Electricity Costs of Energy Intensive Industries

An International Comparison

Electricity Costs of Energy Intensive Industries

An International Comparison

Authors:

Ecofys: Katharina Grave, Mandana Hazrat, Sil Boeve, Felix von Blücher, Charles Bourgault

Fraunhofer-ISI: Barbara Breitschopf, Nele Friedrichsen, Marlene Arens, Ali Aydemir, Martin Pudlik, Vicki Duscha, Jose Ordonez

GWS: Christian Lutz, Anett Großmann, Markus Flaute

July 2015

For the German Ministry of Economic Affairs and Energy

ECOFYS Germany GmbH | Albrechtstraße 10 c | 10117 Berlin | **T** +49 (0)30 29773579-0 | **F** +49 (0)30 29773579-99 | **E** info@ecofys.com | **I** www.ecofys.com
Geschäftsführer C. Petersdorff | **Handelsregister** Amtsgericht Köln | **Handelsregisternr.** HRB 28527 | **Ust-ID-Nr.** DE 187378615

Fraunhofer ISI

ECOFYS
sustainable energy for everyone

Executive Summary

Energy prices are a key factor for the competitiveness of many German companies. To finance the energy transition, the costs of promoting renewable energy technologies in Germany are passed on to the consumer, predominantly via energy prices (i.e. electricity prices). A large number of levies as well as the electricity tax are currently raising the price of electricity and thereby the electricity costs of industries. To limit the burden, especially for energy-intensive industries, the German government has designed various rules regarding exemptions and rebates (privileges).

For the same economic considerations, competing national economies have also introduced special regulations for industrial electricity consumers. The present study examines in detail, the composition of electricity prices in Germany and ten other countries: the Netherlands, the United Kingdom, France, Italy, Denmark, Canada, the United States, China, Korea and Japan. It assesses the effects of the special regulations on the competitiveness of industrial companies in Germany on four levels.

The analysis divides electricity price components into three categories:

> **Electricity purchase prices** include the costs of purchasing electricity on the wholesale market and the margins of the utilities. Their value is determined by the composition and technical characteristics of the power plant fleet, the fuel costs, the development of demand, and the framework regulation of the electricity market.
> **Network charges** distribute the costs of transmission and distribution system operators for their services to end users.
> **State-regulated components** finance the cost of energy policy instruments or channel revenues to the state budget. These components include taxes and levies, as well as the costs of meeting established quotas.

The analysis of national electricity markets shows the different regulatory approaches in the examined countries. While European regulators in Germany, the Netherlands, France, Italy and Denmark distribute the costs of energy policy measures through levies and taxes with defined privileging criteria for individual customers, the British and North American governments employ quota systems for the distribution of costs, thereby leaving the question of burden sharing largely to market players. In none of three Asian countries under consideration was it transparent how the costs of political interventions in the power system are distributed.

In the context of this study, the electricity purchase prices, network charges, and privileging criteria on taxes and levies determined are applied to case study examples from six energy-intensive industries: chemicals, paper, steel, aluminium, copper and textiles. The power consumption of these industries accounts for 70% of electricity consumption in the manufacturing sector and about 27% of total electricity consumption in Germany.

The comparison shows that energy-intensive, large-scale consumers from the metalworking industry and the chemical industry pay the lowest electricity prices in all countries. Aluminium and copper producers, and also electric arc furnace operators, pay no or significantly reduced taxes and levies and low network charges (Figure 1).

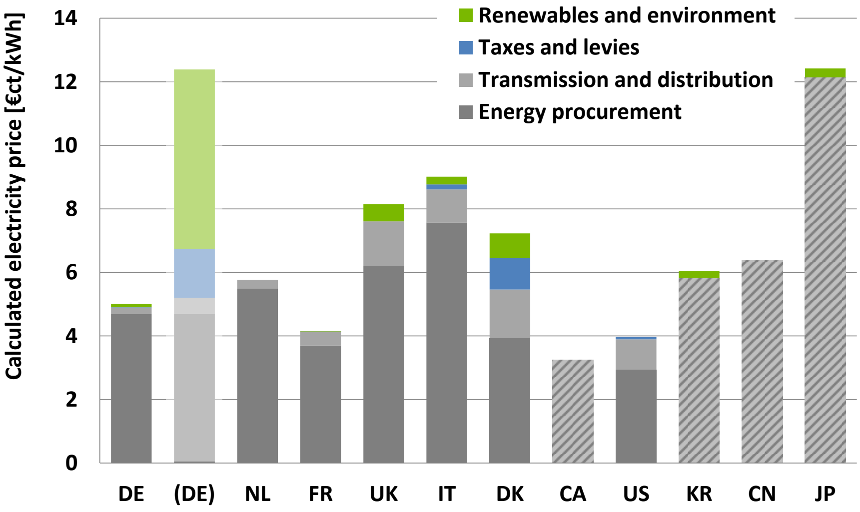


Figure 1: **Electricity prices for big, privileged companies**

The electricity prices of these electricity-intensive large consumers are determined by the electricity purchase prices. In this study, electricity purchase prices are estimated based on power exchange prices. However, electricity prices of individual companies can differ significantly, depending on company-specific consumption structures and procurement strategies for electricity. In most analysed countries, companies with electricity consumption of less than one gigawatt hour per year pay noticeable higher prices (Figure 2).

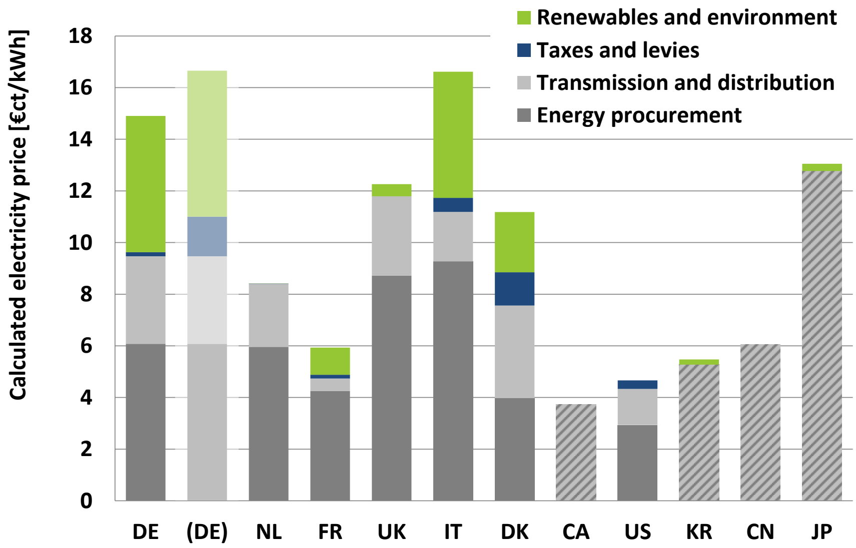


Figure 2: **Electricity prices for small, in Germany hardly privileged companies**

Aluminium and copper producers, steel production in electric arc furnaces, and chemical reduction processes meet almost all of the privileging criteria that are applied by countries to relieve businesses with high international competition from state-regulated electricity tariff components. These privileging criteria include:

Absolute consumption: The rates of many state-regulated electricity tariff components are graded or contain fixed base amounts. Thus companies with high consumption pay, on average, less per unit of energy. For example, in Germany all companies in the special equalisation scheme (BesAR) pay the full EEG surcharge for the first Gigawatt hour of consumption.
Energy intensity: The total electricity costs compared to sales or gross value added shows which company's competitiveness might be put at risk as a result of high electricity prices. In various regulations, companies that exceed a certain threshold of energy intensity are privileged. In the German special equalisation scheme, this threshold is 16% of gross value added in 2015.
Sector affiliation: Some industries are more exposed to international competition than others, so exemptions are often tied to sector affiliation. The revision of the special equalisation scheme is also an example thereof: Depending on the sector affiliation, companies must reach different thresholds of energy intensity to be privileged.
Processes used: Some industrial processes are power-intensive by nature. The power consumption of defined processes is therefore often exempt from taxes and levies. An example is electricity consumption in metallurgical processes, for which no electricity tax is paid in Germany.
Energy efficiency measures: Some regulators reward energy efficient companies with lower electricity prices by reducing taxes and levies. An example of this is the special equalisation scheme in Germany, which requires companies to install energy management systems.
Costs cap: Some regulators set a relative or absolute cost cap to limit the total expenditures per company for a policy measure. For example, the newly regulated special equalisation scheme in Germany limits the payments for the EEG surcharge to a maximum of 4%, or 0.5% of the gross value added of a company.
Autoproduction: Energy-intensive companies sometimes produce their own power to save costs. Self-consumption is often exempt from taxes and levies. The special equalisation scheme in 2014, for instance, provides that companies are charged 15% of the EEG surcharge for self-consumption.

As the example of the German special equalisation scheme shows, criteria are combined in many cases to limit the number of privileged end consumers.

Compared to the other countries studied, Germany raises quite a few and rather high taxes and levies. Without the German privileges, electricity prices for some companies would be almost 8 ct/kWh higher in 2014. The special equalisation scheme on its own accounted for up to 6.2 ct/kWh difference in electricity prices for Germany companies in 2014. Without the special equalisation scheme in Germany, electricity prices for households, commercial consumers, and less energy-intensive industrial companies would be about 1.6 ct/kWh lower in 2014.

To investigate the effects of the German exemptions on the competitiveness of industrial companies, the share of electricity costs to production costs of different products is determined. This share displays how strongly electricity prices, hence the exemptions impact the **competitiveness at product level**. The findings underpin that in particular, aluminium producers and chlorine manufacturers are sensitive to rising electricity costs. Without the special equalisation scheme, the production of these goods would not be profitable in Germany and production facilities would be forced to shut down sooner or later. This also applies to many paper and steel producers.

At the second stage, the importance of energy costs on the **competitiveness at company level** is investigated. An analysis of profit and loss accounts of exemplary companies shows what effects can be expected when rising electricity costs cannot be passed on to customers. This analysis also demonstrates the importance of exemptions for metal producers and papermakers that produce electricity-intensive products. In contrast, diversified companies, such as integrated chemical companies, generate a large share of their income from non-energy-intensive products. These cases show that increased energy costs affect the division's earnings, but have little impact on the company's overall results.

Additional interviews underline the importance of market proximity as well as of qualification of workers for the competitiveness of companies in Germany. These location-specific factors can only compensate rising electricity cost to a certain extent. The case analysis shows that especially companies with a limited, electricity-intensive product portfolio could probably not compensate cost increases.

The analysis of the importance of electricity costs for **competitiveness at sectoral level** determines the short-term impact on product prices, demand, and production in case increased electricity costs in the value chain are fully passed on. It is shown how current prices and total production changes if a single sector is excluded from the special equalisation scheme and the increase in electricity prices is fully passed on product prices. The results show that product prices in the paper industry and in the non-ferrous metal industry would increase substantially. The average increase would be at about 5%. Exports in the metal and paper industry sector would decline by 16% to 18% because of the increased prices. Calculations show that in the short-term, the production of these industries would decrease by 11 to 18%. However, it should be noted that the analyses are based on statistical electricity cost shares and estimated price elasticities of demand. The effects of shut-downs of single companies or the end of production in parts of the supply chain cannot be mapped on sectoral level. This analysis therefore underestimates the effects of electricity cost increases, especially in industries with long and complex supply chains like the chemical industry.

Lastly, in the fourth stage, the long-term **macroeconomic effects** of the exemptions in Germany are investigated by applying a macro-econometric model. It is estimated how the total economic situation would change if privileges were abolished for all sectors. Ex-ante and ex-post scenarios for the timeframe of 2007 to 2020 are used to determine the impact of changes in the exemptions in Germany on production, added value, employment, investment and foreign trade. For the sectors of the-non-privileged industries, commerce, trade, services and households in Germany, the average prices with and without exception are calculated. Electricity prices in other countries stay unchanged in these scenarios.

In the ex-ante scenario (2020) of the complete elimination of the special equalisation scheme, average production prices rise up to 3.5%. For individual companies, the increase of production costs is significantly higher. Compared to the reference, which is the retention of the current regime, German exports in 2020 would be up to 0.3% or EUR 4.7 billion lower. In the calculations, the total negative effect on the gross domestic product amounts to 4 billion Euros or 0.15% in 2020. On the labour market, total employment losses after abolishing the special equalisation scheme would be up to 45,000. If all privileges of the current tax and levies model were to be abolished, calculations show a loss of up to 104,000 jobs by 2020, of which more than 70,000 in the manufacturing sector.

Abolishing the special equalisation scheme would reduce levies for non-privileged sectors and thus lift the cost burden for these sectors. Cost savings for households could amount to two billion Euros annually. In addition, parts of the other industries (approximately 0.5 billion euros) and the commerce, trade, and service sectors (about 2 billion Euros) would be relieved. This results in higher private consumption. Over time, however, consumption growth is weakening as the real income is decreasing. The negative effects in the privileged companies with the change of current regulations outweigh the slightly positive effects of unprivileged consumers that are then charged slightly lower rates, mainly due to lower international competitiveness in price.

The modelling approach has limitations: decisions on the relocation of production are taken at corporate level and depend on company-specific factors, intra-industry integration, and product-related aspects. This cannot be mapped comprehensively using industry statistics. Additional qualitative analyses lead to the suggestion that the effects reported here are probably underestimated at sectoral and macroeconomic level.

Even with these limitations, all analyses at the different levels lead to the same result: existing exemptions for energy-intensive companies support the competitiveness of the industry and have positive macroeconomic effects.

Table of Contents

1 Introduction

In recent years, climate protection has evolved into one of the core political issues in Germany and Europe. Against the background of increasing scientific knowledge of the consequences and conditions of climate change, policies have been implemented aiming at reducing greenhouse gas emissions in Germany by 40% by 2020 (relative to 1990).

In this context, energy generation and energy consumption play a prominent role. Around 82% of German greenhouse gas emissions in 2010 were related to energy. The development of renewable energy sources (RES) is regarded as one lever to reduce energy-related greenhouse gas emissions.

To achieve the stated objectives for 2020, expansion of RES must progress swiftly in the electricity sector, as well as in the heat and transport sectors. After 2020, continuous expansion is also sought for renewables to provide major shares of energy supply. This expansion requires a transformation of the existing energy system. In this process the market as well as the system integration play an important role. Currently, expansion is primarily policy driven. To ensure social acceptance, and for the future development of efficient and effective support policies, the different effects of the politically-lead expansion must be analysed systematically.

The resulting costs and benefits play an important role for different actors and economic groups respectively. The costs and benefits of regulations affect consumption and production costs, but also competitiveness of companies and overall economic growth in Germany. Climate change and energy policies affect the competitiveness of companies by additional costs burdens and in the short term have negative impacts on the whole economy via production, employment and consumption.

To reduce the cost burden on German industry, various exceptions have been introduced over time. These exemptions have eased the burdens of privileged companies, but at the same time they cause higher burdens for non-privileged companies and other energy consumers, including households. Ecofys and the Fraunhofer Institute for Systems and Innovation Research (ISI) have examined the extent to which energy and climate policy instruments affect the competitiveness of German-companies, as well as their macroeconomic effects. The analysis of macroeconomic effects was supported by the Institute of Economic Structures Research (GWS).

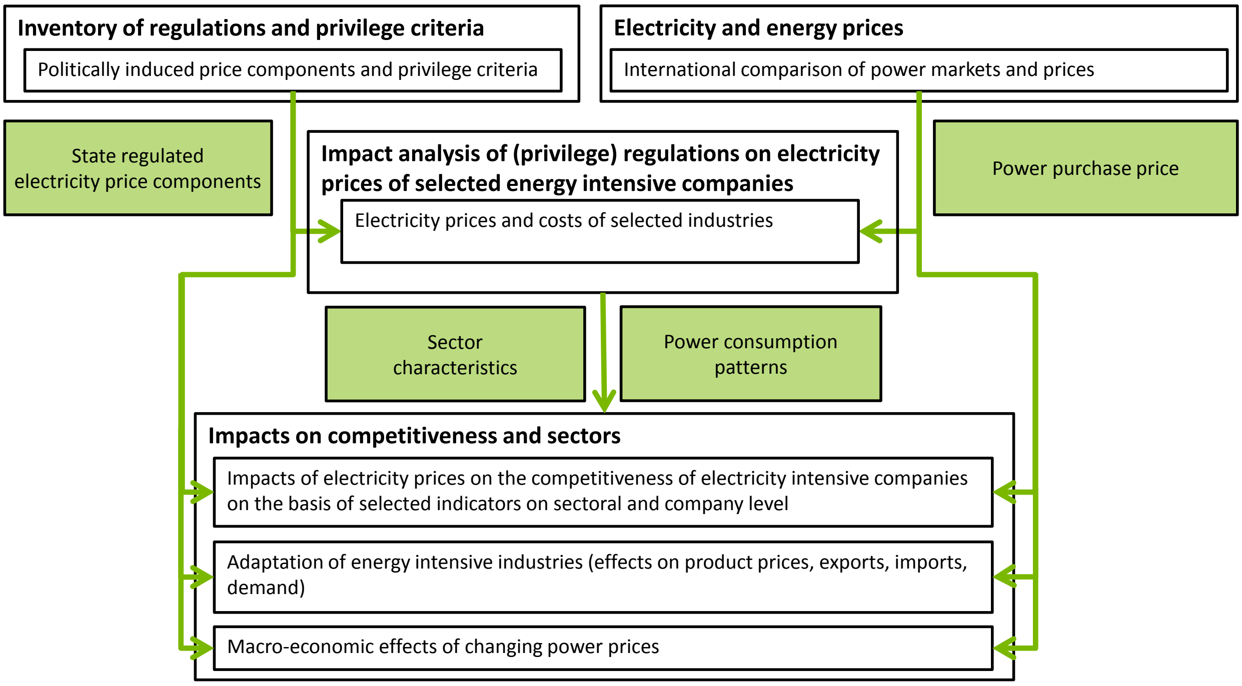


Figure 3: Overview of working process

The issue is analysed in six steps (Figure 3). Firstly, state-regulated electricity price components and exemptions for defined consumer groups are examined. German legislation is compared to regulation in ten other important industrial nations. In parallel, current market framework of all eleven countries and national energy prices are analysed to derive a purchase price for electricity. In the following step, the results are merged. The analysis shows which electricity prices, and consequently electricity costs are expected in individual sectors. The impact of energy costs on the competitiveness of sectors and individual companies is analysed on three levels: on product level, sector level and on national level. Model results for macroeconomic effects of different energy price scenarios for Germany are analysed ex-post and ex ante to 2020.

