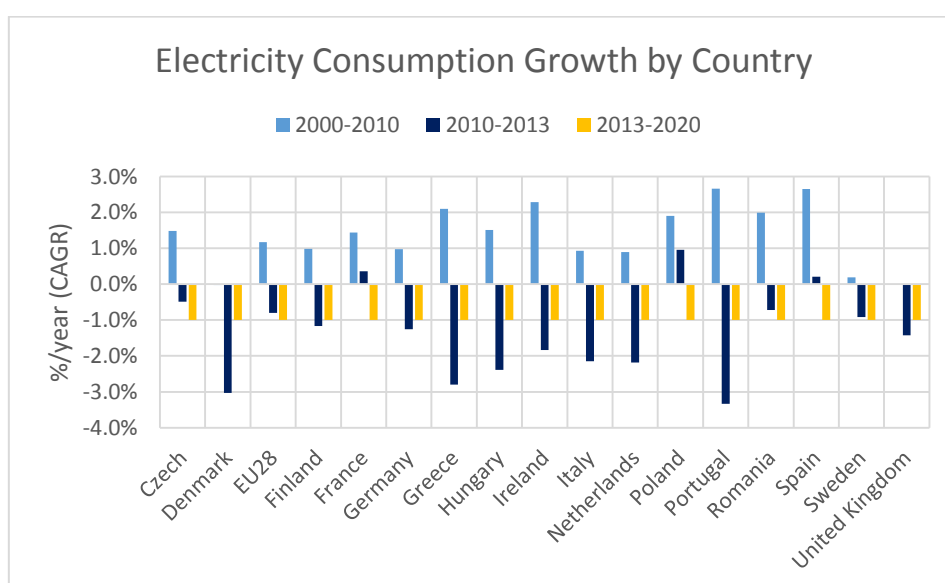


Figure 14: Forecast growth by Country