



Memo

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The current electricity costs of energy-intensive industries in Germany

Background

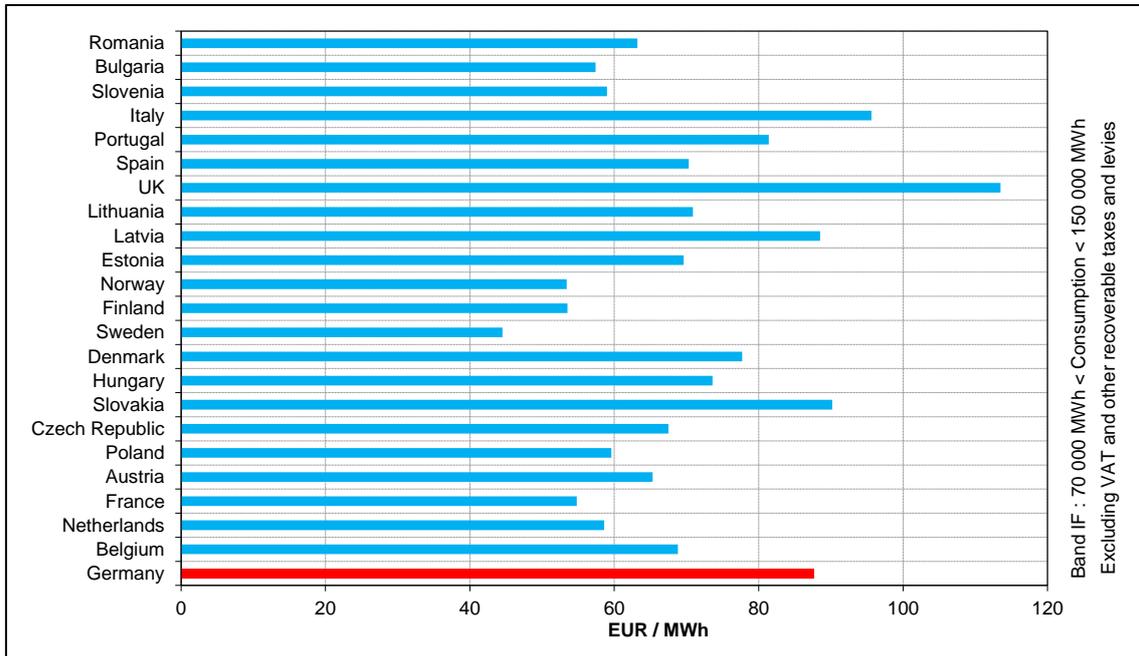
The electricity costs incurred by electricity-intensive industries feature significantly in current discussions surrounding the transformation of the energy sector in Germany. A key problem relating to these discussions is that, although there has been a plethora of comparative statistics and analyses of industrial electricity prices in general, the parameters specific to the electricity cost burdens of the energy-intensive industries have not been sufficiently addressed, if at all. The energy-intensive industry sectors are on the one hand faced with the electricity prices generated on the relevant markets and add-ons resulting from public policy, but on the other hand also benefit from not insubstantial compensation measures.

Against this background, the aim of this short analysis is to show the prices and costs relevant to the electricity-intensive industries in Germany, including the relevant privileges of these industries.