This report summarises the results of the entire research project. The presentation of the methodology and detailed results can be found in separate reports in German language.

This summary starts by presenting electricity price components and their calculation for Germany, Denmark, France, Italy, Canada, Netherlands, United Kingdom, Pennsylvania, Texas, Japan, China and Korea. Technical and economic data for the energy-intensive industries such as steel, aluminium, copper, paper, chemicals and textiles are collected and analysed to capture the competitive situation of the industry and the importance of the current electricity cost for competitiveness. The total power consumption of these sectors comprises about 70% of electricity consumption in the total manufacturing sector and about 27% of total electricity consumption in Germany.

2 Electricity Prices and their Components

National electricity prices consist of three components:

- Electricity purchase price
- Network charges
- Additional, state-regulated components

The following chapters provide an overview of the examined national power systems. They further outline the relevant factors for the formation of wholesale electricity prices, explain the network situation and the calculation of grid fees, as well as additional, politically-determined, regulated price components and existing exemptions for the industry. Further information on markets and prices can be found in the reports on electricity markets and electricity prices and electricity costs for specific industries.

2.1 Germany

Electricity supply and demand

According to Eurostat, the total electricity demand in Germany in 2012 was 526 TWh, which was equivalent to almost one fifth of the total electricity demand within the EU. Households accounted for approximately 26% of this demand, while 43% originated in the industrial sector. The German government has imposed a 10% reduction target for total energy consumption by 2020. By 2050 consumption should be reduced by 25%. These targets apply to the consumption level of 2008.

In 2012, German power stations generated 577 TWh of electricity. 44% of electricity was produced in lignite and hard coal plants. Natural gas power plants produced 12%. Around 24% of the electricity generated in Germany was obtained from renewable energy sources, including wind (8%), biomass (6%) and PV (4%). The share of electricity generated from nuclear energy fell from 22% in 2010 to 16% in 2012. Following a government decision in 2011, eight nuclear power plants were shut down within the same year. Germany's remaining nuclear power plants will go offline in 2022.
The German power plant fleet includes a wide range of different technologies. By the end of 2012, the installed power plant capacity in Germany was 178 GW. Of this, renewables accounted for 76 GW and non-renewable energy sources for 103 GW.

Electricity market

Four major producers dominate the German electricity market at the wholesale level. In 2012, they generated approximately 45.5% (228 TWh) of electricity fed into the networks. On average, households may choose their supplier out of 88 utilities per network area. The majority of utilities limit their availability to a defined region. The monitoring report of the Federal Network Agency (Bundesnetzagentur) for the year 2013 reported that the four largest power companies covered about 43.5% of the electricity demand from households, 55% from industry, and 29% from the trade sector.

Electricity is also traded on the power exchange. Long-term, "future" trading is operated by the German EEX electricity exchange in Leipzig, while short-term spot trading runs on the Franco-German joint venture EpexSpot.

Electricity exchange

Due to its size and central location in Europe, Germany is strongly integrated into the European electricity network system. The country is physically interconnected to nine states. There are hardly any grid congestions between Germany and Austria. Consequently, the two countries share one market area. The German net transfer capacity to the common neighbour Switzerland exceeds 3500 MW. The import and export transmission capacity in 2011 totalled over 20 GW.

Every year, the largest volumes are imported from France, where low-priced base load electricity is generated in nuclear power plants. According to the European Association of Transmission System Operators ENTSO-E, Germany imported more than 20 TWh in 2011, and exported 0.14 TWh to France. Likewise, Germany regularly imports more electricity from the Czech Republic, Sweden and Denmark than it exports to those countries. Every year more than 35 TWh are transmitted between Germany, Austria and Switzerland. The Netherlands' net electricity imports from Germany totalled about 22.5 TWh in 2012. Poland also imports more electricity from Germany than it exports to its neighbour.

Electricity purchase price

Wholesale prices of electricity in Germany have dropped in recent years. The main reasons are declining hard coal prices, low CO2 certificate prices, and the increasing share of renewable energies in the country's electricity mix. Average day-ahead prices at the power exchange fell from 5.11 ct/kWh in 2011 to 3.78 ct/kWh in 2013. The prices for future deliveries (futures) decreased even more, converging to spot prices.

Average electricity purchase prices (excluding network costs, taxes and levies) for industrial consumers with a total demand of 70 to 150 GWh per year amounted to 4.68 ct/kWh in 2013. Prices for major consumers have decreased almost continuously since 2008, the prices for small industrial consumers increased until 2011 and have only declined since.

Due to confidentiality, there is no statistical value available for companies utilising more than 150 GWh per year. Electricity purchase prices are heavily dependent on consumption patterns and purchasing strategies of individual companies. In Germany, some companies trade on power exchanges, directly or through intermediaries. In interviews, German industry representatives sketched a typical purchasing strategy: about 80% of power is acquired in long-term contracts while spot market purchases make up 20%. Therefore, declining or rising spot market prices do not have an immediate impact on the electricity costs of large industrial companies.

For further analysis, an approximate value is calculated using market prices to determine a purchase price of the current costs of energy-intensive industrial companies. It is assumed that one third of the long-term contracts are concluded with two years lead time, one third a year in advance, and one-third during the given year. Day-ahead prices are used as spot market prices. The average price of long-term contracts is weighted with 80% and the spot market price make up 20%. For 2013, this results in a purchase price for of 4.69 ct/kWh for this consumer group of large industrial companies.

Situation and costs of the network

Four network operators assure electricity transport in transmission networks. Around 800 companies operate on the distribution level. Changes in the power plant fleet increase the cost of expanding networks. Due to increasing renewable electricity production in decentralised installations, network charges are increasing, especially at the distribution grid level. Since new power plants and large wind turbines were built mainly in the north of the republic and large nuclear power plants in the south will retire, four large DC lines are planned to improve power transmission. These routes and further network expansion plans are expected to increase network charges on transmission grid level.

Network costs for industrial customers in Germany vary according to power consumption and peak load. If the peak load of a consumer differs from the annual system peak load in time, consumers with a yearly demand of at least 10 GWh may apply for individual network charges. The minimum rates for these reduced network charges depend on the power consumer’s full load hours. In extreme cases, for a consumer with 8000 full load hours, the minimum rate is 10% of the published tariffs.

§19 Electricity Network Access Ordinance surcharge (§19 StromNEV-Umlage)

The reduction of network charges for eligible customers is financed by a surcharge. This surcharge must be paid by all consumers. The tariff was 0.329 ct/kWh in 2013. For consumption above the threshold of 1 GWh/year, consumers pay 0.05 ct/kWh. Industrial enterprises, as well as rail infrastructure and transport companies, whose electricity costs have exceeded four percent of their turnover in the previous calendar year pay 0.025 ct/kWh for consumption above 1 GWh.

Concession fee

Power companies pay concession fees to compensate for their usage of public transport routes. For industrial customers, the upper limit per kilowatt hour is 0.11 ct/kWh. Special contract customers, whose purchase prices are below a published price threshold, are exempted from paying concession fees.

Electricity tax

The current electricity tax is 2.05 ct/kWh and is levied on consumption. The manufacturing, agriculture and forestry industries can apply for tax relief. Provided they save more than €250 per year, they are granted the relief and are only required to pay 1.54 ct/kWh. Depending on the pension payments made by the individual company and its energy efficiency, the tax rate can be further reduced by up to 90% in some cases. However, companies would need to introduce an energy or environmental management system to receive this reduced rate. The consumption of electricity produced from renewable energy sources and small installations, as well as emergency power supply and electricity, which is generated and consumed on board vehicles, are exempt from this tax. The tax on electricity consumption is refunded when consumption is used in electrolysis; the manufacture of glass, ceramics, cement, and metal; and in chemical reduction processes.

Renewable energy surcharge (EEG-Umlage)

The EEG surcharge funds payments to operators of renewable energy installations. In 2013, the standard rate was 5.28 ct/kWh. Manufacturing and railway companies can apply for a "special equalisation scheme" that reduces payments. The conditions were revised in 2014. From 2015 onwards, the minimum electricity cost intensity for companies in certain competitive industries is 16%. In 2016 this threshold for electricity costs compared to the gross value added of the company increases to 17%. Companies from less competitive sectors need to exceed an electricity cost intensity of 20% to take part in the scheme. In addition, companies need to implement an energy management system. If a company is eligible to apply, it is charged 15% of the standard rate of the surcharge from the first gigawatt hour of consumption per year, but not more than 0.5% of gross value added if the electricity intensity of the company is higher than 20%, or 4% of the gross value added, if the electricity intensity of the company is less than 20%. Minimum rates are 0.05 ct/kWh for non-ferrous metal producers and 0.1 ct/kWh for all others.

CHP surcharge (KWKG-Umlage)

The CHP surcharge scheme is based on the law for the preservation, modernisation and expansion of combined heat and power (CHP Act). It funds additional costs of combined power and heat generation as opposed to separate production. The CHP surcharge is recalculated every year and amounted to 0.126 ct/kWh in 2013. Companies with electricity demand greater than 100 MWh per year, pay 0.55 ct/kWh for consumption exceeding 100 MWh. If their electricity costs in the previous year exceeded 4% of revenue, energy-intensive manufacturers pay only 0.025 ct/kWh for consumption above 100 MWh.

Offshore liability surcharge

Since 2013 network operators pass the costs of service compensation in the case of interference or delay in the connection of offshore wind farms on to power consumption. The surcharge depends on consumption levels. For electricity purchases below 1 GWh, 0.25 ct/kWh can be added to the network charges. For electricity purchases above 1 GWh, the surcharge is reduced to 0.05 ct/kWh. If their share of energy costs in the previous year accounted for more than 4% of their turnover, manufacturers only pay 0.025 ct/kWh for electricity purchases over 1 GWh.

Conclusion

Privilege criteria for taxes (electricity tax), fees (concession fee), network charges and levies (EEG surcharge, CHP surcharge) are determined in the respective laws and regulations. There is not one uniform definition for energy-intensive companies. Privilege criteria vary widely; they include, among other things total electricity consumption, electricity costs compared to the value added or turnover, deviations from a threshold for power purchase prices, and specific processes.

2.2 Netherlands

Electricity supply and demand

In the Netherlands, electricity demand has barely risen in recent years. Since 2004, it has varied between 104 and 109 TWh annually. After a continuous and slight increase in demand in the years leading up to 2008, the economic crisis in 2009 was responsible for a reduction in industrial electricity demand. In 2012, industry consumed about 33% of the electricity demand of 106 TWh, while households constituted 24% of electricity demand.

In 2012, electricity generation in the Netherlands totalled in about 102 TWh, which is 10% less than in 2011. Including imports and exports, electricity supplied was 119 TWh. Gas made up 53% of the Netherland's electricity mix in 2012 (10% less than in 2011). The remaining energy sources for electricity generation were hard coal (24%), renewable energy (11%), nuclear power (4%), and other sources (8%). The strong focus on gas power plants in electricity production can be explained by the local natural gas reserves in the Netherlands.

Electricity market

75% of installed capacity is owned by the four largest companies Vattenfall/Nuon (24%), RWE/Essent (23%), GDF SUEZ (21%) and E.ON (8%). In 2011, the three largest utilities Vattenfall/Nuon, RWE/Essent and Eneco had a market share of 80%.
In 2012, 80% of the Dutch electricity market was traded "over the counter" (OTC) and 20% on the electricity exchange APX-ENDEX. In 2012 the APX spot market had a volume of 50 TWh, and the futures market 34 TWh.

Electricity exchange

The Netherlands is interconnected to Germany and Belgium via high-voltage lines. Since 2008, the submarine cable NorNed connects the Netherlands and Norway. The BritNed cable, which provides a connection to the UK, went into operation in 2011.
In some years, Germany produced and exported up to one fifth of the electricity consumed in the Netherlands. In 2012, 22.5 TWh of electricity were imported from Germany. Via the NorNed cable more electricity is imported from Norway than exported. In recent years Belgium and the UK have,

for the most part, imported more electricity from the Netherlands than they exported there, but imports and exports are both small.

Electricity purchase price

Due to the existing power plants, the Dutch electricity market is strongly linked to the gas price. As a result of developments in international gas and coal markets, wholesale price differences with countries such as Germany and France have increased significantly. The Netherlands imports a large share of its electricity from Germany.
Power prices on the Dutch exchange APX were 5.2 ct/kWh in 2011. It dropped the following year to 4.9 ct/kWh and then climbed back up to 5.2 ct/kWh in 2013. German average electricity spot prices in 2013 were about 1.4 ct/kWh lower.
For 2013, Eurostat reported procurement prices of 5.55 ct/kWh for industrial consumers with an annual demand between 70 and 150 GWh. Prices for this category, which is the largest for which data are available, have fallen since 2011. For households with consumption of 2500 to 5000 kWh/year, the 2013 price was the lowest since 2007 at 7.6 ct/kWh.
For industrial companies with a consumption of more than 150 GWh per year, there is no statistical data. To make prices comparable with the results of other countries, a price is calculated analogously to the German data on the basis of stock market prices. As a result, the assumed electricity price for 2013 is 5.5 ct/kWh.

Situation and costs of the network

The national transmission grid operator TenneT operates the Dutch high-voltage grid and interconnectors. Eight distribution system operators (DSO) manage the regional distribution networks. The DSO are largely owned by municipalities and regions.

While the wholesale price of electricity is higher, the network costs tend to be lower than those in Germany. The network charges for the industry align to two components. The "Systeemdienstentarief" applies to connections to the high-voltage network or networks that are directly or indirectly connected to the high-voltage grid. It is measured by the energy demand (kWh), and amounts to 0.11 ct/kWh in 2012. The additional "Transporttarief" is made up of fixed connection costs, prices for delivery of annual peak load (kW), and monthly load rates (kW). Large consumers pay an average of 0.4 ct/kWh and medium-large industrial consumers about 0.8 ct/kWh.

Electricity tax

The Dutch electricity tax has very high rates for the first consumption levels and lower rates for high consumption levels. Power generation, chemical reduction, electrolysis, metallurgical processes and use of electricity in cogeneration plants are exempt from the tax. Industrial companies that consume more than 10 GWh per year and have an energy management system in place, receive a discount, which reduces the total expenditure for the SDE+ -surcharge and the energy tax to the European minimum tax rate of 0.05 ct/kWh.

Promotion of renewable energy sources: SDE+

The support costs for renewable energy are paid by all consumers via the SDE+ scheme. The base rate of the surcharge is 0.11 ct/kWh. The surcharge's tariff depends on the annual electricity consumption of the consumer and decreases with increasing power consumption. Industrial companies that consume more than 10 GWh per year and introduce an energy management system as part of the "Covenant" agreement receive a discount, which reduces the total payments for energy tax and SDE to the European fixed minimum rate of 0.05 ct/kWh.

Conclusion

The list of current price components in the Netherlands is considerably shorter than in Germany. The Dutch system relies on voluntary energy efficiency agreements, the "Covenants". The participants are granted extensive discounts on tariffs for the electricity tax and the surcharge to promote renewable energies (SDE+). Exemptions are laid down in the laws and regulations that are currently applicable. They are based on the European requirements for energy taxes.

2.3 United Kingdom

Electricity supply and demand

Total electricity demand in the UK is decreasing. Until 2008, demand varied between 330 to 350 TWh per year. In 2013 it amounted to 317 TWh, of which 36% came from households. The commercial, trade, and service sectors were responsible for 31% of electricity demand in 2013 and another 31% was consumed in industrial enterprises. The three industries with largest power consumption are chemical, food-processing, and paper industries. In total, they account for 40% of industrial electricity demand. By 2050, the government expects the demand for electricity to increase in the range 30% to 60%.

In 2013, electricity generation in UK consisted of 36% coal, 27% gas, 20% nuclear power, 2% hydropower, and 15% other renewables. Compared to 2011, the production of coal in particular (2011: 30%) and renewables (2011: 9.4%) rose, while the generation of electricity from gas (2011: 40%) had dropped significantly. The British government expects capacity bottlenecks in the current system and has pre-emptively implemented a capacity market, which should go into effect in 2018.

Electricity market

The largest producer of electricity in the UK is Electricité de France (EDF), which produces about one-sixth of the current supply. Further important generators including E.ON UK, RWE npower-, Scottish and Southern Energy (SSE) and Scottish Power (SP), all had a market share of more than 10% in 2012.

In 2011, the British government announced an electricity market reform, which would gradually come into force from 2014 onwards. Main components of the electricity market reform include the introduction of contracts for difference (CFD) and a capacity market.

Electricity exchange

The UK has only few connections to the continental electricity system. The interconnector with France has about 2000 MW transmission capacity and the line to the Netherlands has 1000 MW transfer capacity. Since 2010 the northern part of UK has been connected to the Republic of Ireland. Throughout the year, the United Kingdom imports more electricity from France and the Netherlands than it exports to those countries. In 2012 the UK reached a net import peak of more than 12 TWh.

Electricity purchase price

The wholesale prices for electricity are closely linked to gas prices. This relationship weakened in 2012, as electricity produced from gas decreased in favour of electricity from coal-fired power plants. In 2013, a total of 23 TWh was traded at the APX Power UK, of which 9 TWh was traded in the day-ahead market. The average price on the day-ahead market in 2013 amounted to £49.68/MWh. This corresponds to about €60/MWh, which is significantly higher than in other European countries. Due to limited interconnector capacity, there is little opportunity for arbitrage.

Electricity prices for households with consumption of 2500 to 5000 kWh/year were 13.5 ct/kWh in 2013, which was its highest level since 2007. For large industrial customers with a consumption between 70 and 150 GWh/year, the price reached a statistical value of 7.5 ct/kWh.

For the UK, energy price information from Eurostat include price components, which can be traced back to regulation. For this reason, a procurement rate for large industrial customers for further analysis is calculated, analogous to Germany, on the basis of stock market prices. This rate is 6.21 ct/kWh.

Situation and costs of the network

The transmission network in England and Wales and the interconnectors to France and the Netherlands are operated by National Grid. SSE and SP operate the network in Scotland while Northern Ireland Electricity (NIE) operates the network of Northern Ireland. Distribution networks are divided regionally between seven companies, which are regulated by Ofgem ("Office of the Gas and Electricity Markets"). Within the country, the network structure is relatively weak, which leads to significantly different regional network charges.

Network charges in the UK are divided into transmission grid (TNuoS) and distribution fees (DNuoS). Charges for the transmission of electricity vary depending on the area. They are determined by peak demand during the winter months (between November and February) and by annual energy consumption between 4 and 7 P.M.

Capacity market

In December 2014 a capacity market was introduced with a first auction, in which capacity payments for 2018 were offered. According to this first auction, installed capacity will receive an additional payment of £19.40/kW per year (about €24/kW per year). The capacity market will be funded from 2018 via a charge on energy suppliers. The costs will be passed on to the final customer via electricity prices. Autogeneration is exempt from the surcharge. The Ministry of Energy and Climate Change (DECC) predicts indirect cost effects of the electricity market reform (CFD and capacity market) amounting to 1 p/kWh in 2020. About one third of this effect is attributable to the capacity market.

Electricity tax: Climate Change Levy

The Climate Change Levy is a tax on electricity for business customers that is used for reducing the social security contributions paid by employers, as well as promoting energy efficiency and low-carbon technologies. The conclusion of a Climate Change Agreement (agreements between a sector or a company and the Department of Energy) justifies a reduction in the Climate Change Levy. Since the introduction of the Carbon Price Floor, the reduction has been 90%. In 2013 the base rate was 0.509 p/kWh, while privileged companies paid 0.0509 p/kWh.

Promotion of renewable energy sources

In the promotion of renewable energies, the British government relies on different concepts, each of which has an impact on the price of electricity. Tariffs are not established via policy. Instead utilities must meet certain conditions. How they pass costs to the consumer is up to them. In Eurostat, the price components are listed along with procurement prices in the category "energy and supply".

The Renewables Obligation requires electricity suppliers to source a certain proportion of their electricity from renewable energy or buy energy obligation certificates. The resulting costs are then passed on to consumers. A formal privilege criterion does not exist yet the utilities charge the industry less than households; which explains the slightly lower burden. For 2013, the costs to commercial and industrial consumers were estimated to about 0.8 p/kWh.

The CFD system is supposed to replace the existing quota system (Renewables Obligations) by 2017 and accelerate the expansion of electricity from renewable energy and nuclear power. It started in the fall of 2014, with first auctions in February 2015. The CFD is financed via a surcharge, which the Low Carbon Costs Company (LCCC) raises from the power company. This surcharge is passed on to end users via the electricity price. The UK Energy and Climate Ministry (DECC) estimates the effect of Contracts for Difference and the capacity market at 1 p/kWh in 2020. Two thirds of this can be considered a result of the Contracts for Difference. Concrete privileging criteria for the surcharge are not yet known, but they are expected to be based on sector boundaries. The aim is to compensate electro-intensive businesses. The list of sectors that meet the privileging criteria is expected to be aligned with the list of sectors that are compensated for the indirect costs of the EU ETS which is defined by the European Commission (Carbon Leakage List).

Carbon Price Floor

The Carbon Price Floor is a minimum price for CO2 emission allowances from the EU ETS and was introduced by the British government in 2013 at national level. To limit the impact of the carbon floor price on electricity prices, the maximum level of the Carbon Price Support is set at £18 until 2020, meaning the planned increase in the carbon floor price (£30/tCO2 in 2020) is also indirectly capped. More specifically, its value depends on the price development in the EU-ETS. Eligible electro-intensive industries receive compensation payments of up to 80% of the indirect costs incurred as a result of the Carbon Price Floor. The group of privileged sectors complies with the sectors in the carbon leakage list (EU ETS) of the European Commission.

Value-added tax (VAT)

The standard rate of VAT in the UK is 20%. A reduced rate of 5% is applied to the electricity consumption of households and charitable organisations.

Conclusion

The cost of energy and climate policy in the United Kingdom are usually distributed via power suppliers. There are no fixed rates, but quotas that are to be met by supplying companies. To reduce the impact of rising policy-induced costs on energy-intensive industries, the government is increasingly relying on compensation payments, which are expected to gain importance in the future.

2.4 France

Electricity supply and demand

Electricity consumption in France has risen by 17% from 384 in 2000 to 450 TWh in 2013. The share of industry amongst electricity consumers reduced both in relative and absolute terms, from 135 TWh (35%) in 2000 to 115 TWh (26%) in 2013. Household consumption increased from 129 TWh to 167 TWh in 2013.

Overall, in 2013 approximately 551 TWh of electricity was generated in France. Nuclear power plants provided the majority with 75.4%. Hydropower without pumped storage made up 13%, while gas, coal and oil make up a combined share of 5%. The share of renewable energies excluding hydropower was also about 5%.

Electricity market

Three major players act on the production level: EDF, GDF SUEZ (since April 2015 Engie) and E.ON (formerly SNET). Together they generated more than 95% of electricity in France in 2012, 90% of which was generated by the plants of EDF, which are primarily (85%) based on electricity from nuclear power plants. EDF is a private, monopolist company in which the French state holds the majority of shares.

Self-producing suppliers in the retail market include EDF, Engie, Poweo and Direct Energie. To further strengthen competition in the electricity market, the Law on the Reorganisation of the Electricity Market (NOME law) was adopted in December 2010. Since July 2011 it has facilitated the market entrance of other electricity suppliers through the purchase of cheap nuclear electricity von EDF (L'Accès à l'Électricité Regule Nucléaire Historique, ARENH) at a fixed price of 4.2 ct/kWh.

In addition, a consortium (Exeltium) of about 25 large electricity-intensive companies concluded a private contract with EDF for 24 years, which allows them to set a certain market price for 148 TWh over the entire period. This price was set at €50/MWh until 2014. After the negotiations between EDF and the consortium in 2014, the price was reduced by 20% to correspond with the low spot market prices.

Electricity trading in France is carried out on the EPEX Spot and consists of day-ahead and intraday markets. Unlike the day-ahead market, an order can be entered up to 45 minutes before the delivery date in the order book in the intraday market. In 2011, the trading volume on the stock exchange only made up about 10% (60 TWh) of the country’s entire electricity demand. Much of the wholesale trade is contracted via bilateral supply agreements.

Electricity exchange

France is the largest electricity exporter in Europe. According to ENTSO-E data, France exported about 64 TWh in 2011 while importing 9 TWh. France’s export target countries in 2011 were Germany (20.3 TWh), Italy (14.3 TWh), Switzerland (12.3 TWh) and the United Kingdom (6.1 TWh). On average, net electricity exports have decreased. In the years 2009 and 2010 in particular there was a drop to 24 and 28 TWh respectively, while from 2003 to 2005 averages were approximately 61 TWh. In 2011 and 2012 the exports increased again to 55 and 43 TWh.

Electricity purchase price

In the French price zone, the market price is relatively constant between €45 and 47/MWh. Notable price spikes have been reported, particularly in seasons that require heating. This is mainly due to the fact that about one-third of households in France are electrically heated.

Electricity prices are primarily fixed within the framework of bilateral agreements and stock market trading plays a minor role. Households with a consumption 2,500-5,000 kWh/year paid an average of 5.81 ct/kWh for electricity procurement in 2013. Large industrial customers with a consumption between 70 and 150 GWh/year paid an average of 4.42 ct/kWh according to Eurostat. For further calculations it was assumed that large energy-intensive industrial consumers do not pay more than the foreseen price of 4.2 cents/kWh set out in the NOME law.

Costs of the transmissions system (Tarif d’utilisation des réseaux publics d’électricité)

The transmission system operator RTE is responsible for the transmission of electricity, as well as the construction, maintenance and servicing of the public network (Réseau public). The distribution networks are managed by EDF through its subsidiary ERDF and by smaller, local actors.

The network user charges TURPE in France include the costs for the use of the distribution and transmission network. Depending on the type of procurement, they are included in the electricity tariff (agreement between electricity supplier and distribution network operators) or are agreed separately with the customer. The network charges are applied uniformly across the entire network area. They are partly based on the connected capacity and partly on energy consumption. Some rates vary according to season, week, or time of day.

Electricity tax: (Taxe sur la consommation finale d‵électricité)

The excise duty (TCFE) applies to the amount of electricity purchased, but differs according to business and non-business consumption and on the level of grid connection (three levels: under 36 kVA, between 36-250 kVA and over 36 kVA). Companies with grid connection level above 250 kVA pay 0.05 ct/kWh.

Energy-intensive companies can be exempted from the electricity tax. This applies to power consumption in certain processes (i.e. electrolysis, metal processing), when the electricity costs account for more than half of the product cost of a company, when electricity is used for the production of electricity, and when maintaining the power supply. The generation of electricity by small producers (production of up to 240 GWh/year) and for self-consumption (autogeneration) is also exempt from the tax. Companies that are classified as large energy consumers and are subject to ETS are also exempt from tax. Companies considered to be large consumers are those with energy costs that exceed 3% of turnover and a total tax amount of 0.5% of gross value added.

Support of renewable energies (Contribution au service public de l'électricité)

The CSPE finances electricity produced from renewable energy sources, subsidised electricity prices for socially disadvantaged, and power supply to overseas territories that are not connected to the grid. The CSPE contribution was 1.05 ct/kWh in 2012 and in 2013 it rose to 1.35 ct/kWh. The surcharge has an upper limit of €569,418 per point of consumption and a limit of maximum 0.5% of the gross value added of the company. Producers of electricity for self-consumption are exempted from the surcharge for up to 240 GWh per production location.

Value Added Tax (Taxe sur la valeur ajoutée)

The TVA (VAT) is 19.6% for each unit of power consumption, without exception or privilege.

Conclusion

For consumers, the premiums for CSPE and TCFE on the regulated delivery price can total 2.3 ct/kWh. The CTA tariff of about 0.1-0.3 ct/kWh (approximately 1-3% of the cost of electricity) has to be added. Due to the exemptions mentioned for certain customers, the total payments for these components can be limited to 0.1 ct/kWh (only CTA).

Special agreements between energy-intensive industries and the electricity supplier EDF set electricity purchase prices that fall below the market price, and therefore also below the Eurostat average electricity purchase price of 4.42 ct/kWh for electricity purchases for companies that consume up to 150 GWh/year.

The only exemptions for the energy-intensive industries apply to the excise tax TCFE and the CSPE surcharge. Electricity price components often depend on consumption level, installed capacity, and voltage level. Power consumers with a connected capacity below 36 kW pay the highest electricity cost per corresponding amount of electricity, whereas the lowest costs are incurred for connected loads of more than 250 kW. The magnitude of a few price components such as network charges or pension levies (Contribution Tarifaire d'Acheminement CTA) depend on the tariff group. Customers have the possibility to choose between different time-varying tariffs, which can, in turn, have an impact on their network charges and electricity prices.

2.5 Italy

Electricity supply and demand

In 2013 Italy consumed about 287 TWh of electricity, about 40% in the industrial sector, 31% in the service sector, and 23% from households. Compared to 2000, consumption increased only by 14 TWh. However, from 2006 and 2008, higher consumption of about 309 TWh was recorded. The share of industry in total electricity consumption decreased from 52% in 2000 to 40% in 2013.

In 2013, a total of 286 GWh of electricity was produced. The mix in Italy consisted of 43% from natural gas, 18% from coal, and 15% from hydropower. Furthermore, 6% came from oil, 6% from PV, 4% from wind, 3% from biomass and 2% from geothermal. As in other countries, an increase in electricity production from coal and a simultaneous decrease in the production of electricity from gas was recorded in Italy over the previous year 2012. Since 2011, the share of wind and PV has risen slightly.

Electricity market

In terms of power generation, the three largest companies had a combined market share of 41% in 2012. ENEL is the largest electricity producer with a market share of 26%. The company is controlled by the state. Electricity is traded on the electricity exchange Gestore mer cati Energetici (GME).

The electricity market was liberalised for all end users in July 2007. In 2012 the two largest trading companies had a market share of 44% in electricity trading. The remaining 56% was traded by 410 smaller companies.

Electricity exchange

Italy has interconnector capacity to Austria, Switzerland, France, Slovenia and Greece. Italy imports more electricity than it exports. The share of imports in demand since 2009 is about 15%. France and Switzerland are large providers of electricity to Italy, but small amounts also come from Austria and Slovenia. Only Greece imported more electricity from Italy in some years than it exported there, but in very small amounts.

Electricity purchase price

Electricity is traded in Italy at comparatively high prices. This is due to the gas-based power plant fleet. In 2013 the Italian wholesale price for electricity was 6.3 ct/kWh. Therefore Italy uses most of its import capacities. However, this is still not sufficient, to lower the price to a level of the neighbouring countries for all consumers.

Energy-intensive companies have the opportunity, via a "virtual interconnector", to benefit from lower electricity prices abroad by purchasing electricity from a supplier in Germany, France, Austria, Switzerland and Slovenia. Companies that want to participate in this programme make a purchase bid and pay additional transfer fees amounting to 4 ct/kWh. The "virtual interconnector" is to be closed by the end of 2015.

Additionally, energy intensive companies have the opportunity to refinance investments in energy efficiency via white certificates. An interruptible load scheme opens additional sources of income for electricity consumers. Both additional sources of income are not taken into account in further calculations.

Since there is no detailed electricity price data on Italy available, the Eurostat value for the largest consumption category of companies with more than 150 GWh of yearly consumption has been adopted. This was 7.57 ct/kWh in 2013. Households that consumed 2500-5000 kWh paid on average 10.64 ct/kWh for electricity in 2013.

Situation and costs of the network

The maximum and high-voltage grid as well as more than 90% of the entire Italian electricity grid is operated by Terna. The state-run "Cassa Depositi e Prestiti" holds a majority stake in the company. Prior to liberalisation, the electricity grid was integrated in the ENEL group.

Because of insufficient network capacity within the country, Italy is divided into six zones on the stock exchange: North, Central North, Central South, South, Sicily and Sardinia.

Network costs in Italy are financed by all consumers through taxes to finance the infrastructure for the transmission, distribution, and measuring. The amounts depend on the voltage level, connection capacity, and consumption.

In addition, a charge for all end users was introduced in 2014 to finance the transmission system operator Terna. In July 2014 the normal rate was 0.299 ct/kWh. There are several gradations depending on the voltage level including the lowest rate of 0.061 ct/kWh for end users of the higher voltage levels.

Electricity tax

The normal tariff of the Italian electricity tax was 2.27 ct/kWh in July 2014. In the electricity tax there are several tariff levels according to voltage level and power consumption and including complete exemption. Consumers with a connection to higher voltage levels pay 0.0075 ct/kWh for consumption that exceeds 12 GWh/month.

Promotion of renewable energy sources: incentivi alle fonti rinnovabili e assimilate

The charge for the promotion of renewable energy was 6.38 ct/kWh in July 2014. There are several steps down to the lowest tariff of 1.47 ct/kWh. Additionally, end consumers with a connection to higher voltage levels and consumption that exceeds 12 GWh/month have to pay €137.26/counter. Energy intensive businesses are exempt from the tax if they exceed a certain consumption amount (8 to 12 GWh/month).

Surcharge to ensure the safety of nuclear power

The "oneri per la Messa in sicurezza del nucleare e compensazioni territoriali‟ is a surcharge to ensure the safety of nuclear power and contributes to the financing of the costs of dismantling nuclear power plants (Latina, Caorso, Trino Vercellese, Garigliano). Since 2005, part of the fee (€100 million) has gone into the general state budget. The delivery consists of two components: The A2 component for the safety of nuclear power plants, and the MCT component that covers the costs of land use in connection with the dismantling of nuclear power plants. The MCT-surcharge is the same for all end users: 0.0182 ct/kWh. The A2 surcharge varies slightly, depending on the voltage level and power consumption. The normal rate is 0.1462 cents/kWh (July 2014). There are several tariff levels including the lowest tariff of 0.0502 cents/kWh. On top of this is 371.85 cents/meter (July 2014) for consumption that exceeds 12 GWh/month for consumers at higher voltage levels.

Promotion of energy efficiency: promozione dell'efficienza energetica

The charge for the promotion of energy efficiency contributes to the financing of energy efficiency measures. The amount of the surcharge is the same for all consumers and was 0.045 ct/kWh in July 2014.

Surcharge for promotion of the state railway company

Component A4 (regimi tariffari Speciali per la società Ferrovie dello Stato) finances the support of the Italian railway system. The amount depends on the voltage level, the connection capacity, and the consumption. The normal rate is 0.229 ct/kWh (July 2014). There are several levels, the lowest of which is a rate of 0.069 ct/kWh for consumption that exceeds 12 GWh/month for consumers of the higher voltage levels.

Surcharge to help small energy companies

The surcharge UC4 (compensazioni per le Imprese elettriche Minori) supports all electricity companies that have less than 5,000 customers. The normal tariff was 0.058 ct/kWh in July 2014. Commercial end-users at lower voltage levels paid 0.03 ct/kWh, those at average voltage level paid 0.02 ct/kWh and those at the higher voltage levels 0.01 ct/kWh in 2014.

Surcharge to ensure supply continuity

The surcharge UC6 to ensure supply continuity was created in 2014. The normal rate was 0.006 ct/kWh in July 2014 for companies in the low voltage level. Consumers of middle and high voltage levels did not pay any surcharge.

Surcharge to support research in the electricity industry

The component A5 (alla ricerca di sistema sostegno) funds research on the power industry and applies to all end consumers. The normal rate was 0.037 ct/kWh (July 2014). There are several levels depending on connection capacity and power consumption down to the lowest tariff of €366.68/meter and 0.003 ct/kWh for consumption exceeding 12 GWh/month.

Surcharge to finance the electricity bonus

The component As (copertura del bonus elettrico) finances the bonus granted to economically weak clients and customers with physical disabilities. All end-users pay this component. The normal rate was 0.007 ct/kWh in July 2014. There are several levels depending on wire size and power consumption, the lowest of which is 0.002 ct/kWh for consumption starting at 12 GWh/month.

Funding to support energy-intensive companies

The component Ae (copertura delle agevolazioni per le Imprese a forte consumo di energia Elettrica) is designed to refinance tax benefits of energy-intensive companies. Energy-intensive companies that consume more than 2.5 GWh/year, incur electricity costs of more than 2% of their gross value added, and are connected to the medium or high voltage level, receive tax relief between 15 and 60% of the aforementioned duties. The surcharge that finances these tax reliefs is paid by all consumers, except energy-intensive companies. The base rate is 0.506 ct/kWh (July 2014). There are several gradations depending on the voltage level and power consumption down to the lowest rate of 0.118 ct/kWh for consumption starting at 12 GWh/month.