Electricity prices for very large industrial consumers according to Eurostat

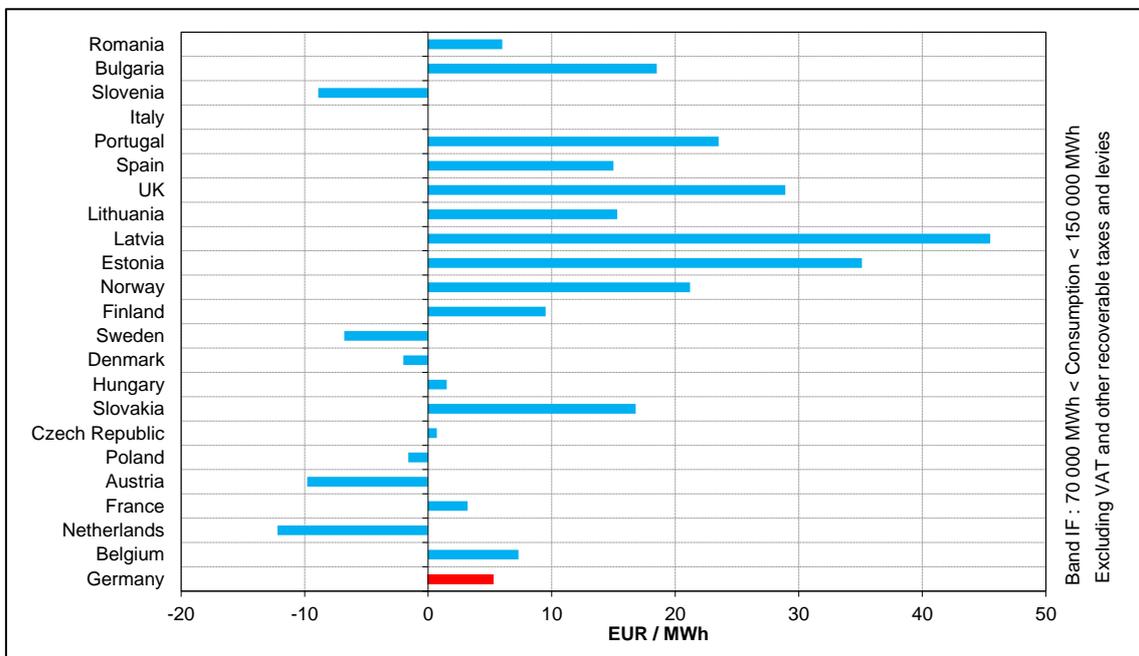
The official statistics published by Eurostat record not only the electricity prices charged to private households, but also compare the prices for industrial consumers at European level. Figure 1 shows the most recent data available (2016) and provides a comparison of major industrial consumers in various EU countries. In the consumption band of 70 to 150 gigawatt hours (GWh – a million kilowatt hours), the representative price for Germany in 2016 amounted to approx. 8.77 Euro cents per kilowatt hour (ct/kWh) or 87.7 Euro per megawatt hour (€/MWh) if VAT and other recoverable taxes and levies are excluded. The prices for this consumption band in the country comparison are not the highest in Europe, but are certainly in the upper echelons. The power price for large industrial electricity consumers in the United Kingdom, Italy, Slovakia and Latvia exceeded the German price level in 2016; the respective prices in Portugal are slightly lower than in Germany.

Figure 1 A comparison of the electricity prices (excluding VAT) for major industrial consumers in various EU countries, 2016



Source: Eurostat, calculations by author

Figure 2 A comparison of the change in electricity prices (excluding VAT) for major industrial consumers in various EU countries, 2007–2016

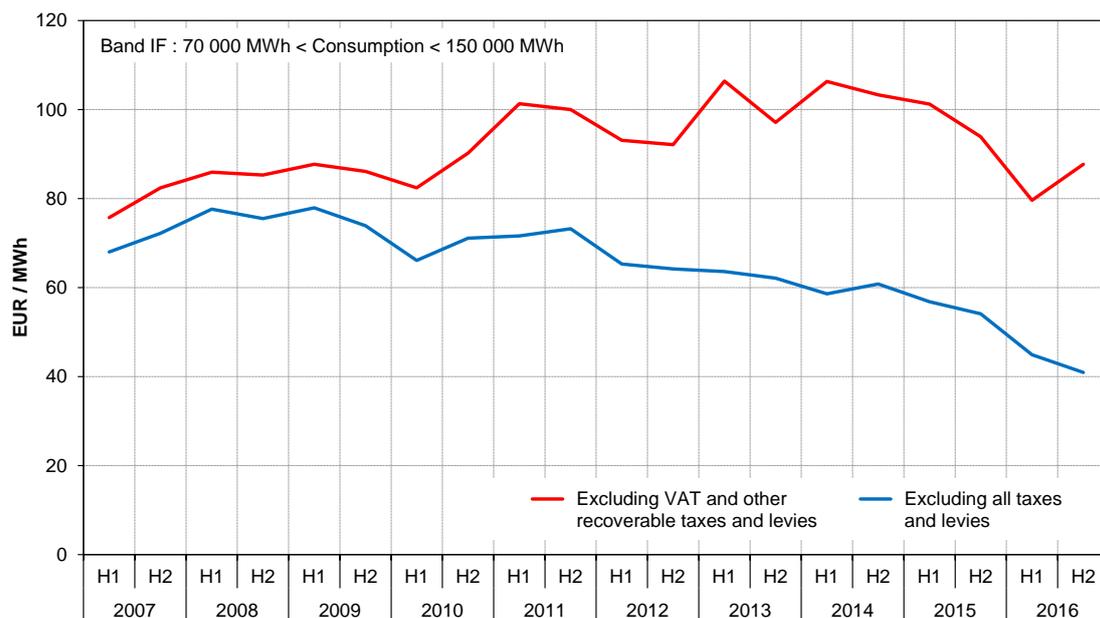


Source: Eurostat, calculations by author

A comparison of the trend over several years (Figure 2) clearly illustrates that the price changes have varied greatly over time from country to country and that the change in

prices in Germany is clearly within the lower range of the different European countries. The comparatively high industrial electricity prices recorded for Germany by Eurostat are, therefore, at least partly the result of a baseline effect, rather than an extraordinary increase in prices in recent years.

Figure 3 A comparison of electricity prices excluding VAT and recoverable taxes and levies (according to Eurostat definitions and methodology) and electricity prices without all taxes and levies for major industrial consumers in Germany, 2007–2015



Source: Eurostat, calculations by author

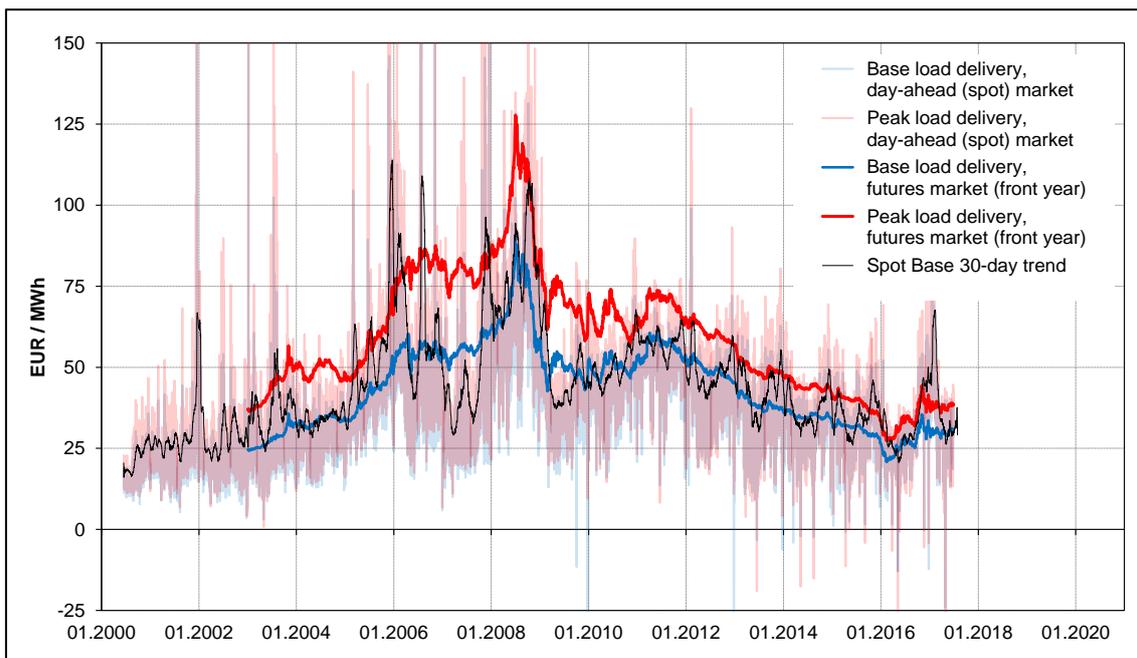
However, the fundamental problem of price comparisons based on official statistics provided by Eurostat is that a number of specifics for the energy-intensive industries are not taken into account in the officially recorded industrial electricity prices. The significantly increasing differences between electricity prices without recoverable taxes and levies and without all taxes and levies according to the Eurostat methodology for Germany during the period from 2007 to 2016 (Figure 3) raises the question of whether the different components of electricity prices for the electricity-intensive industries (i.e. bulk consumers) as well as the full range of compensation measures are appropriately reflected in the definitions and methodologies of Eurostat’s data collection with regard to the specific situation of energy-intensive industries. The increasing distance between the prices excluding all taxes and levies on the one hand and excluding VAT and other recoverable taxes and levies on the other hand finds no equivalent in the trends for the effective levels of taxes and levies if deductions and compensation measures are reflected appropriately for electricity-intensive industries with consumption levels of more than 70,000 megawatt hours annually.

With this in mind, the following sections will focus on the composition of electricity prices and of the corresponding compensation measures for the electricity-intensive industries in particular.

Price developments in the German wholesale electricity markets

Bulk consumers – a category which includes the vast majority of energy-intensive industries (chemicals, iron and steel, non-ferrous metals, etc.) – base their electricity procurement on the reference prices of the electricity exchanges. They can arrange their electricity procurement both as future deliveries and on the basis of daily or intraday spot trading. The prices paid by the companies for future deliveries are slightly higher than those on the spot market, but using future deliveries largely eliminates the volatility risks inherent to spot markets. In reality, bulk consumers structure/optimize their electricity procurement on the basis of their risk appetite, using a portfolio of various future and spot market products.

Figure 4 Development of future and spot market prices for base load deliveries on the German-Austrian power exchange, 2003–2017



Source: *EEX, EPEX Spot, calculations by author*

Figure 4 shows the development of prices for future base and peak load deliveries (for the subsequent calendar year in each case) and in spot trading (for the following day in each case). This overview illustrates, on the one hand, that the two price trends basically follow the same course but also, on the other hand, that the spot market prices of electricity are much more volatile. Equally, though, it is evident that the mean values for spot market procurement generally go hand in hand with the potential to secure low electricity procurement prices on the exchange. In other words, hedging against the volatility of the

spot market by making use of forward procurement consequently results in the procurer paying a price surcharge.