Value-added tax (VAT)

The VAT is levied on all price components and is normally 22%. Households pay a reduced rate of 10% for electricity.

Conclusion

The numerous duties and taxes in Italy vary greatly between individual end consumers depending on the amount of consumption, voltage level, connection capacity, and the share of electricity costs to gross value added of an industrial company. Thus, for the example end consumers, a significant burden difference arises of between 11.2 ct/kWh that households pay for levies and taxes and 1.5 ct that is paid by large, energy-intensive industrial companies per kWh.

2.6 Denmark

Electricity supply and demand

Total Danish electricity consumption was 31.5 TWh in 2013. It has declined slightly since 2010. Service companies and households made up the largest share of consumption, each with about 33%. Industry's share is 27%.

The total gross electricity generation was about 30.6 TWh in 2012. Close to 50% came from large CHP plants and about 11% from decentralised CHP plants. Renewable energy sources accounted for 48.2% of the national gross electricity production in 2012. Of this amount, the largest share (70%) was generated by wind farms, which corresponds to 33.4% of national gross electricity production.

Electricity market

Electricity production in Denmark is dominated by Vattenfall and Dong, which together manage about two thirds of the total capacity. Both Vattenfall and Dong are state-owned companies: Dong is owned by the Danish state, and Vattenfall is owned by the Swedish state. The transmission system operator energienet.dk is also a state-owned enterprise. The retail market has been liberalised and customers are free to choose their supplier. However, the rate at which customers switch suppliers is very low. In 2013 around 80% of customers purchased their electricity within the framework of the supply obligation, which regulates the price of electricity. Since 2013, the licenses for the basic services have been auctioned off and the former monopolist care must also offer a base product whose price is also monitored by the regulatory authority.

Much of the electricity is traded on the Nord Pool Spot exchange. The stock market integrates the electricity markets of Norway, Sweden, Finland, Denmark and the Baltic states.

Electricity exchange

The price zone Denmark West has connections to Germany, Sweden and Norway. Denmark East is connected to Germany and Sweden. According to ENTSO-E data, the flow direction of the Danish electricity exports and imports is not distinct. In the past ten years, Denmark has exported more electricity to Germany than it imported from its neighbour with the exceptions of 2010 and 2013. In the directions of Norway and Sweden, the exchanges fluctuate more: in 2011, 2012 and 2014 Denmark exported more electricity to the Scandinavian countries than it imported. In 2010 to 2013 the reverse was true. In 2009, the export balance to Sweden was positive, but negative to Norway.

Electricity purchase prices

The price of electricity in Denmark is based on the development of prices on the Nordic power exchange Nord Pool. According to the regulator, the price at Nord Pool determines about 90% of the final price. The remaining 10% consist of distribution expenses incl. margins, which is the framework within which the providers compete. The average exchange price for the two Danish price zones was at about 3,46ct/kWh in 2013.

Based on data from Nord Pool Spot the average market price in 2013 was €38.98/MWh in the Denmark 1 zone and 39.6 euros/MWh in the Denmark 2 zone.

No detailed calculations were carried out on the basis of day-ahead and long-term procurement for Denmark. Due to a lack of data availability from Eurostat, the electricity price of enterprises with a consumption exceeding 150 GWh, is assumed to be the same as for the underlying class (70-150 GWh): 3.93 ct/kWh in 2013.

The price of electricity for households reported by the Danish Energy Agency was 2.22 DKK/kWh (29.75 ct/kWh) in 2012. For industrial customers, an average electricity price of 0.62 DKK/kWh (about 8.3 ct/kWh) is recorded by the Danish Energy Agency. This value includes the network charges, but no taxes.

Situation and costs of the network

The Danish transmission grid is divided into two zones that have not been connected to each other since 2010. Denmark West (DK1) mainly comprises the Jutland peninsula and the island of Funen, and is synchronised with continental Europe, while Denmark East (DK 2) comprises the eastern islands of Zealand and is synchronised with the Scandinavian countries. The gap is closed by a DC-submarine cable.

The transmission network tariff for households was about 0.99 ct/kWh (0.074 DKK/kWh) in 2013. The fee is used to cover costs of repair, maintenance, development and operation of the national electricity grid. In addition to pure network charges a system component is included that covers the cost of system security, such as the purchase of balancing energy. The distribution fees for households amounted to some 0.33 DKK/kWh (4.4 ct/kWh) in 2013.

Electricity tax: Elafgift

Since January 2014, a single concentrated electricity tax (Elafgift) is charged instead of various taxes and fees. The tariff for households was 11.17 ct/kWh in 2014. Companies can usually be reimbursed up to a base fee of 0.05 ct/kWh (0.4 öre/kWh) if they are registered for VAT. The tax refund is only valid on consumed electricity (not resold electricity), and can only be applied to the share of electricity consumption which was used in the production of taxable products.

For their electricity used in heating, space cooling and hot water preparation, companies can apply for a partial refund. The partial refund is 5.64 ct/kWh (42.1 öre/kWh). For houses heated by an electrically-powered heat pumps, a reduction of the electricity tax can be requested. For this purpose the house must be registered in the construction and housing register (Bygnings- og Bolig Registret / BBR Registret). The reduced rate is applied to the annual consumption that exceeds 4,000 kWh/year and is 5.52 ct/kWh (41.2 öre/kWh).

Promotion of renewable energy sources: Public Service Obligation

The national transmission system operator energienet.dk has defined tasks of public interest: "public service obligations". These include the promotion of renewable energies and CHP, grid connection and integration of wind power plants and small cogeneration plants, as well as the support of improvements of energy efficiency. The Public Service Obligation (PSO) tariff is designed to refinance these and other activities. The PSO tariff is levied on electricity consumers based on gross electricity consumption.

For electricity production for self-consumption, a reduced rate is applied. The reduction relates to the cost of support for renewable energy generation and local CHP plants. Self-consumption units do not pay the part of the surcharge that serves to promote the respective facility. Small plants for self-supply can be exempted from the full PSO tariff. Likewise, users whose consumption exceeds 100 GWh/year can benefit from a reduced rate for consumption above 100 GWh/year. The standard PSO rate in the first quarter of 2014 was 2.55 ct/kWh. The reduced tariff for a consumption of more than 100 GWh/year was 0.7 ct/kWh; the reduced rate for autogeneration was 0.13 ct/kWh.

Conclusion

The Danish power system is often seen as a model for the reconstruction of the German electricity system. The share of wind generation is significantly higher than in Germany and thermal power generation is carried out largely in cogeneration. Stock market trading is highly liquid. The wholesale price for delivery on the following day (day-ahead) is located approximately at the level of the German exchange prices. Concerning the privileges in the electricity tax, Denmark refers to the minimum load of €0.5/MWh defined by the EU. The reduction in Danish electricity taxes is granted with respect to the energy consumed in the production of VAT-liable products, for electricity used in the heating and cooling of rooms, for water heating in commerce, and the heat supply by electric heat pump in households. A discount on the Public Service Obligation tariff for energy-intensive customers with high consumption is possible.

2.7 Korea

Electricity supply and demand

Electricity consumption in South Korea has steadily increased since 2005 from 372 to 503 TWh. It has thus reached a similar level to that of German electricity consumption. In industry and in household and commerce consumption has increased by 29% on average and in 2011 amounted to about 246 TWh in trade, 61 TWh in industry, and 149 TWh in households. In the crisis years of 2008 and 2009 only a short-term stagnation was recognisable.

Electricity generation is divided into the three main blocks: coal (39%, 205 TWh), nuclear power (30%, 154 TWh) and gas (22%, 115 TWh). Generation from coal and natural gas has almost doubled since 2005, with a similar development in percentage terms, while nuclear energy has remained relatively constant. In absolute terms, renewable energy sources play a marginal role, also when considering hydropower.

Electricity market

Three groups of stakeholders act on the Korean wholesale market for electricity. On the demand side, there is the Korea Electric Power Corporation (KEPCO), a listed company owned by the state, which buys the entire volume of electricity traded on the spot market. Furthermore, KEPCO is responsible for both, the transport and distribution and supply of electricity. The electricity suppliers are divided into two groups: private producers that sell their electricity to KEPCO at the "marginal system price" and the subsidiaries (100%) of KEPCO, which generate approximately 89% of electricity at a lower rate than the "marginal system price". Electricity generation units operate at full capacity resulting in power scarcity in hot summer months and even partly in winter. During this time, the private electricity producers are able to obtain very high electricity prices, while prices are subject to state regulation for KEPCO subsidiaries.

Overall, the situation in the electricity market is very tense, as generation is not always able to cover the demand at all times. In the summer of 2012, for example, the energy-intensive electric steel producers were asked to cease production if the spare capacity were to drop to below 4 GW. In these cases the companies receive a compensation of 47 ct/kWh.

On the retail market KEPCO is the only electricity supplier. The electricity purchase prices for end consumers are regulated and consist of two parts: the basic price (per household connection and amount or power input) and the price of labour, which is based on the amount of consumption.

Retail prices of KEPCO subsidiaries are composed of two components: energy costs (fixed and variable energy costs excluding fuel costs) and the cost of fuel. Energy costs must be approved by the Electricity Commission, while the fuel costs are normally automatically adapted to the development of fuel prices every two months. However, the government has suspended this adjustment so that KEPCO and its subsidiary companies take on debt due to uncovered fuel costs.

Transmission grid und Electricity exchange

For geo-political reasons, Korea's electricity system is not connected to the systems of other countries.

Electricity purchase prices

The Korean electricity market has experienced a low level of liberalisation. The government is trying to keep the end consumer prices low and to ensure an adequate supply of electricity to all customers simultaneously. The passing on of rising costs requires ministerial authorisation, which is not always granted. Price increases in electricity production are not directly passed on to end consumers, but first defrayed to the budget of a governmental agency.

The electricity purchase prices for commercial and service companies (medium and small enterprises), as well as industry, are graduated differently. In 2012, there were different tariffs for "small business and services" (SBS) and industrial enterprises, which were unified in 2013. The price of electricity consists of an energy and a base price, which differ for both consumption groups according to power supply, voltage level, and season. With a load of up to 300 kW, the working price is between 4.4 ct/kWh (transitional season) and 7.9 ct/kWh (summer), while for an installed capacity of more than 300 kW the prices lie between 3.6 ct/kWh (summer and transitional season, off-peak) and 13.45 ct/kWh (summer peak). The basic price amounts to €4.9 - 6.7/kW, depending on the connected load and voltage level.

Costs of the transmission system

Since the Korean electricity market is only partially liberalised, utilities and the network operator are not unbundled. Network costs are included in the regulated electricity tariffs, without being listed separately.

Taxes and levies: EPIDF

The Korean government has introduced an "EPIDF" surcharge by which research and development, energy saving measures, a feed-in tariff for renewable energy and other electricity market policies are financed. All consumers pay 3.7% of the electricity price for this surcharge. Exemptions do not exist. Because this surcharge is carried out in relation to the electricity reference price, consumption groups with low prices (e.g. industry) pay a lower amount in absolute terms.

Adjustment of the purchase price

A scheme for businesses and industry (not households) concerns the overrun of the contracted quantity. If the power consumption in a month exceeds the agreed base price category, 2.5 times the basic price is to be paid for the additional consumption.

Security of supply

For companies (industrial and commercial) that have a current contract for an installed capacity of more than 75 kW, there is an obligation to designate a person responsible for disconnecting power in case of emergency. If they do not have a power safety officer in the business, they can commission the Korea Electric Corporation Safety Commission to provide the legally prescribed power security services for their businesses. The costs can range from €49.8 to €1389/year. The amount is marginal for large power consumers when compared to the cost of electricity.

Value-added tax (VAT)

The VAT rate is 10% of the electricity tariff, without exception.

Conclusion

The Korean government determines the electricity prices. They try to maintain a balance between the desired low electricity prices for consumers and sufficient supply of electricity for all. The costs of energy policies are therefore not deducted from differentiated electricity price components, but rather are included in the regulated electricity price. In some cases the public utility companies acquire debt as a result of various necessities.

2.8 China

Electricity supply and demand

From 1980 to 2009, annual energy consumption in China rose dramatically from 295 to 3660 TWh. The growth in demand for electricity is on average 12% per year. China's consumption in 2010 was just under 17.5% of global consumption. Households consume only about 10% of total demand. Almost three-quarters of consumption come from industry. Industrial consumption is the greatest driver in the development of electricity generation and infrastructure.

In 2013, electricity production was 5313 TWh in China. In 2013, 77% of electricity production was based on coal. Renewables accounted for approximately 21% of electricity generation while the remainder was generated by gas and nuclear power plants. The EIA forecasts total power production to grow to 9853 TWh by 2035, which is more than three times the level of 2010.

Although the growth of fossil fuel power plants slowed down in recent years, coal power plants were responsible for close to 50 GW of the total 85 GW of new generation capacity in 2012. In 2013, the Chinese government predicted that in 2015, the "peak in coal production" is to be achieved, along with the planned transformation of the electricity system towards greater energy efficiency and a pioneering role in the development of low-emission power generation. A significant structural change is not expected to occur in the coming years, coal is expected to remain the main source of production in China's energy mix. Medium to long-term it is anticipated that the share of electricity produced from coal drops from 78% in 2010 to 55% by 2035.

Electricity market

In 2002 the Chinese government divided the state utilities into separate generation, transmission, and service units. Since then, the Chinese power production sector has been dominated by five state owned companies that produce half of China's electricity.

In contrast to electricity generation, power consumption in China is market driven: consumers pay for electricity according to usage. The market signals the consumption side, however, does not have a direct effect on the generation side, as this is centrally coordinated and regulated.

Electricity trading is usually handled trilaterally. Consumers pay the purchased power per kWh directly to the network operators, which in turn pay the electricity generators. Over the past years there have been test markets for bilateral, direct trading between producers and consumers in various provinces. Since 2009, it is has been possible, in principle, for large consumers who fulfil certain criteria (voltage level, consumption amount) to participate in the wholesale market. The trade agreements are largely reduced to target industries such as aluminium production. Trading volumes remained negligible in recent years. On average, only about 0.002% of the gross requirements were handled through the wholesale market.

Government price fixing is not able to match supply and demand. Power shortages are fairly common. Therefore, China's energy-related reforms are aimed at gradually shaping a more competitive market.

Electricity exchange

In 2012 the State Grid Corporation signed a supply contract with the Russian electricity export monopolists for the supply of a total of 100 TWh over 25 years. China imported 3.5 TWh from Russia in 2014. There are also exchanges with Mongolia, Burma and Vietnam. Overall, China's electricity exports in 2013 were 18.7 TWh.

Electricity purchase price

The Chinese electricity price is highly regulated. The National Development and Reform Commission sets the price for different consumer groups. Networks and large portions of industrial consumers are nationalised. The government is responsible for capacity planning, investment planning, and essentially for price formation. Price negotiations are complex and the results are not published.

Situation and costs of the network

The restructuring of the electricity sector in China was completed in 2002 with the unbundling of the State Power Corporation. Among other things, this resulted in the founding of the two network operators in China. The transmission and distribution network is operated in northern China by the State Grid Corporation, and in the south by the Southern Power Company.

The National Development and Reform Commission published benchmark prices for network charges. The pricing in the provinces is set by the network operator. Network costs account for approximately 20-30% of the final customer tariff. Prices range from 100-160 CNY/100kWh.

Electricity tax

Since 2004, China has had a differentiated electricity tax for industrial companies, with the aim of limiting the growth of the least efficient companies in energy-intensive industries. Enterprises are classified by the central government into four categories: eliminated, restricted, permitted, and encouraged. Companies in the "encouraged" and "permitted" categories pay the normal tariff. Companies that belong to the "restricted" category pay an additional tax of currently 0.1 CNY/kWh (2013); companies in the "eliminated" category pay an additional tax of 0.3 CNY/kWh. In the cement industry surcharges of up to 0.4 CNY/kWh are charged.

Taxes and levies of the central government

The central government collects taxes for specific purposes that are included in the retail tariff: tax for the promotion of renewable energies (0.008 CNY/kWh), tax on the promotion of agriculture and the network expansion (0.02 CNY/kWh), tax to promote a hydropower project (0.007 CNY/kWh), and a surcharge to finance desulfurisation installations in coal-fired power plants (0.008 - 0.015 CNY/kWh).

Taxes and levies of the provinces

The provincial governments have introduced policies to support energy-intensive industries. Most of these policies provide exceptions for certain sectors, particularly the aluminium industry, which experienced a reduction in its electricity prices. Although these policies should have been abolished since 2010, they continue to exist in different provinces. They include reductions between 0.017 CNY/kWh and 0.1 CNY/kWh compared to the normal retail tariff for industrial electricity customers.

Conclusion

Electricity tariffs for different consumer groups, including industry, are determined for each province. The retail tariff already includes network charges, taxes, and levies.

2.9 Japan

Electricity supply and demand

Japan, with a consumption of 860 TWh, has the second highest demand for electricity in Asia. Between 2009 and 2012, the annual demand for electricity was reduced by 220 TWh, which corresponds to a reduction of about 20%. The industrial sector is the sector with the greatest electricity demand, accounting for 30% of total demand, followed by the commercial and public service sectors. The IEEFA predicts a further reduction in demand for electricity by one per cent per year until 2020.

In recent years, the electricity mix in Japan has changed significantly due to the events surrounding Fukushima Daiichi in March 2011. Before the earthquake in 2011 nuclear power supplied about 26% of electricity in Japan. In 2012 the electricity mix consisted of 38.4% natural gas, 29.3% coal and 8.1% hydropower. Nuclear power amounted to only 1.5% of the electricity mix. The share of renewable energy sources is relatively low with 4.6% excluding hydropower. In 2012, the overall generation and demand was 923 TWh.

Electricity market

Japan's electricity economy is dominated by ten private, integrated utilities, which act as regional monopolies and own more than 90% of total generation capacities. They also control the transmission and distribution infrastructure in the country. In addition, they cover 96.4% of total electricity trade in Japan. The remaining part is produced by industrial plants or independent power producers. The largest utility is the Tokyo Electric Power Company (TEPCO), which in 2011 provided 24% of the total electricity demand and supplies the regions around the Tokyo metropolitan area.