Midway through February 2016, the spot market price for base load deliveries was €21.99/MWh on the EEX. Prices recovered during the course of 2016, peaked in January 2017 (mainly as a spillover from the tight market conditions in France due to outages of nuclear power plants and in Southern Germany due to bottlenecks in coal supplies) and have stabilized at levels of around €30/MWh since spring 2017. From 2011 to 2016 the annual average of wholesale prices for day-ahead baseload deliveries in the German/Austrian spot market has fallen from €51.12/MWh to €28.98/MWh or by 43%. Compared with the all-time peak of the annual average in 2008, the wholesale market price for day-ahead deliveries has fallen by approx. 66%. The trajectories for peak deliveries follow comparable patterns as for baseload deliveries; the spread between peak and base prices is, however, steadily shrinking.

The corresponding future base load prices for the following year averaged at €26.58/MWh in 2016, falling from €56.07/MWh in 2011 and amounting to 62% less than in 2008. As for the spot prices, futures contracts for peak load deliveries followed the same trajectory but show steadily shrinking spreads compared to the respective base-load contracts.

The general trend of falling prices in the German wholesale market in recent years can be attributed to three factors in particular:

- a significant drop in hard coal prices which was not compensated by the decreasing exchange rate between the US-Dollar and the Euro (without this counter-trend, the hard coal prices for deliveries to Europe would have declined much more dramatically);
- the price level for emission allowances within the EU Emissions Trading System (carbon prices) is still too low and is not recovering; and
- the price-lowering effects of expanding renewable energies (which are above all – but certainly not exclusively – reflected in the spot market).

According to the recent price settlements for future deliveries, between €29 and €31/MWh can currently be secured on electricity exchanges up to 2023, depending on the procurement strategy adopted.

Price developments in other European wholesale electricity markets

The price trends at different trading hubs in Europe – although more or less strongly interconnected and subject to the common rules of the European internal market for electricity – show significant similarities and differences (Table 1):

- The highly integrated power markets of Germany/Austria, France and the Netherlands show very similar price levels and trends over the course of the last decade. However, since 2012 the spreads between spot prices in Germany on the one hand and France and the Netherlands on the other hand have increased

significantly, which clearly results from the decreasing coal prices in a system in which price formation is dominated by hard coal-fired power generation units, the fast growing share of power generation from renewable energy sources and Germany and the network congestions that still exist between the countries.

- The prices on the Polish spot market were significantly lower than on the German electricity exchange before 2009; this was followed by a phase of increasing market integration and converging price levels. Since 2014 the spot prices in Poland have significantly exceeded the German prices levels.
- The system price in the Nord Pool market region in Scandinavia follows the typical patterns of a hydro-electric system in which prices depend strongly on the hydrological situation in a specific year. For many years in the past decade, the Scandinavian power prices were significantly lower than in Germany and for only a few years (e.g. 2010 and 2013) the spot prices averaged levels above those observed on the German wholesale market.

Table 1 Development of spot market prices on different European electricity exchanges, 2005-2016

	Germany EPEX Base	Germany EPEX Peak	France EPEX Base	Netherlands APX/EPEX Base	Poland TGE Base	Scandinavia Elspot Base	Italy GME Base	Spain OMEL Base	UK APX/UKPX Base
	EUR/MWh								
2005	45.98	56.00	46.67	52.82	28.23	29.30	58.59	53.67	52.07
2006	50.79	63.81	49.29	58.41	30.07	48.58	74.75	50.53	55.38
2007	37.99	48.75	40.88	41.90	30.43	27.95	70.99	39.35	40.69
2008	65.76	79.43	69.15	70.25	55.56	44.74	86.99	64.44	85.44
2009	38.85	46.83	43.01	39.24	39.07	35.03	63.72	36.96	41.33
2010	44.49	50.95	47.50	45.38	47.91	53.14	64.12	37.01	48.54
2011	51.12	57.12	48.89	52.03	48.40	47.15	72.23	49.93	55.09
2012	42.60	48.51	46.94	48.00	41.58	31.27	75.48	47.23	55.62
2013	37.78	43.13	43.24	52.01	36.63	38.12	62.99	44.26	59.60
2014	32.76	36.80	34.63	41.20	42.76	29.60	52.08	42.13	52.14
2015	31.63	35.16	38.48	40.17	37.61	21.04	52.31	50.32	54.93
2016	28.98	32.01	36.75	32.02	36.68	26.89	42.78	39.67	52.06
Compared to German base prices									
2005	-	+22%	+2%	+15%	-39%	-36%	+27%	+17%	+13%
2006	-	+26%	-3%	+15%	-41%	-4%	+47%	-1%	+9%
2007	-	+28%	+8%	+10%	-20%	-26%	+87%	+4%	+7%
2008	-	+21%	+5%	+7%	-16%	-32%	+32%	-2%	+30%
2009	-	+21%	+11%	+1%	+1%	-10%	+64%	-5%	+6%
2010	-	+15%	+7%	+2%	+8%	+19%	+44%	-17%	+9%
2011	-	+12%	-4%	+2%	-5%	-8%	+41%	-2%	+8%
2012	-	+14%	+10%	+13%	-2%	-27%	+77%	+11%	+31%
2013	-	+14%	+14%	+38%	-3%	+1%	+67%	+17%	+58%
2014	-	+12%	+6%	+26%	+31%	-10%	+59%	+29%	+59%
2015	-	+11%	+22%	+27%	+19%	-33%	+65%	+59%	+74%
2016	-	+10%	+27%	+10%	+27%	-7%	+48%	+37%	+80%

Sources: EEX, EPEX, APX, UKPX, Elspot, GME, OMEL, TGE, ECB, calculations by author

- Price formation on the Italian and the Spanish (and the Iberian) wholesale markets is dominated by gas and oil-based power generation, which leads to significantly higher price levels.

- The wholesale market of England and Wales is very specific because of two overlapping trends. Firstly, price formation is mainly based on gas-fired generation units and the occasionally increasing gas prices in the UK market have also caused the wholesale prices to increase. Secondly, the set-up of a complementary UK price floor mechanism to the EU ETS in 2013 and the stepwise increase of the price floor have triggered further price increases or over-compensated the effects from changing natural gas prices.

All in all, power purchases on the German spot market (but also for the respective future contracts) have been hugely cheaper than in all other wholesale markets in Europe, except in the Scandinavian market. The increasing convergence of base and peak load prices in the German/Austrian wholesale market clearly indicates the merit order effects of the increasing share of wind and solar energy in the German system, which can significantly lower the wholesale market prices.

Price developments in the US wholesale electricity markets

Most of the recent debates on power prices no longer focus on the situation in Europe but rather on the comparison with the power markets in the USA.

Table 2 Development of spot market prices at different US electricity trading hubs and on the German electricity exchange, 2005-2016

	Germany EPEX Base	Germany EPEX Peak	New England Mass Peak	PJM PJM West Peak	Midwest Indiana Peak	Texas ERCOT North* Peak	Southwest Palo Verde Peak	Northwest Mid-C Peak	Northern California NP-15 Peak
	EUR/MWh								
2005	45.98	56.00	70.58	61.45	51.21	56.99	53.99	50.38	58.22
2006	50.79	63.81	55.55	49.37	41.17	48.60	46.24	40.31	48.64
2007	37.99	48.75	56.27	52.15	44.77	43.44	45.59	41.57	48.59
2008	65.76	79.43	61.34	56.85	45.43	49.91	49.30	44.45	54.48
2009	38.85	46.83	33.12	31.96	24.78	25.02	24.99	25.68	28.18
2010	44.49	50.95	42.13	40.35	31.17	31.70	29.31	27.10	30.41
2011	51.12	57.12	37.78	37.33	29.17	45.58	26.10	21.15	26.09
2012	42.60	48.51	32.92	31.89	26.92	27.93	23.07	17.91	25.37
2013	37.78	43.13	49.07	40.82	28.38	28.82	28.26	28.13	33.29
2014	32.76	36.80	57.78	47.86	36.55	33.97	31.99	29.27	35.35
2015	31.63	35.16	44.59	39.10	30.82	26.65	24.53	23.47	32.94
2016	28.98	32.01	32.06	31.23	31.57	24.53	23.05	20.62	30.24
Compared to German peak prices									
2005	-18%	-	+26%	+10%	-9%	+2%	-4%	-10%	+4%
2006	-20%	-	-13%	-23%	-35%	-24%	-28%	-37%	-24%
2007	-22%	-	+15%	+7%	-8%	-11%	-6%	-15%	-0%
2008	-17%	-	-23%	-28%	-43%	-37%	-38%	-44%	-31%
2009	-17%	-	-29%	-32%	-47%	-47%	-47%	-45%	-40%
2010	-13%	-	-17%	-21%	-39%	-38%	-42%	-47%	-40%
2011	-10%	-	-34%	-35%	-49%	-20%	-54%	-63%	-54%
2012	-12%	-	-32%	-34%	-45%	-42%	-52%	-63%	-48%
2013	-12%	-	+14%	-5%	-34%	-33%	-34%	-35%	-23%
2014	-11%	-	+57%	+30%	-1%	-8%	-13%	-20%	-4%
2015	-10%	-	+27%	+11%	-12%	-24%	-30%	-33%	-6%
2016	-9%	-	+0%	-2%	-1%	-23%	-28%	-36%	-6%

Note: * ERCOT Houston up to 2014

Sources: EIA, FERC, ERCOT, ISOs, ECB, calculations by author

Table 2 indicates the levels and trends of prices at different wholesale trading hubs in the USA. The table shows, in contrast to Table 1 with the comparison among European markets, the annual average of settlement prices for peak load deliveries, which is more common in the US debate. For all markets the price levels were significantly below the respective German price levels before 2012. However, in more recent years the wholesale peak prices in New England, the PJM control zone, the Midwest and California are roughly comparable with German levels or even exceeded them significantly. In Texas, the South Western and the North Western market regions, the peak price levels were 23% to 36% lower than those on the German wholesale market in 2015 and 2016.