The first efforts to liberalise the electricity market began in 1995. In early 2013 the government under Prime Minister Abe presented a three-stage reform plan that aimed to liberalise the national electricity market. This reform plan envisages the dissolution of the monopoly of the ten major regional utilities and the opening of the market to new entrants by 2020. All end-users shall by then be able to choose their electricity supplier in this liberalised market. At the same time, the reform shall promote competition within the electricity market and lower electricity prices for the consumers.

The Japanese electricity market is divided into two sectors; a regulated sector, which accounts for 37% of electricity consumption, and a liberalised part, which covers 63% of the electricity demand. End consumers with a power supply of less than 6 kV are covered by the regulated sector. Since 2005 consumers with a connection of more than 6 kV obtain their electricity from the liberalised sector. Also in this year, electricity trading on the Japanese electricity exchange (Japan Electric Power Exchange - JEPX) began, which has led to the liberalisation of the wholesale trade and to a convergence of prices among the different regions. However, with a share of 1.3% (2013) of the total market, the volume traded on the JEPX is low.

Transmission grid und Electricity exchange

Due to Japan's geographical position, the country is not engaged in electricity importing or exporting.

Electricity purchase price

The Japanese electricity purchase prices include payments for electricity and transport. Six monopolists publish their tariffs, which each depend on the installed capacity and power consumption, as well as the time of year and the time of peak load.

Situation and costs of the network

For historical reasons two distribution systems exist in Japan with different power frequencies. In the eastern part the frequency is 50 Hz and in the western part 60 Hz. Because of this frequency difference, the different networks cannot be connected directly. To bridge the border close couplers are used. Among other things, these two systems ensure that a transfer of electricity between the two metropolitan areas Kanto (Tokyo region) and Kansai (Osaka region) is only possible to a limited extent in the case of bottlenecks.

In Japan, costs of network infrastructure are included in the full cost of energy suppliers and are passed on to the end customer via electricity prices. Electricity price components that are associated with the network infrastructure are not reported separately by the ministry or the energy suppliers. The proportion of net costs on the price of electricity is estimated to be 8.2% for transmission costs, 3.9% for transformer costs and 12.5% for distribution costs.

Electricity tax: Electric power source development promotion tax

All consumers pay an electricity tax of 0.375 yen/kWh (0.33 ct/kWh). There are no exemptions to this tax.

Global Warming Tax

The Global Warming Tax is a tax on fossil fuels, calculated according to the respective CO_2 content. In 2014, the tax rate was 289 yen/tCO_2, which, according to calculations from the Japanese Department of Energy, is reflected in the price of electricity with 110 yen/MWh (about €1/MWh). The tax is not an explicit electricity price component, but is paid by the electricity suppliers and passed to end consumers under the full cost calculation. There are no privileges.

Promotion of renewable energy sources

The surcharge to finance the feed-in tariff for renewable energy sources, which must be paid by the supplier to the producers of electricity from renewable energy sources, is ultimately paid by all consumers. Their value is determined by a state authority based on the national total costs of the feed-in tariff. From May 2013 to April 2014 the normal tariff was 0.35 yen/kWh (approximately 0.24 ct/kWh). Consumers from the energy-intensive manufacturing sector, whose ratio of power consumption to gross value added corresponds to 8 times the average ratio, pay a reduced rate of 0.07 yen/kWh (approximately 0.05 ct/kWh).

An additional surcharge is intended to finance the compensation of excess electricity, which is fed into the network by small photovoltaic systems (of households). This "PV surcharge" is 0.05 yen/kWh (0.03 ct/kWh) and has no exceptions.

Conclusion

The Japanese government raises only low taxes and levies on the already high electricity prices. The only explicit regulation privileging of industrial enterprises is to be found in the surcharge for financing the promotion of renewable energies. It accounts for the relative electricity cost intensity.

2.10 USA - Pennsylvania

Electricity supply

Power consumption in Pennsylvania was about 158 TWh in 2012, with a peak load of 45.6 GW. The demand arises almost equally from the industrial, households and commerce, and trade and services sectors.

The electricity of the US state of Pennsylvania is, in large part, based on coal. In 2012, 39% of the electricity in Pennsylvania was generated by coal-fired power plants. Nuclear power plants made up 34% of total power generation. Gas power plants form the third pillar of electricity generation and accounted for 24% in 2012. Renewable energy sources, including hydropower, generate less than 3% of electricity.

The share of natural gas in total generation is constantly increasing and replacing hard coal as an energy source. This is due to the decline in gas prices as a result of additional production from unconventional sources (fracking).

Electricity market

The state of Pennsylvania is located in the north eastern part of the United States and is therefore part of the Pennsylvania-New Jersey-Maryland Interconnection (PJM), which covers 13 states and the District of Columbia. The PJM electricity trading is organised on a competitive central pool market. The trade is distributed into various segments: a day-ahead market; a real-time market, which determines new prices every five minutes; various capacity and reserve markets; and long-term annual and monthly auctions for transmission rights. The price is set by means of nodal prices, which means that prices are determined for each individual network node and can, in the case of network bottlenecks, differ from another in the various regions. The capacity payments are determined via nodes as well. A trading of Financial Transmission Rights (FTRs) allows the actors to hedge against high congestion costs. In PJM a total of 800 buyers, sellers and traders are active in the market.

The retail market for electricity in Pennsylvania is fully liberalised. The consumers can choose between different electricity suppliers. In 2011, large industrial companies were able to choose from 33 utilities. In addition, these consumers can also participate directly in the pool market.

Electricity purchase price

Overall, the importance of energy sources in the generation of electricity is shifting from coal to natural gas in the PJM market and in Pennsylvania. This is due to the decline in natural gas prices due to the increase in the use of unconventional sources (fracking). Since the power plant fleet adapts slowly, coal power plants continue to set the price in the region in many hours.

The weighted average of all marginal prices in PJM in 2012 was $35.23/MWh (about €27/MWh), which is 23.3% lower than in 2011 and the lowest value since 2002. The capacity payments in the market amounted to anywhere from 20 to nearly $250/MW per day, depending on year and zone. Between January and September 2012, the weighted average nodal total price for wholesale customers was at $48.40/MWh (€38/MWh), including the costs of the capacity market, for reserve deployment and administrative costs at PJM. This represented a decrease of 27.3% compared to the corresponding period in 2011.

Electricity prices in Pennsylvania vary regionally. To determine a wholesale price for industrial customers, the average price of electricity on the hub PJM-West is used for Pennsylvania. In 2012 this was 2.94 €ct/kWh.

Situation and costs of the network

The transmission network is operated by PJM Interconnection LLC and comprises, along with Pennsylvania, twelve other states and Washington DC. A variety of local network operators are active on the distribution level. PJM is well connected with other transmission systems on the US east coast: NYISO (New York State), SERC (South-eastern states), TVA (Federal States Tennessee, Alabama, Mississippi and Kentucky), and MISO (Midwestern states).

Network costs include a basic fee and charges for energy and power. They vary with the connection level, consumption, and peak load.

Capacity market

The Reliability Pricing Model is a capacity market in PJM, which sets long-term price signals for generation capacity and thus ensures security of supply. The level of capacity payments can vary due to lack of transmission network capacities depending on the region within PJM. The electricity price components of capacity costs are based on the individual share of peak load of the end customer. To date, the capacity costs have accounted for only a small portion of the total electricity costs for all end consumers, usually less than 1 $ct/kWh. There is no privileged tariff, but industrial consumers can offer capacity themselves via Demand Response. Due to the calculation methodology, end consumers with a uniform load profile pay less than end users, whose consumption takes place during peak load periods.

Promotion of renewable energy sources and other tasks of the utilities

The pricing by the utility companies is subject to state control. Therefore, the utilities disclose individual price components that finance the fulfilment of state-defined quotas and duties. In the example of the utility PECO those are costs to finance energy efficiency programmes, costs of smart meter programmes, and costs of meeting the prescribed amount of energy from renewable sources. The tariffs decrease with annual consumption and depend on the network level. Large consumers on high-voltage grid pay considerably less than households.

Value-added tax (VAT)

The sales tax is similar to a value added tax, but has a different value in various cities and counties. The normal rate is 6-8% of the electricity price. Electricity and gas, which enter directly into the production process (not for lighting, heating or cooling), are exempt from the tax.

Conclusion

An explicit exemption exists only for the sales tax in Pennsylvania. For most other components differentiated tariffs exist according to customer group, power consumption and connected load at the individual providers. This causes a reduced burden on energy-intensive industries even without state defined exemptions, such as in the example of capacity payments.

2.11 USA - Texas

Electricity supply and demand

In 2010 power consumption in Texas was 358 TWh. Even compared to other US states, this consumption is high per capita. The reason for this, in addition to the air conditioning and electric heating, is energy intensive industries that have settled in the state, including aluminium, chemicals, timber, glass and refineries. Because of the climate, the peak loads of every year are reached in summer. The highest ever measured load in the region was in August 2011 at 69 GW.

Gas (45.4%) made up the largest share of electricity in 2011, followed by coal (36.5%), nuclear power (10%) and renewables (6.7%, of which 6.4% came from wind).

Electricity market

The five largest companies (Luminant, NRG Energy, NextEra Energy Inc, CPS Energy and Cal-Pine Corp) own about half of Texas’ power plants. Compared with other examined states the ownership structure of the power plants in Texas is diversified.

The Texas electricity market is liberalised. As in Pennsylvania, electricity is traded on a pool market in Texas. The responsible network and system operator is the Electric Reliability Council of Texas (ERCOT), an independent system operator (ISO).

The competitive wholesale price has been traded on nodal pricing since 2010. Unlike in other regions of the US, no additional capacity mechanisms exist to ensure supply security in Texas. There is a day-ahead and a real-time market. Similar to the FTRs offered at PJM, there is also a market for Congestion Revenue Rights (CRR) at ERCOT, which serves to hedge against congestion costs. In addition, there is an "Ancillary Service Market", which provides reserve power and capacity.

Following the liberalisation, a large number of new gas power plants were built in Texas because the electricity price had been set by less-efficient old equipment for a long time. Due to the large number of new power plants, however, overcapacities emerged and prices sank.

The retail market in Texas is fully liberalised. Thus, all electricity consumers have contracts with competitive electricity suppliers. In 2011, there were 60 utilities for large industrial and commercial enterprises in Texas. The main electricity suppliers for industrial customers were the South-Western Public Service Company and the Entergy Texas Int.

Electricity purchase price

Along with gas prices, electricity prices have also fallen from an average of $49/MWh in the period between 2002 and 2008 to an average of $36/MWh (about €26/MWh) between 2009 and 2011. The utilities must refinance their investments through the wholesale prices they receive. Occasional price spikes in shortages are therefore important to entice investments for additional power plants. Accordingly, the electricity price is volatile during certain hours. The monthly averages vary from less than $20/MWh up to $140/MWh. In 2011, the rates reached the limit of $3000/MWh six times in a total of 19 hours.

The decline in natural gas prices by fracking in Texas is reflected in the electricity price, which is set by gas-fired plants in the wholesale market in the region. In Texas there is no uniform electricity price. Within the ERCOT market region there are regional rates, which, however, do not differ significantly from each other. Electricity price spikes occur especially in the summer due to the climatic conditions of the region.

For further calculations, an average electricity price is determined by the prices of the Texas South hub. In 2012 this price was 3.78 ct/kWh.

Situation and costs of the network

The share of wind energy has risen sharply in recent years and makes additional network expansion necessary. As an independent system operator (ISO) under the supervision of the Public Utility Commission of Texas, ERCOT organises the use of about 550 generation units and some 65,000 km of transmission grid.

In the electricity bill, network charges are mostly included in production costs. They contain margins for network operators and are graded according to different consumer groups, connected load, peak load and annual consumption.

Promotion of renewable energy sources and other tasks of the utilities

In Texas, the pricing of the utilities is also subject to state control. Therefore, the utilities disclose individual price components, which finance the realisation of state-defined quotas and duties. The Public Utility Commission publishes all tariffs and their components. In Texas, companies may price in costs for the transition to a competitive system, cost of reconstruction after storms, and energy efficiency costs. The tariffs per kilowatt-hour in Texas decline with increasing annual consumption and depend on the network level. Large consumers on high-voltage grid pay considerably less than households.

Value-added tax (VAT)

Concerning the sales tax, direct consumption of electricity and gas for heating, cooling or illuminating the production facility during the production, and consumption in processes such as "electroplating, electrolysis, and cathodic protection" are exempted from the tax. However, direct consumption for the operation of production processes counts towards the exemptions. If an organisation can demonstrate that more than 50% of its electricity and gas consumption is exempt from the provisions laid down above, then its entire electricity and gas consumption is exempted from the sales tax. However, the sale of electricity for consumption in households is excluded from the sales tax.

Conclusion

All electricity price components are staggered in Texas, according to installed capacity and customer group. Industrial consumers in particular have the opportunity to reduce their costs of electricity with special tariffs (e.g. time of day tariffs, with interruptible load tariffs or contributions to a reduction in peak demand). Only for the sales tax are explicit exceptions for industrial companies in Texas exist.

2.12 Canada

Electricity supply

Canada has an electricity consumption of 502 TWh. With 207 TWh, Quebec has the highest electricity consumption of the Canadian provinces. Industry consumes around 47% of electricity in Quebec and households around 34%. Canada is one of the largest producers of hydroelectricity worldwide. Hydropower accounted for around 63% of Canada's electricity production in 2011. Thermal power plants made up 19% and nuclear energy 16%.

The generation from wind energy is the fastest growing area of power generation in Canada. From 2013 to 2014, the performance of wind turbines has grown by 1.6 GW. With a share of around 1%

wind power has not played a significant role in the Canadian generation mix, but it is anticipated to gain importance as Canada attempts to reach its renewables expansion targets. By 2020, renewable energy sources (including hydropower) are set to reach 90% of Canada's electricity generation. The individual regions across Canada differ in terms of their generation structure, regulation, and policies promoting renewable energy. Provinces set targets and provide portfolio standards. These apply to renewable energy sources as a whole as well as for individual technologies.

Electricity market

The largest generator of electricity in Quebec is Hydro Quebec Production (around 75% of installed capacity in 2012), which belongs to Hydro Quebec, a private corporation in which the public have a majority share. The TSO Trans Energy and the largest distribution network operators are subsidiaries of Hydro.

Electricity exchange

Canada produces more electricity than it is able to consume because of its rich natural hydropower resources. Quebec alone could provide up to 55 TWh of electricity in the US due to the installed interconnectors. The actual net export is subject to yearly fluctuations; the previous peak value of 22.9 TWh between Quebec and the United States was reached in 2009.

Electricity purchase price

Due to different resources, policies and production technologies, electricity prices differ significantly between the provinces. While Alberta is quite advanced in terms of deregulation and offers market-based prices, a mix of regulated and market prices can be found in Ontario. In other provinces there are often only regulated prices. Canada has low electricity prices compared to the other countries studied and are even below US electricity prices, which is why the country is a net exporter of electricity. This is due to the hydroelectric power plants that generate electricity at low marginal costs. In Quebec, prices must be approved by a regulatory authority (Régie de l'énergie Québec). There is a special regulation (load retention rate) for companies that have economic problems. These companies receive a discount on the variable component of the electricity tariff. This discount is calculated on a ratio, which takes the share of variable costs, granted discounts, the grant period, and company shares into account. Since the degree of electricity market regulation varies in the different regions, the electricity pricing or configuration depends on the region.

Depending on the type of consumer, premiums or discounts on the fixed amount or usage-bound prices are granted. Premiums on consumption over fixed quantity addition, mark-ups during periods of low temperatures in winter, bonuses for increased power demand, discounts for interruptible loads, discounts for connection to medium- or high-tension-voltage levels (from <5 kV, staggered), and reductions for transformation losses are generally allowed.

In Ontario there is the possibility to sign a "large business electricity price cap" or "large business fixed price quote request" for large consumers. Both apply only to companies that consume more than 150 MWh/year, and for the "fixed price" in a special load profiles offered individually. The price cap is designed to protect against strong wholesale price increases.

The lowest prices were paid by households in 2012 in Quebec, with approximately 7.7 CA$ct/kWh, while households in Ontario had to pay 13.5 CA$ct/kWh. In British Columbia and Manitoba, households paid between 8.5 and 9.5 CA$ct/kWh. Albeit at a low level, the Canadian electricity prices have risen over the years although they are on average cheaper for industrial consumers than households by about one-third.

Costs of the transmission system

The long distances between generation and consumption sites cause relatively high transmission costs. This is why in 2011 the TSO Trans Energy in Quebec invested approximately CA$1.3 billion in grid stabilisation and expansion.

The electricity price components such as network charges, production and sales, and renewables support are not listed separately in Quebec, but are integrated in the electricity price tariff. So-called "credits" may be granted depending on the consumer. The value of the current tariff rate is dependent on consumption (amount and time), connection load and voltage level.

Network costs in Ontario account for the cost of transmission and distribution, as well as administrative costs for measurement and accounting.

Taxes and levies

Regulatory Charges in Ontario include costs that are incurred by the IESO (Independent Electricity Sys-tem Operator) during the operation of the wholesale market and in maintaining grid stability (purchase of reserves), as well as administrative costs of the OPA (Ontario Power Authority). In general, they are set or approved by the OEB (Ontario Energy Board) and contain a wholesale fee of 0.62 CA$ct/kWh as well as a surcharge of 0.1 CA$ct/kWh to cover the cost of rural and remote areas and connecting renewable energy systems (OPA/IESO). On top of these is a service fee of 25 CA$ct/kWh for customers who purchase their electricity directly from the distribution system operators and not from a utility company and a debt service fee of 0.7 CA$ct/kWh to cover the debts of the former Ontario Hydro.

As part of the Industrial Electricity Incentive programme, a discount is applied to portions of the variable Regulatory and Delivery Charges and on the debt service fee of additional electricity consumption in Ontario. Only companies in certain sectors of the economy that either open a new production area or expand their production/ power consumption are eligible to receive this discount. The discount will be credited only to the electricity consumption that can be attributed to the production expansion.

Promotion of renewable energy sources

The "Green Energy Act" in Ontario aims to support the promotion of renewable energy sources, conservation of resources, load management and "smart grid". This generation tariff is paid out by the OPA and is financed by consumers, which means that the production costs/tariffs feed into the market price and the Regulatory Charges via the electricity bill. However, the Ontario Clean Energy Benefit, which reduces the total electricity costs (incl. HST) by 10% up to 3 MWh per month for households, farms, and small businesses, is financed by the public funding.