The comparison of German and US wholesale prices leads to mixed results for recent years: Some markets continue to deliver significantly lower prices than in Germany but others now exceed these levels. It should be noted, however, that the prices indicated in Table 2 exclusively cover the settlements in the energy markets and do not reflect additional costs for capacity markets, locational pricing, etc. Last but not least, the pricing components and compensation measures beyond the wholesale market prices need to be taken into account.

Compensation for pass-through of carbon costs to the wholesale market prices

Based initially on an exchange's reference price, the electricity procurement costs can be further reduced by an array of special provisions for the energy-intensive industries.

In the first instance, the EU Emissions Trading System and the European Union's corresponding state aid guidelines¹ allow the member states to compensate the energy-intensive industries for the carbon costs priced in on the electricity market. The corresponding ruling for Germany has been in force since January 2013 and allows for the compensation of a sizeable proportion of the carbon cost mark-up on the wholesale market.² It stipulates that in 2016 a company can be reimbursed for 80%³ of the reference cost mark-up for 760 grams of CO₂ per kWh, based on sector-specific electricity consumption values. With a real carbon cost mark-up on approximately 900 grams of CO₂ per kWh in the Continental European market, approximately 68% of the carbon costs that are effectively priced in are compensated. With a reference price of €7.80 for the compensation

¹ Communication from the Commission, *Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012* (OJ EU C 158 dated 5 June 2012, p. 4).

² German Federal Ministry of Economics and Technology (BMWi), *Directive on state aid for companies in sectors/subsectors in relation to which the assumption is made that there is a considerable risk of 'carbon leakage' due to the costs relating to EU ETS certificates being priced in to electricity prices (state aid for indirect carbon costs)*, 30 January 2013 (German Federal Gazette, BAnz AT 07.02.2013 B1).

³ This rate is reduced from 0.85 for 2013 to 2015 to 0.80 for 2016 to 2018 and 0.75 for 2019 and 2020 but will nevertheless continue to provide a significant level of compensation.

of indirect carbon costs for 2016⁴, around €4.74/MWh is compensated, which can be subtracted from the aforementioned wholesale electricity price of approximately €28.98/MWh, resulting in an effective cost of procuring electricity via the wholesale market of €24.23/MWh for baseload deliveries or €27.27/MWh for peak load contracts, which is much closer to the low-price market regions in the USA.

Broad exemption from network access fees

Energy-intensive companies can exempt themselves largely from paying network access fees if they meet certain criteria. The legal foundations for this are provided in Section 19 (2) sentences 1 and 2 of the German Electricity Network Charges Ordinance (StromNEV).⁵

Firstly, deductions of the individual network access fees may be arranged, i.e. partial exemption is possible if a company's peak load can be foreseen to deviate from the peak load situation of the network in question. These companies may be awarded discounts of up to a maximum of 80% of the network access fees. In the case of steelworks, for example, the discounts amount to at least 30% to 40%.

Secondly, pursuant to Section 19 (2) sentence 1 StromNEV, companies can negotiate individual network access fees and, according to Section 19 (2) sentence 2a and the implementation provisions of the Federal Network Agency⁶, companies can exempt themselves from up to 90% of the regular network access fees.

An 80% deduction is possible if the electricity procurement for a company's own consumption amounts to at least 7,000 hours of use from a single consumption point within the general supply grid and if the electricity consumption from the said consumption point exceeds 10 gigawatt hours (GWh). If the own consumption amounts to 7,500 hours, the allowed deduction amounts to 85% and for the case of 8,000 hours a deduction of 90% of the regular network fees is possible. For many energy-intensive bulk consumers, high reduction rates apply. The network operators' resultant shortfalls in income are offset by allocation of the costs to the final consumers. In turn, this cost allocation amounts to a mere €0.25/MWh for the energy-intensive bulk consumers and is therefore negligible, especially in view of the economic benefits of their exemption from paying network access fees.

Broad exemption from taxes and levies

⁴ The compensation for a certain year is calculated on the basis of the front year futures for deliveries in mid-December from the previous year.

⁵ *Electricity Network Charges Ordinance (StromNEV)* dated 25 July 2005 (Federal Law Gazette BGBl. I, p. 2,225), as amended by Article 8 of the Act dated 22 December 2016 (BGBl. I, p. 3,106).

⁶ German Federal Network Agency (BNetzA), Ruling Chamber 4, Decision BK4-13-739, Bonn, 11.12.2013.

In addition to wholesale market prices and network access fees, electricity supply in Germany is subject to a series of taxes, levies and surcharges. Electricity-intensive industries, however, benefit from significant deductions of these taxes, levies and surcharges:

- Electricity supply to end consumers is subject to an electricity tax at a standard rate of €20.5/MWh. Electricity-intensive industrial production processes are fully exempted from the tax; all other industries can benefit from a tax deduction of up to 90%.
- The remuneration scheme for electricity generation from renewable energies (Renewable Energy Sources Act⁷) foresees a surcharge to cover the costs of the scheme. The standard rate for this surcharge was €63.54/MWh in 2016. Electricity-intensive industries can benefit from significant reductions of the surcharge (including a cap for the surcharge that is directly linked to the cost structures of the firms), which leads to levels as low as €0.35/MWh.
- The support scheme for Combined Heat and Power Plants (CHP) is also financed with a surcharge on electricity deliveries to end consumers. The standard rate of the CHP surcharge amounted to €4.45/MWh in 2016; for electricity-intensive industries a reduced rate of €0.25/MWh applied.
- The roll-out of infrastructure for power generation from offshore wind plants is supported by a liability support scheme for the transmission system operators. This support scheme is also financed via a surcharge at a standard rate of €0.40/MWh but reduced rates for the electricity-intensive industries, which can be as low as €0.25/MWh.

For non-privileged electricity consumers the sum of taxes and surcharges amounts to €89.00/MWh (without concession fees and VAT); for the electricity-intensive industries the total cost of taxes and surcharges amounts to approx. €4.00/MWh.

Free allocation of emission allowances

Almost across the board the energy-intensive companies receive sizeable free allocations of emission allowances within the EU Emissions Trading System (EU ETS). These allocations are still very generous after the start of the third EU ETS trading period, because while the allocation process was switched to relatively ambitious benchmarks (representing the top 10% of plants in the EU), these benchmarks relate to the production levels of the (pre-crisis) reference period of 2005 to 2008, with the result that the effective free allocation is again very generous. It should also be noted that the iron and steel industries effectively continue to benefit from free allocation for the generation of electricity using waste gases, even though electricity generation is, as a rule, excluded from

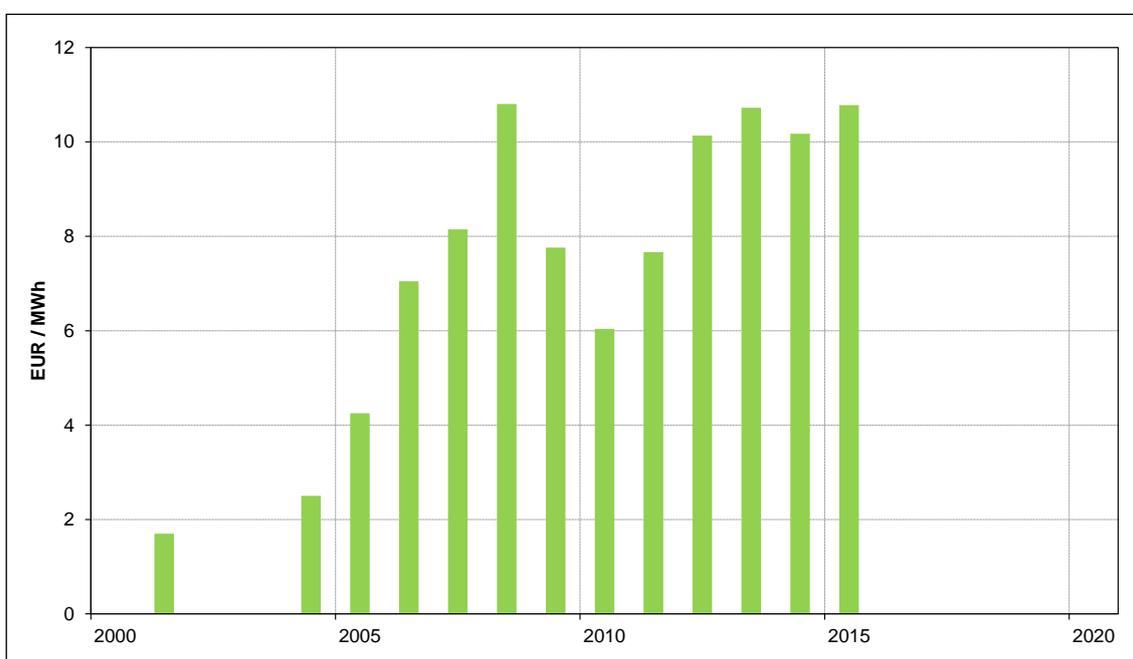
⁷ *German Renewable Energy Sources Act (EEG)* dated 21 July 2014 (Federal Law Gazette BGBl. I, p. 1,066), as amended by Article 24 Section 29 of the Act dated 23 June 2017 (BGBl. I, p. 1,693).

this free allocation as of 2013. It will not be possible to fully evaluate the actual allocation situation of energy-intensive industries until the definitive allocation data becomes available, but the data available to date indicates a very high free allocation once again and therefore the broad exemption from the carbon costs incurred due to the EU ETS.