Value-added tax (VAT)

The Harmonised Sales Tax is a tax that is paid by end-consumers.

Conclusion

In Quebec, the rates differ according to consumption; voltage level and client group are composed of both a variable and fixed component.

The electricity reference prices in Ontario can be obtained either at a regulated tariff (RPP) or at the market price (Hoep). These reference prices can determine up to 60% of the electricity bill. Other electricity price components include utilities, regulators, "Debt-Retirement", and Clean Energy Benefit surcharges.

3 Comparison of electricity price components

To determine the various costs and benefits of the industrial sector through electricity price increases, the wholesale prices will first be calculated by taking into account the current 2013 energy and climate policy provisions and exceptions for example companies. For the various regions being studied in Europe, North America and Asia, detailed information on electricity prices is available.

Calculation of the energy component

The price paid by companies for electricity without taxes, levies and network charges, depends on the size and the procurement strategy of the respective companies. Industrial companies with a relatively small absolute consumption draw power normally from a power utility company. The power utility company passes on procurement costs and a margin via the price of electricity. This procurement price will depend to a certain extent on the negotiating power of individual companies. To derive the procurement price for smaller electricity end consumers (≤ 150 GWh) in European countries, statistical values from Eurostat are referenced (see Table 1).

Table 1: European power procurement costs for different consumption classes in Eurostat

ENERGY PROCUREMENT COSTS (ct/kWh)	DE	NL	FR	IT	DK	UK
Enterprises with a consumption of 70 to 150 GWh per year	4.91	5.56	4.42	7.41	3.93	7.72
Enterprises with a consumption of 20 to 70 GWh per year	5.15	5.46	4.29	8.3	3.93	8.00
Enterprises with a consumption of 2 to 20 GWh per year	5.59	5.69	4.42	9.02	3.93	8.18
Enterprises with a consumption of 0.5 to 2 GWh per year	6.08	5.96	5.00	9.27	3.98	8.72

For companies with high power consumption over 150 GWh, these statistics are not available for countries. In the liberalised European electricity markets, these companies trade electricity partly among themselves or through intermediaries at power exchanges. Interviews with German industry representatives have shown that typical purchasing strategies are made up of about 80% long-term contracts and 20% spot market purchase. Therefore declining or rising prices on the spot market do not have an immediate impact on the procurement costs of large industrial companies.

The reference prices depend strongly on the demand structure and the purchasing strategy of each company. To find a comparable price, an approximate value is calculated using power exchange rates for countries with liquid electricity trading. It is assumed that of the long-term contracts that are concluded, one third have an amortisation period of two years, one third have an amortisation of one year, and one-third an amortisation period of less than one year. The day-ahead prices in each country are used as spot market prices. The reference price is made up of the average price of long-term contracts, with a weight of 80%, and the spot market price weighted at 20%.

This calculation method is applied for Germany, Great Britain and the Netherlands. Data from the power exchanges EEX, EPEX and APX form the basis. For Germany, data on the prices of long-term contracts in the form of futures can be found on the EEX electricity exchange. Due to the unfavourable data situation in the Netherlands and the UK, it will simply be assumed that the electricity prices in long-term contracts are 10% higher than the average day-ahead prices in the same year. This assumption is justified by the isolated data that is available.

In France, the trade on the electricity market is rather insignificant. The reason for this is the market power of the monopolist EDF. A law guarantees that alternative electricity suppliers can buy nuclear electricity at a price of 42 euros/MWh. Therefore this value was used in the calculations as a wholesale price.

Italy is an exception because a law provides large industrial companies with priority access to interconnector capacity. The companies can benefit from lower prices in neighbouring countries, but must pay in advance. Since Eurostat offers a statistical value for electricity prices paid by large companies, this value is used for Italy.

The price of electricity in Denmark is based on the development of prices on the Nordic electricity exchange Nord Pool. According to the regulator, this determines about 90% of the price. The remaining 10% are distribution costs including margins, or the framework within which the providers can compete. The average quoted price for the two Danish price areas was at about 3,46ct/kWh in 2013. Due to a lack of data for companies with procurement of > 150 GWh, the same value as for the underlying class (70-150 GWh), namely 3.93 ct/kWh for 2013, is used.

Table 2 presents the assumptions for the energy procurement prices of major industrial consumers in Europe.

Table 2: Energy procurement costs for big energy consumers in Europe, 2013

ENERGY PROCURMENT COSTS (ct/kWh)	DE	NL	FR	IT	DK	UK
Enterprises with a consumption of more than 150 GWh per year	4.69	5.50	4.20	7.57	3.93 .	6.21

There is more and more robust statistical data available in Europe than in non-European countries. In the US, Canada, and China there are various parallel market systems and regulatory frameworks that vary according to the province or state. In Canada, China, Korea, and Japan the price formation is not transparent and does not differentiate between grid and energy costs.

For the US, the current prices of two industrial states, Pennsylvania and Texas, were analysed, both are part of larger market areas. Pennsylvania is located in the market area of the system operator PJM and in Texas the market is organised by ERCOT. Both system operators charge nodal prices, whereas in Germany there is one single price for the entire market area. To calculate an electricity reference price analogous with the European prices, information from two regional hubs, PJM for West Pennsylvania and South ERCOT for Texas, is used.

For Canada, the electricity price for the state of Quebec is used in calculations. Quebec's power generation structure produces particularly cheap electricity and can be exported so it supplies a large portion of the electricity needed by the power-intensive industry in Canada. The electricity market in Quebec is highly regulated. Electricity tariffs for companies including network charges and any taxes on connection capacity, electricity supply, and voltage level, are uniformly defined and published. Exemptions are not known, but could be done on a bilateral basis through private contracts. Here, the published price of electricity is used.

In Korea, the electricity tariffs for companies on power connection, electricity supply and voltage level are established by the state. For these, the published rates are used.

In Japan, there are six regional monopolies that also publish their tariffs. For this, the tariffs of the TEPCO utility, whose monopoly covers the Greater Tokyo area, are used.

In China an electricity price is set nationally. Provinces can ensure that their electricity prices are above or below the national electricity price through subsidies and price premiums. For the calculations the national value is used.

Table 3 presents the determined procurement prices for energy-intensive businesses in Pennsylvania, Texas, Canada, Korea, China and Japan. As prices in Canada, Korea, China and Japan depend on the connected load, total consumption and the voltage level, prices of a very large company with a uniform demand structure are used. This could, for example, be an aluminium smelter.

Table 3: Energy procurement costs for energy intensive industries in countries outside of Europe

ENERGY PROCUREMENT (ct/kWh)	PA	TX	CA*	KR*	CN*	JP*
Electricity price for an energy-intensive company	3.78	2.94	3.24	5.82	6.37	12.42

* prices include network charges

Network charges

The network charges of companies depend on technical characteristics, in particular the level of grid connection. The number of hours of electricity use as well as the timing of demand and peak load within one year are important factors in the calculation of network charges. Lower fees do not necessarily mean that companies are privileged over other customers, but reflect, if anything, the lower cost of power usage per kWh for companies. Since network charges depend on the time of demand, among other things, the quantification relies on published data when possible. For Germany data from the monitoring report of the Federal Network Agency is used. Schemes that involve reduced network charges or exemptions are also considered. These apply in Germany for example, to customers with more than 7,000 hours of use and an annual consumption of more than 10 GWh. In addition to network charges, concession fees and the Section 19 surcharge for avoided network charges are calculated for Germany.

In France, network charges for households and businesses are broken down into various components such as billing, metering, transport etc., and calculated according to peak load and installed capacity. In a study of the French Energy Agency (CRE, 2013A), network charges for energy-intensive businesses are listed. For the study sample , they amount between 0.6 and 0.65 ct/kWh, as these companies are connected directly to the high-voltage line and therefore do not use the distribution network.

In the UK, regional network charges vary greatly. While they are very low in the north of the country, customers in London pay very high network charges. The Netherlands has relatively low network charges compared to the other regions studied. For the United States, publications from the Publications Public Utility Commission in Texas and the tariffs of the large PECO utility in Pennsylvania will be referred to. In China, Korea, Japan and Canada, the grid costs are included in the published tariffs and are not explicitly stated.

Taxes and levies

Criteria for exemptions and possibly reduced tariff levels are taken into account when calculating the tax burdens and privileges of the sectors studied. The calculated total costs correspond with the amount of the electricity taken from the grid. The result of the calculation is therefore the specific electricity load purchased from the grid of the studied company in ct/kWh.

Table 4 shows the maximum rates of taxes and levies for industrial consumers identified in 2013. These often correspond to the tariffs of household customers.

Table 4: Electricity price components for industrial users without privileges

TAXES AND LEVIES (ct/kWh)	D	NL	UK	F	IT	DK	KR	CH	JP	TX	PA
Electricity tax	1.54	2.55			2.27	5.54		0.05	0.33		
TCCFE				0.3							
TDCFE				0.23							
TICFE				0.05							
Utility Gross Receipt Tax										0.02	
Transition to Competition Charge										0.08	
Hurricane Reconstruction Cost charge										0.43	
State tax adjustment clause											0.07
UNIVERSAL SERVICE FUND CHARGE											0.08
CTA				0.3							
Warm Home Discount			0.24								
Climate Change Levy			0.51								
Surcharge to support security in nuclear					0.16						
Surcharge to support the state railway company					0.23						
Surcharge to support small energy suppliers					0.06						
Surcharge to support security of supply					0.01						
Surcharge to support research in the field of electricity industry					0.04						
Surcharge to finance reduced electricity tariffs					0.01						
Surcharge to support energy intensive industries					0.51						
Tax to support agriculture and grid extension								0.0024			

Note: there is no electricity tax in Canada (Quebec) and Korea.

Promotion of RES, energy efficiency and environmental protection

The promotion of renewable energy is carried out in two different ways: in Germany, the Netherlands and France support rates for renewable energy facilities are published. The costs are then determined as electricity price increases and tariffs for the corresponding surcharge are published. In the North American countries and the United Kingdom certificates systems and feed-in tariff (FIT) are applied. The utilities price adds the proceeds from certificates or FIT into the electricity purchase price. For these states, estimates of the premiums on electricity prices from official bodies or the published accounting rates of large electricity suppliers will be referred to if available.

Table 5: Electricity price components to support renewable energies, energy efficiency and environmental protection

RENEWABLES AND ENVIROMENT (ct/kWh)	D	NL	UK	F	IT	DK	KR	CH	JP	TX	PA
EEG-Surcharge	5.28										
Offshore-liability surcharge	0.25										
CHP-surcharge	0.13										
SDE+		0.11									
CSPE				1.35							
Renewables Obligation			0.94								
Climate Change Levy (only for business)			0.61								
Energy Company Obligation (only HH)			0.71								
FIT			0.24								
Smart Meter And Better Billing			0.05								
Smart Meter Cost Recovery surcharge											0.21
Recovery of Alternative Energy Portfolio Standard Costs											0.05
Efficiency and conservation programme											0.26
Energy Efficiency Cost Recovery Factor										0.08	
Tax Accounting Repair Credit											0.07
Consumer Education Plan Costs											0
EPIDF							0.44				
PSO-Tariff						2.33					
Support to energy efficiency					0.05						
Support to renewable energies					6.38						
Tax to support renewable energies								0.00			
Tax to support a hydro project								0.00			
Surcharge to finance desulfurasation in coal power plants								0.00			
Global Warming Tax									0.1		
Surcharge to finance feed-in-tariffs for renewable energies									0.24		
PV-surcharge									0.03		

Note: In Canada, the production costs of renewable energy are factored in the price of electricity by the energy suppliers. Estimates of additional costs, if any, are not available.

4 Electricity costs and competitiveness of energy-intensive industries

The results listed below are estimates based on industry averages as well as individual company information. They intend to illustrate the impact, rather than being directly representative, because each company has its own structures, linkages and contracts, and the available information about these characteristics is limited. In this respect, the presented results reflect plausible examples for sectors or companies or logical deductions, depending on the level of analysis and the respective approach, and not accurate statements about prices, costs and production for all companies.

In contrast to the scenario calculations in the macroeconomic analysis, the analyses of the effects of an electricity price increase at the level of companies and sectors are based on the data of a single year. The estimation of industrial electricity prices draws on the results from the chapter on electricity price components and gives electricity prices for a fictitious company that reflects the respective sector-specific characteristics. The analysis of the economic effects at company level draws on the annual accounts from existing companies. It shows to what extent the profit margins of a company would be affected by an electricity price increase compared to other cost increases. For the sector analysis, the electricity-intensive sectors are disaggregated into an electricity-intensive and a non electricity-intensive part. An input-output model and a trade model are applied to show the effect of an electricity price increase on the prices and production of the most relevant upstream and downstream sectors. The starting point of this analysis is the assumption that the electricity price increase is passed through fully to the product price. However, depending on the degree of competition, an electricity price increase can passed through partly or even not at all. And a detailed mapping of intra-industrial linkages is not possible based on the existing input-output tables. More detailed information about the sectors, approaches and assessment base can be found in the respective full reports (in German).

4.1 Steel industry

In the iron and steel industry, about two-thirds of the world's crude steel is produced using the primary route (blast furnace and converter) and one third using the electricity-intensive secondary route (electric arc furnace).

China is the world's largest steelmaker with a share of 47%; Germany follows in fourth place with 2.7%. The share of steel industry sales in manufacturing sector sales is 2% in Germany. In this industry, 9.5 TWh of its total electricity consumption of 21.7 TWh (2010) are produced in its own power plants (mainly for the primary route).

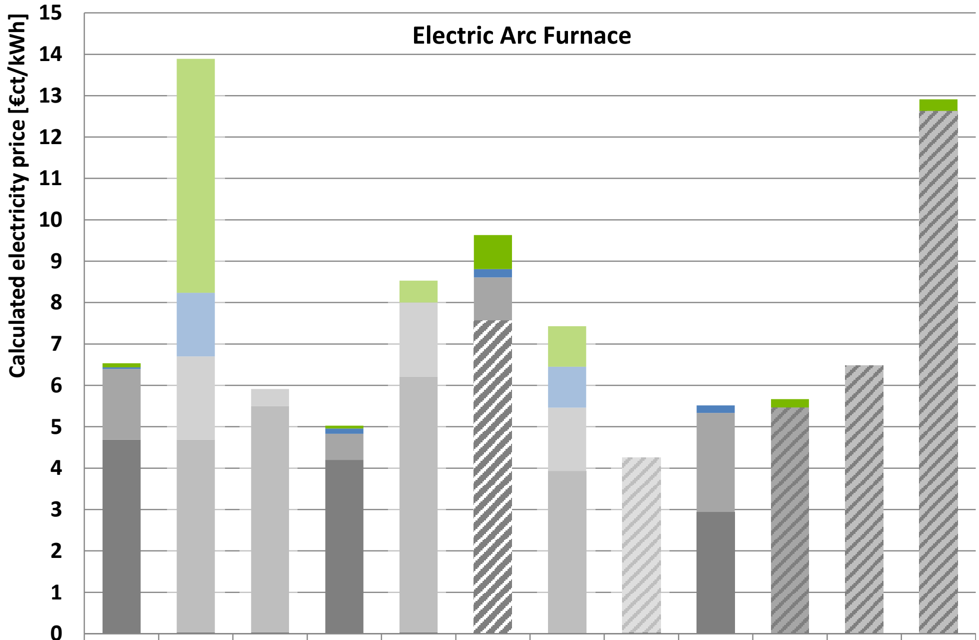
Comparison of electricity prices in the steel industry

In the steel industry, electric steelworks and companies with a high percentage of rolling processes benefit from the special equalisation scheme (BesAR) under the German Renewable Energies Act (EEG). Companies or company parts of oxygen steel manufacturers are represented only to a small extent, as they generate a high proportion of their electricity consumption themselves. Electricity prices for electricity from the public grid are calculated for two example companies:

(i) an electric steel plant with an installed capacity of 127 MW, an annual consumption of 572 GWh and an electricity cost share in gross value added of 22%.
(ii) A blast furnace steel producer with an annual electricity consumption of 160 GWh from the public grid and in-house electricity generation (90%). The overall capacity is 240 MW. The share of electricity costs in gross value added is assumed to be 12%.

Figure 4 shows the results of the calculation for electric steel production. For the US and Canada prices are presented for Texas and Quebec. Under the existing regulations of electricity price components, German electric steel manufacturers paid comparatively high electricity prices per kilowatt-hour in 2013. The main cost drivers are the electricity procurement costs, but also the grid costs. In most countries, companies are largely exempt from electricity tax and levies so the effects of BesAR and other exemptions in Germany are thus the norm rather than an exception.

There is no or only minor generation of electric steel in the Netherlands, UK, Denmark and Canada. Prices are therefore presented in lightly grey colours. There are several additional energy policies in Italy that might reduce procurement prices significantly, therefore the Italian procurement prices are shaded. The German privileged price is compared to a price without privileges.



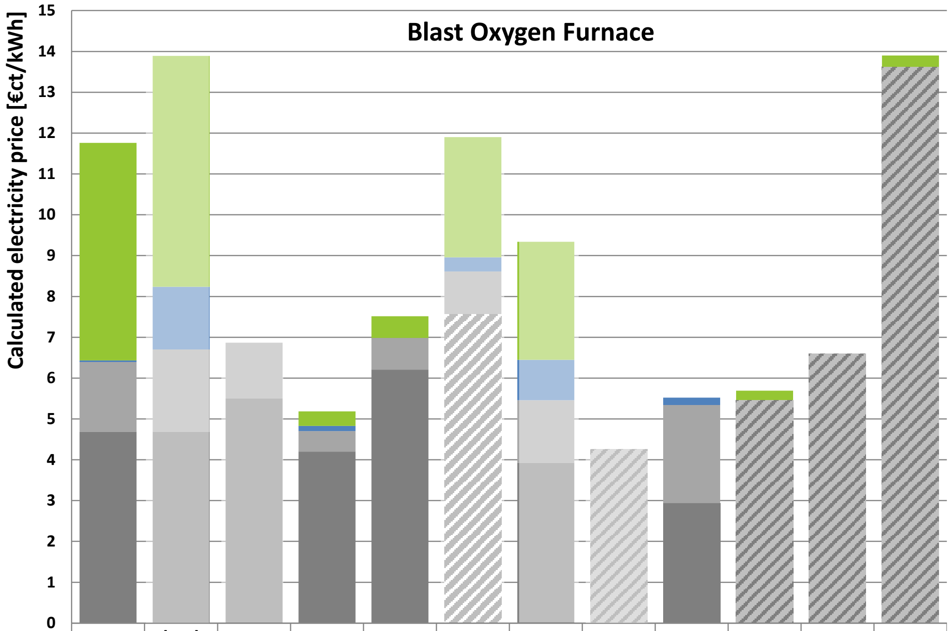
	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	0.10	5.65	0.00	0.07	0.53	0.82	0.98		0.00	0.20		0.28
Taxes and levies	0.04	1.54	0.00	0.13	0.00	0.20	0.99		0.18	0.00		
Transport and distribution	1.71	2.01	0.41	0.63	1.79	1.04	1.53		2.39	0.00		
Energy procurement	4.69	4.69	5.50	4.20	6.21	7.57	3.93	4.26	2.94	5.46	6.48	12.63

Figure 4: Calculated electricity price for electric steel producers (in ct/kWh).