Cost benefits and cost allocation of the financing mechanisms for electricity generation from renewable energies

Providing support for electricity generation from renewable energies through remuneration mechanisms results in some significant price effects on the wholesale electricity market.⁸

Figure 5 Price decrease in the German wholesale market caused by power generation from renewable energy sources, 2003–2016



Source: Cludius et al. (2014), Öko-Institut (2015)

The econometric analysis of this ‘merit order effect’ reveals an approx. €10/MWh reduction in the wholesale price since 2012. In other words, without the remuneration mechanisms for electricity generation from renewable energies, wholesale electricity prices

⁸ Cludius, J.; Hermann, H.; Matthes, F.Chr.; Graichen, V. (2014): *The merit order effect of wind and photovoltaic electricity generation in Germany 2008-2016 estimation and distributional implications*. Energy Economics 44 (2014) pp. 302-213.

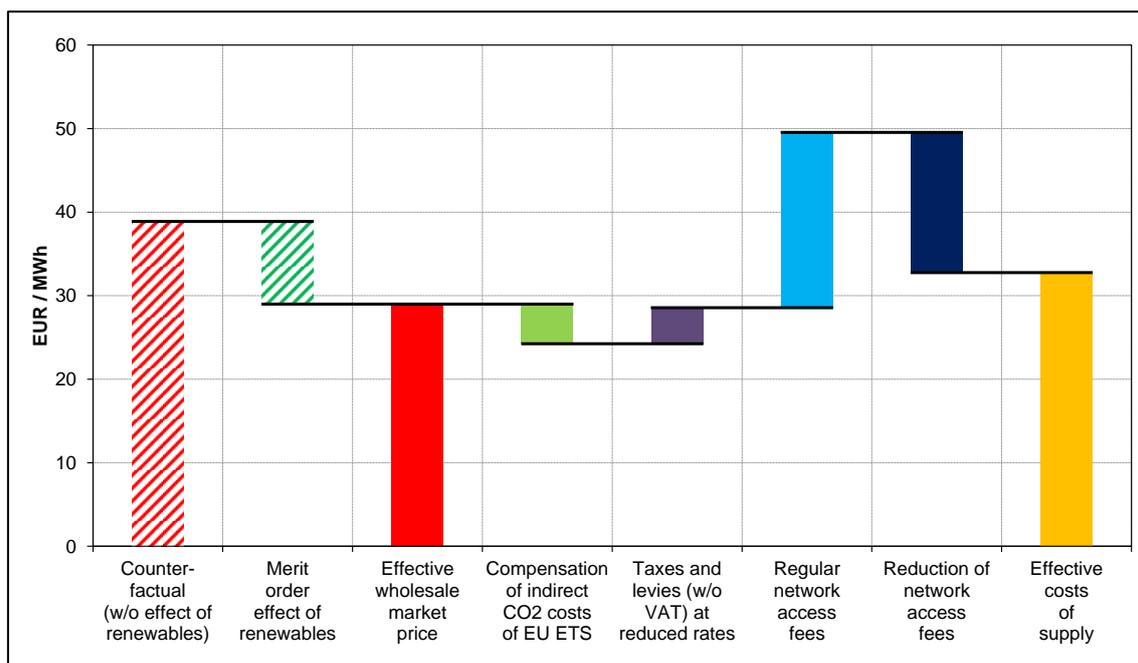
Öko-Institut (2015): *Die Umlage des Erneuerbaren-Energien-Gesetzes (EEG). Hintergründe, Trends, Treiber und Perspektiven*. Kurzstudie für das Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg, Berlin, 8 November 2015.

would have amounted to approx. €38.90/MWh in 2015. As active final consumers within the wholesale market, energy-intensive industrial companies benefit from these price-reducing effects and are only required to pay marginal sums to make up the shortfalls in the support system (see above). The net benefit of supporting electricity generation from renewable energies is therefore just below €10/MWh.

Final remarks

Electricity prices in other European countries and the USA are frequently cited as benchmarks in current discussions relating to the impact of the German energy transition on electricity-intensive industries. A comprehensive assessment of wholesale market trends and their interactions with the support of power generation from renewable energy sources, the broad range of specific provisions to reduce network access fees, taxes and surcharges as well as further compensation for the price components triggered by the EU ETS leads to a fundamentally different view.

Figure 6 Comprehensive assessment of electricity costs for electricity-intensive industries in Germany, 2016



Source: *Calculations by author*

If all special provisions and compensation measures are considered (Figure 6), electricity-intensive industries can have electricity supplies available at the point of consumption at a price which is very close to the pure wholesale market price. Compared to other European markets, this provides a significant competitive advantage and is comparable even with most of the regions in the USA with extremely competitive power prices.

The mechanism of these compensatory measures (in particular in relation to the compensation of CO₂ costs) would uphold the substantial comparability of these prices, even

in the case of significant price increases caused by a successful and ambitious structural reform of the EU ETS.