Note: Texas and Quebec are used to represent the USA and Canada respectively.

In the second case (oxygen steel producer), the German electricity unit prices are significantly higher as a result of the full EEG surcharge. Only Italy and Japan would have significantly higher electricity prices for electricity from the public grid in this case, although for both countries the value represents an upper limit. It is assumed that further reductions by energy policy measures are possible.

The high installed capacity in comparison to total electricity consumption from the grid in the example case results in very high grid costs in the US-American example. Again, this value represents an upper limit. Figure 5 depicts the values for the Netherlands, Italy, Denmark and Canada in lightly grey colours because there is minor or no oxygen steel production in these countries.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	5.33	5.65	0.00	0.36	0.53	2.95	2.89		0.00	0.23		0.28
Taxes and levies	0.04	1.54	0.00	0.13	0.00	0.35	0.99		0.18	0.00		
Transport and distribution	1.71	2.01	1.37	0.50	0.78	1.04	1.53		2.40	0.00		
Energy procurement	4.69	4.69	5.50	4.20	6.21	7.57	3.93	4.26	2.94	5.46	6.6	13.62

Figure 5: Electricity price for oxygen steel produced in blast furnaces (supplied from public grid) (in ct/kWh).
Note: Texas and Quebec are used to represent the US and Canada, respectively.

Competitiveness at the level of products and companies

The extent to which the price of electricity is reflected in the product price and thus may affect the competitiveness at product level is shown for the share of electricity costs designated to steel wire rod in Figure 6. The electricity costs are based on assumptions about the electricity intensity for wire rod production using EAF. In addition, material costs and labour costs are roughly estimated. The share of electricity costs in the product price is, with privileges, around 9% and approximately 18% for non-privileged production. There has to be a sufficient margin remaining between the price and the depicted cost of production to cover capital and other running costs.

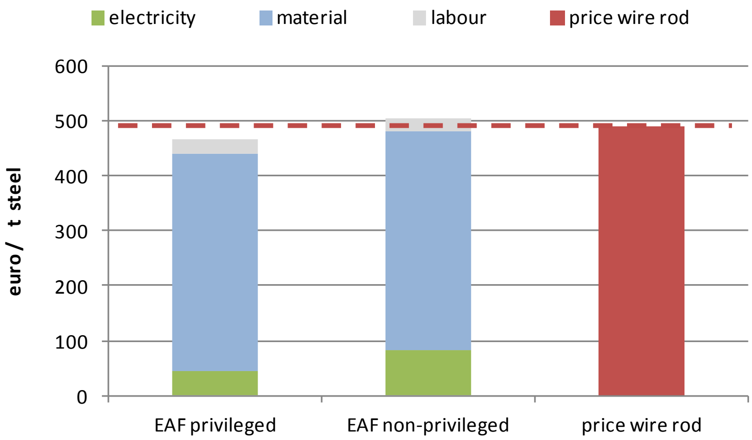


Figure 6: Comparison of product price and electricity costs (EAF and rolls), taking into account costs for labour and material

Figure 6 bases on data from environmental and annual reports of companies in the steel industry. Further costs, e.g. for equipment and additional material are not depicted.

The competitiveness of an enterprise is illustrated using key economic performance indicators (EBITDA, EBIT, EBT from profit and loss accounts). The sensitivity of the company to abolishing BesAR is evident through the change in these business figures. The absolute level indicates limits for the company. It is assumed that higher electricity costs will not be passed onto the consumer via the product price, but are manifested directly as a decline in profits.

Figure 7 shows the data from the financial statements of a real German steelmaker. The information from the profit and loss accounts and the environmental reports suggest that, with the full EEG surcharge, losses would have to be reported. The impact would be greater than an assumed 20% increase in labour costs.

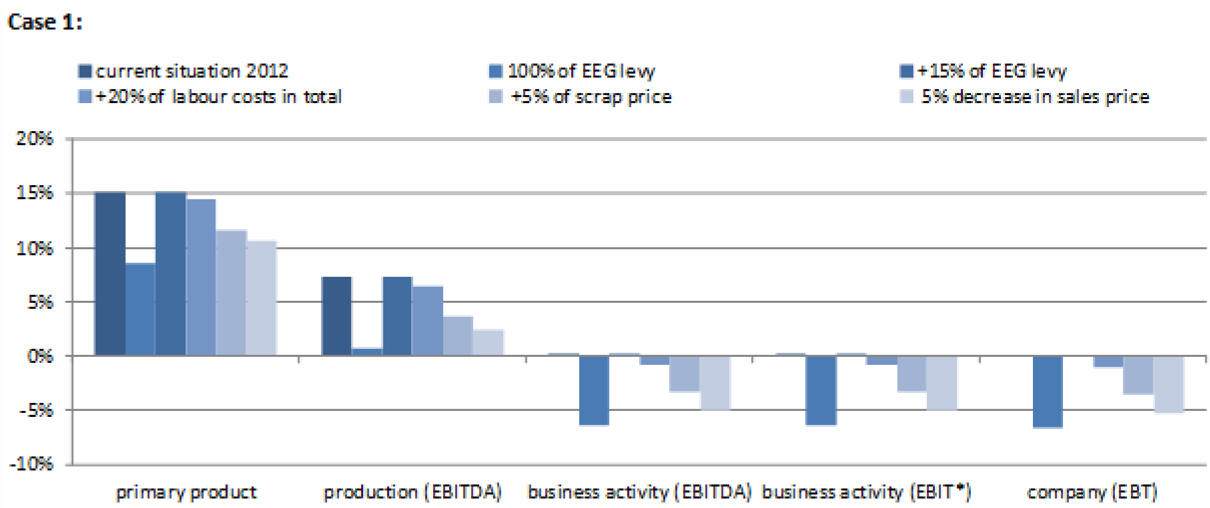


Figure 7: Competitiveness of a German steel producer

Figure 8 shows the results of a specialised German steel processing company that achieves a relatively high product price and can therefore compensate for the higher electricity costs relatively well. Due to its special niche product, the company has a somewhat monopolistic position. It could pass the costs of a full EEG surcharge on to its customers, and even higher material costs and higher wages to some extent and still achieve a positive result.

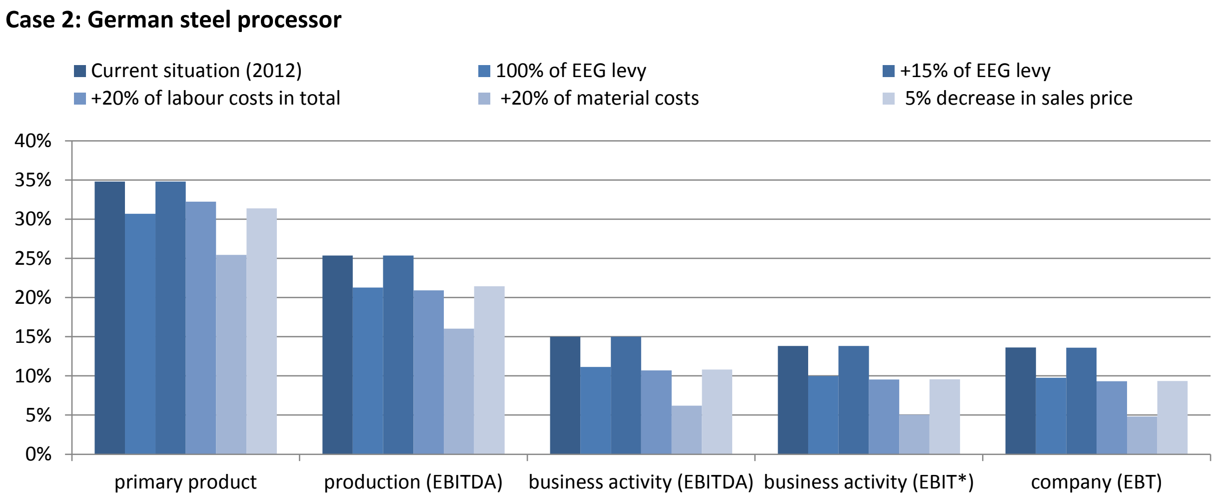


Figure 8: Competitiveness of a German steel processor (Source: Own calculation and depiction)

Competitiveness on industry level

The impact of electricity prices on the industry's competitiveness is measured via the change in product prices, demand, and production. The analysis examines the effect on product prices and production in the case of abolishing the BesAR only for the industry under consideration. This assessment is based on aggregated industry data (input-output table from the Federal Statistical Office and trade data from the UNComTrade database) and the assumption that companies can pass on higher electricity prices fully via the product price.

Under this assumption, the modelling results of the applied input-output and trade modules show an increase in product prices of 3.3% for electricity-intensive companies in the sector and 1.5% for non-energy-intensive companies. The consequence of this assumed increase in product prices is a 16% drop in exports, a 5% decline in domestic demand and approximately 18% reduction in total production.

Conclusion

The steel industry is highly competitive and competition is continuing to increase, as producers have to share a shrinking market. German steelmakers have little chance in price competition with producers from other countries, but they do have a good position in quality competition around high quality end products. However, other countries are catching up, particularly in Asia (China, Korea), and the margins on premium products are shrinking. There is excess capacity both in the EU and globally, especially in China. Due to the high production costs of steel, transport costs play a subordinate role, which means that steel can, to a certain extent, be imported and exported. However, there are local and regional purchasing preferences.

The main strengths of the domestic steel industry, according to the DG Enterprise and Industry of the European Union, are the high quality of products, innovative capacity, technical leadership, material and energy efficiency and the skilled workforce. Industry representatives indicated customer proximity/loyalty and the high level of integration within the value chain as the most important location factors. Another important advantage is the geographic location, particularly near water, for example, because the transportation of scrap (for electric steel) is associated with high costs. Good infrastructure and staff qualifications are also seen as advantages. A company also stated that what matters to customers in Germany is quality so they do not necessarily want the cheapest product. The high degree of uncertainty in politics, in particular concerning the development of energy costs, is considered to be disadvantageous.

Payment of the full EEG surcharge or of only 5% of the EEG surcharge as in the analysed example, would potentially lead to losses and therefore shut-downs at companies that do not supply premium product markets. Albeit its high energy efficiency, the return on equity in the example above is very low for standard products and high for premium products. The industry analysis shows significant drops in demand and production cuts in the steel industry if the BesAR is abolished and electricity price increases are passed on in the product price. However, these results are based on aggregated industry data, which may not accurately reflect the company-specific situation and intra-industrial dependencies. The analysis shows that no general statements can be made for companies in the steel industry regarding their electricity price sensitivity, but that the extent to which the electricity price influences competitiveness depends very much on different company-specific factors.

4.2 Aluminium industry

Products of the aluminium industry are roughly divided into three groups:

(i) raw aluminium (i.e. high purity aluminium ingots),
(ii) aluminium semi-finished products (i.e. strips, sheets, rods, profiles, tubes, etc.), and
(iii) aluminium end products (e.g. aluminium foil, aluminium wires, and aluminium heat sinks).

The production of metallic aluminium from aluminium oxide (via electrolysis) is extremely energy-intensive.

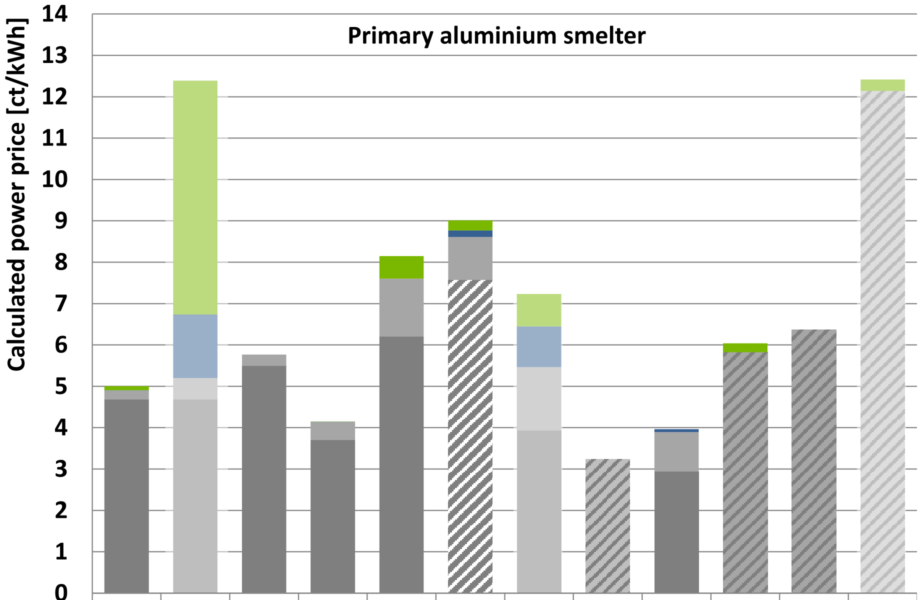
The largest primary aluminium producer worldwide is China. Germany plays a minor role with 1% of world production, but still produced the third highest amount in Europe in 2010. German demand for primary aluminium cannot be covered by the amount produced domestically. In Germany, the share of aluminium production in the total gross value added in the manufacturing sector was about 0.5% in 2010.

Comparison of electricity prices in the aluminium industry

For the international comparison of electricity prices, only the primary aluminium sector is considered, which accounts for a large share of the industry's electricity consumption. To estimate the electricity costs, a fictitious primary aluminium smelter is modelled based on average production-related technical data of European smelters (1950 GWh/a electricity consumption, 0% autogeneration, 230 MW installed capacity, 8585 full load hours, 15,000 kWh/t specific power consumption).

The electricity prices determined for primary aluminium producers in Figure 9 show the strong influence of electricity procurement costs. Companies in all countries can take advantage of exceptions or derogations for politically induced electricity price components. In some countries, the procurement price is significantly higher than in Germany, e.g. in Japan, but also in the Netherlands, Italy and the UK. Because the companies in Germany now purchase their electricity on the power exchange or over the counter (OTC), bilateral contracts no longer exist, according to the interviewees. On the other hand, there are often special instruments in other countries that compensate for the difference in price. For example, in Italy companies receive compensation under a regulation of interruptible loads of €17.5/MWh on the mainland and €35/MWh on the islands. In addition, there is a regulation that allows for privileged access to interconnector capacity to neighbouring markets with lower electricity prices. For this reason, procurement costs for Italy are shaded in Figure 9. In Denmark and in Japan, there is no primary aluminium production, therefore, the prices are presented in lightly grey shades.

Also in the Spanish case, which is not under examination in this study, companies receive flexibility compensations that amount to about €20/MWh. In the US and in Sweden, there are long-term electricity supply agreements with significantly lower prices than in Germany. According to the German metal trade association, electricity prices above 5 ct/kWh have not been competitive in 2013. In the Netherlands, in Italy and in UK, sites have been closed because of costs.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	0.10	5.65	0.00	0.01	0.54	0.24	0.78		0.00	0.22		0.28
Taxes and levies	0.01	1.54	0.00	0.00	0.00	0.16	0.99		0.07	0.00		
Transmission and distribution	0.20	0.51	0.27	0.44	1.40	1.04	1.53		0.95	0.00		
Energy procurement	4.69	4.69	5.50	3.70	6.21	7.57	3.93	3.24	2.94	5.82	6.37	12.14

Figure 9: Electricity price of an aluminium smelter with a yearly consumption of 1950 GWh

*Note: Texas and Quebec are used to represent the US and Canada, respectively.

Competitiveness at the level of products and companies

The extent to which the electricity price is reflected in the product price and can affect competitiveness at product level is represented by the share of electricity costs in the standard product of primary aluminium. The world market price of aluminium on the LME (London Metal Exchange, Aluminium Cash LME Daily official $/t) showed an average price of about €1,550 for the period May 2011 - April 2013. Without privileges, the electricity costs alone for one tonne of aluminium would have exceeded the market price of aluminium. In addition to electricity costs, labour costs, the costs of alumina (or aluminium oxide), and anode costs are important but not illustrated in Figure 10. Only two of these four cost components vary significantly across regions, because aluminium oxide and carbon (the raw material for the anode) are primarily traded on commodity exchanges and are thus priced globally. The share of electricity costs in production costs is generally between 30 and 50%.

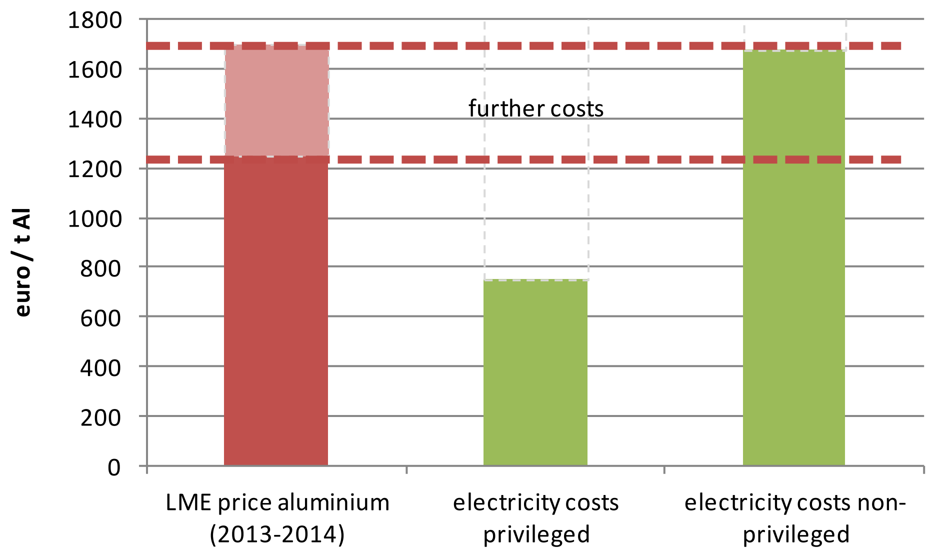
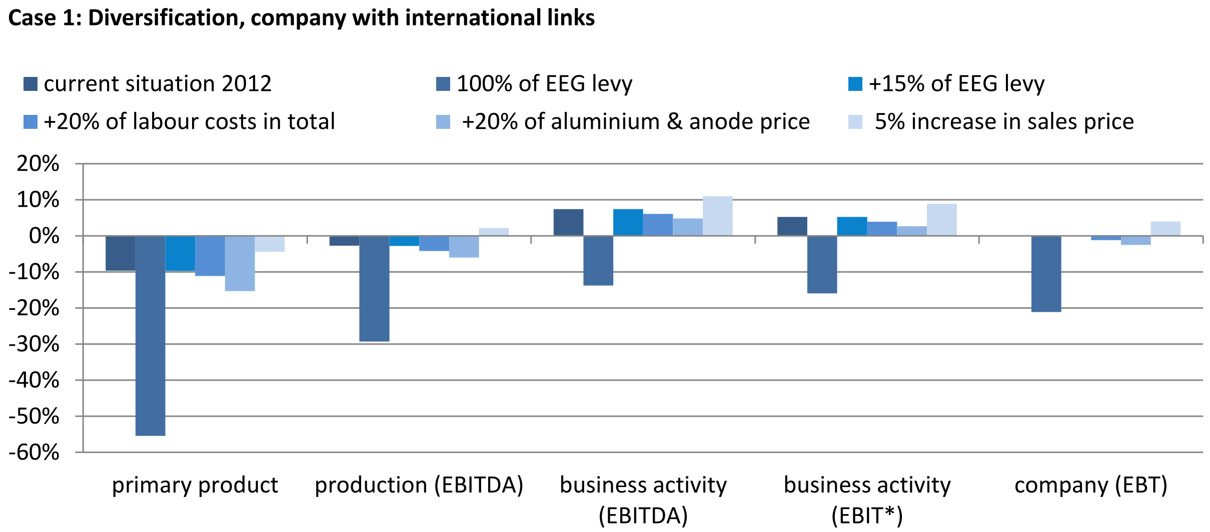


Figure 10: Price comparison of primary aluminium and electricity costs

Source: own calculations based on literature and LME information; Note: Further costs are not quantified and only added for illustration purposes.

The competitiveness of an enterprise is illustrated using key economic performance indicators (EBITDA, EBIT, EBT from profit and loss accounts). The sensitivity of the company to abolishing BesAR is evident through the change in these business figures. The absolute level indicates limits for the company. It is assumed that higher electricity costs will not be passed onto the consumer via the product price, but are manifested directly as a decline in profits.

The analysis includes two companies that manufacture both primary and secondary route aluminium products with different degrees of vertical integration. The main difference is the achieved product price and potentially cheaper purchase prices for raw materials due to the marked vertical integration (of various stages in the value chain). Figure 11 shows that, while an increase in the EEG surcharge would directly endanger the existence of Company 1, Company 2 would have a negative result in primary production. The extent to which, or for how long, an electricity price increase can be recouped by the higher product price of further processed products or even passed on via the product price cannot be determined. If the international capital providers or investors expect an interest rate of 11% on deployed capital, this could only just be managed by Company 2 under a full EEG surcharge.



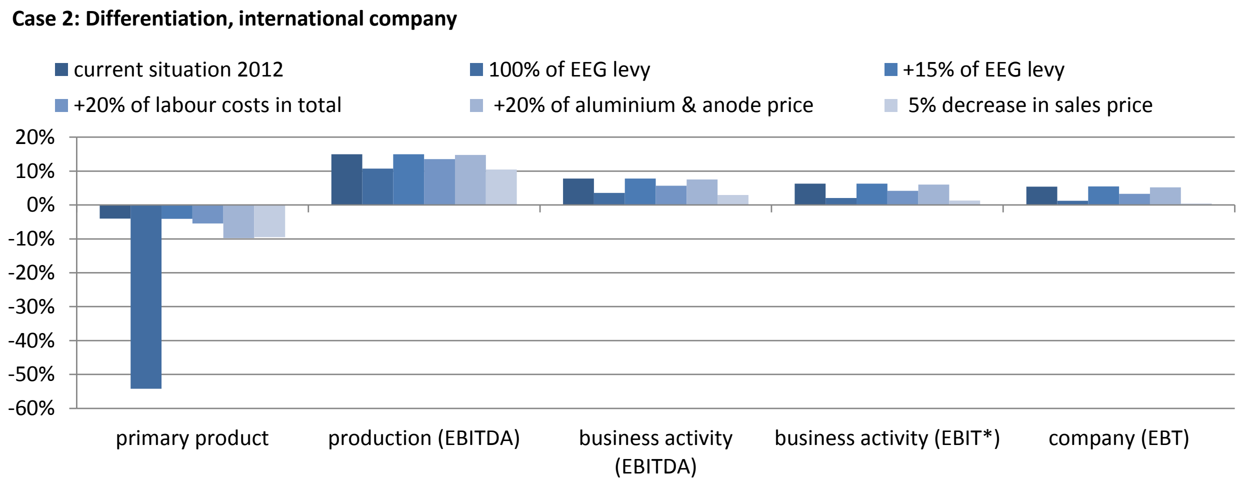


Figure 11: Results of analysing two companies from the aluminium sector

Source: own calculation

Note: Deviations for company 1 were calculated using a price premium, to show how a product price increase of 5% could lead to profitability for the company.

Competitiveness on industry level

The impact of electricity prices on the industry's competitiveness is measured via the change in product prices, demand, and production. The analysis examines the effect on product prices and production in the case of abolishing the BesAR only for the industry under consideration. This assessment is based on aggregated industry data (input-output table from the Federal Statistical Office and trade data from the UNComTrade database) and the assumption that companies can pass on higher electricity prices fully via the product price. Because of a lack of data, the non-ferrous metal industry is examined as opposed to the aluminium industry.

Under this assumption, the results of the applied input-output and trade modules for the non-ferrous metal industry show an increase in product prices of 4.7% for the energy-intensive companies in the industry and of 0.2% for non-energy-intensive companies. The consequence of this assumed increase in product prices is roughly an 18% drop in exports, a 5% decline in domestic demand and an approximately 17% reduction in production.

Conclusion

Because of the price quotation of aluminium on the LME (London Metal Exchange), aluminium is to be regarded as a global product and thus subject to fierce competition. The production costs are strongly driven by electricity prices, which vary regionally.

Due to the ability of some companies to serve the special needs of downstream industries, i.e. by developing customised products through close cooperation, the competitiveness of individual companies may be positive. However, there is a mixed picture. Companies that do not supply premium products, generate losses when electricity prices are high. Even with premium products, it should be taken into account that there is a limit to passing on electricity cost increases to downstream industries, such as the automobile sector, because further processed aluminium products are price indexed to the LME and transferring costs impairs competitiveness of downstream industries: higher costs in the automobile industry affect its competitiveness.

In interviews, the important location factors cited for the aluminium industry include the proximity to customers and the integrated value chain and therefore the associated customer networks. Furthermore, customer structure plays a role and in Germany, demands special products. The infrastructure in Germany as well as transportation costs, which are particularly relevant for secondary aluminium, were also emphasised as relevant factors. Planning security was another important issue mentioned by interview partners. This concerns the reliability of electricity prices that would offer them greater investment security.

At sectoral level, there is a significant decline in demand and production in the non-ferrous metal industry if the increase in electricity prices is passed on to customers. The aluminium industry is likely to be more severely affected than, for example, companies in the copper industry since its production process is extremely energy-intensive (aluminium: 15000kWh/t; copper: 1500kWh/t). Due to intra- and inter-industrial linkages impacts on other industries might occur, but are not depicted by statistical data on sector level. Ultimately, however, the extent to which abolishing the BesAR affects competitiveness in the aluminium sector is determined by company-specific factors.

4.3 Copper industry

Copper is a universal base material that is used in all sectors of the economy. The raw material for copper smelting is copper concentrate, which is imported to Germany. About half of the copper produced in Germany comes from secondary sources (recycling) and is not imported as concentrate. The most electricity-intensive process for producing copper is electrolytic refining (primary and secondary copper), which forms 99.99% grade copper (cathode copper). The cathode copper is melted and casted as billets, ingots or wire rod depending on further processing.

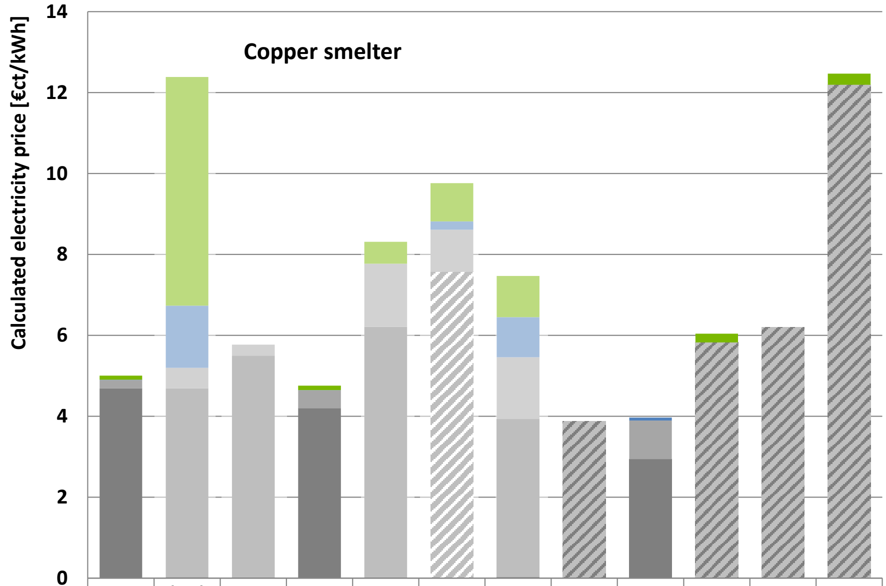
China is the largest producer of copper by far. Germany contributes just under 4% of global production, but is still the largest producer in Europe. However, there are only 64 listed companies in Germany so the data in the official statistics is partly subject to confidentiality. Germany consistently has a strong export surplus in the semi-finished copper trade. The copper industry's share of gross value added (at factor costs) in the gross value added of the manufacturing sector in Germany amounted to 0.28% (in 2010). This is the highest share of the European countries under consideration with the exception of Italy, which has approximately 0.41%.

Comparison of electricity prices in the copper industry

Electricity prices for the copper industry were derived from three fictitious companies. Two of them are presented below. They illustrate the range of possible prices. The first company produces refined copper and semi-finished products (500 GWh/year electricity consumption, 60 MW installed capacity, 8600 full load hours, no autogeneration, electricity costs > 20% of gross value added), and the second company is an end-product manufacturer, e.g. of high quality technology goods (5 GWh/year electricity consumption, 0.85 MW installed capacity, 6000 full load hours, no autogeneration and electricity cost < 20% of gross value added).

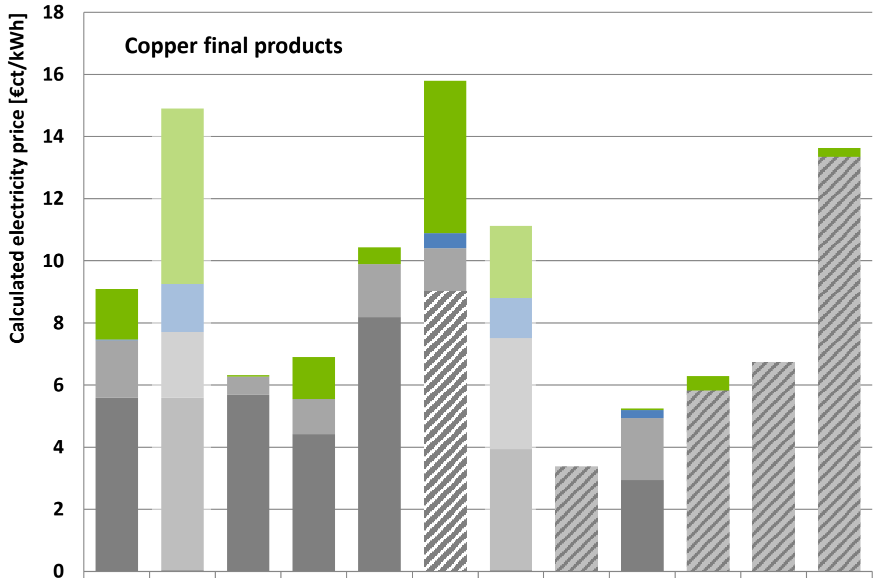
The results in Figure 12 and Figure 13 show significant differences in network charges, taxes and levies for Germany, France, and Denmark. The manufacturer of copper end-products is less privileged and therefore pays more. As with aluminium, the electricity supply cost is the driving component. This is lowest in North America. In Germany, the copper industry pays, according to its own statements, 5 ct/kWh and thus slightly more than the market price. In contrast, copper generators estimate global prices to be significantly lower, at about 3 ct/kWh. Copper generators proclaim that due to strict environmental regulations in Germany, power consumption for electrolysis is about 30% higher than in other countries with less strict environmental regulation.

In both figures, two prices for Germany are depicted, one for the privileged customer and one without privileges, the latter would be significantly higher. Italian electricity prices are shaded because there are several energy policies in that country that might reduce electricity procurement prices for energy intensive companies significantly. There is no production of primary copper in Italy, Denmark, UK and the Netherlands, therefore values for these countries are presented in lightly grey colours in the first figure. In Denmark there are also no copper processing companies, therefore the Danish price is presented in lightly grey shades even in the second figure.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	0.10	5.65	0.00	0.11	0.54	0.94	1.02		0.00	0.22		0.28
Taxes and levies	0.01	1.54	0.00	0.00	0.00	0.21	0.99		0.07	0.00		
Transmission and distribution	0.20	0.51	0.27	0.44	1.56	1.04	1.53		0.95	0.00		
Energy procurement	4.69	4.69	5.50	4.20	6.21	7.57	3.93	3.88	2.94	5.82	6.20	12.19

Figure 12: Electricity prices for the copper smelter (Consumption 500 GWh p.a.)



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	1.62	5.65	0.04	1.35	0.54	4.91	2.33		0.04	0.46		0.28
Taxes and levies	0.03	1.54	0.00	0.00	0.00	0.48	1.29		0.26	0.00		
Transmission and distribution	1.85	2.12	0.58	1.13	1.71	1.38	3.58		2.00	0.00		
Energy procurement	5.59	5.59	5.69	4.42	8.18	9.02	3.93	3.37	2.94	5.82	6.74	13.35

Figure 13: Electricity prices for the producer of copper end products (Consumption 5 GWh p.a.)

Competitiveness at the level of products and companies

The extent to which the price of electricity is reflected in the product price and thus may affect the competitiveness at product level is illustrated by the share of electricity costs in the cathode copper product. Raw material costs are very high because mining companies' revenues are based on the LME copper price minus treatment and refining charges (TC/RC).For this reason electricity costs are also compared with TC/RC which also have to cover labour and capital costs. The price of high-grade copper (grade A) on the LME was around €5,800/t in 2011 and 2012. It is highly fluctuating. The treatment/refining charges and the price of copper are nationally or globally traded prices and are thus regarded as given from the company perspective. Electricity costs are based on an electricity efficient production of (processed) copper products which requires 1300 kWh/t copper.

Figure 14 shows the cost of electricity and of other major input materials in comparison to the LME price for cathode copper. Due to their volatility, prices are indicated with a spread. The same applies for TC/RC. Similarly, costs for raw materials are also indicated in a spread as they are quoted on the LME price minus treatment and refining charges for their copper concentrate or scrap. Further costs are indicated but cannot be quantified exactly.

The available data show that the material costs in the copper production dominate the costs per unit to a greater extent than in the aluminium sector. A comparison of TC/RC with electricity costs underpins the significance of electricity prices for copper production under varying TC/RC. Non privileged electricity costs might exceed the income from TC/RC making copper production unprofitable. However, it should be noted that additional material and labour costs as well as premiums for processed copper products are not included in this illustration.

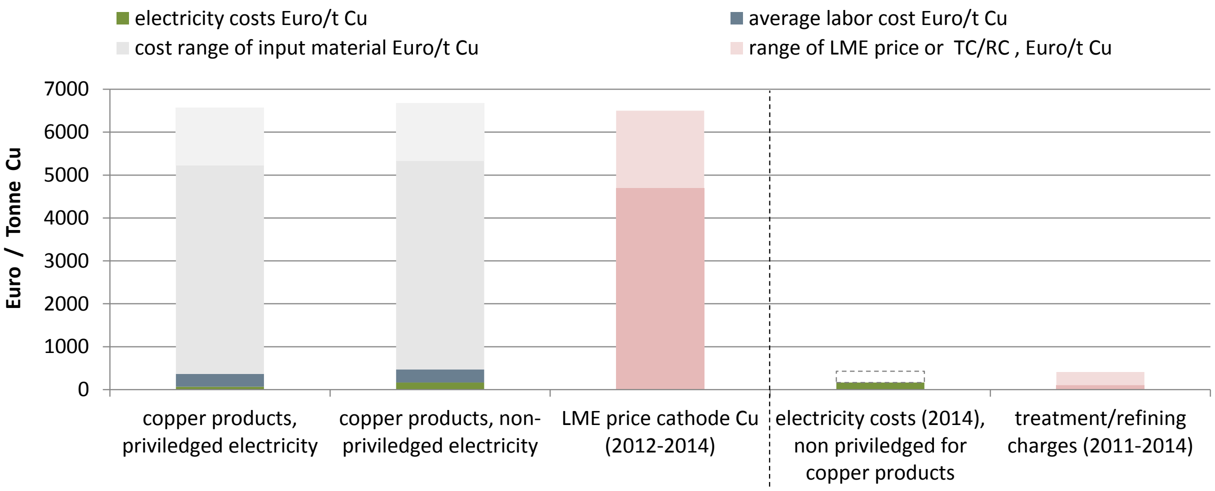


Figure 14: Comparison of electricity costs and premiums for processing copper concentrate
Source: own graph based on various sources (company reports, press releases)

The competitiveness of an enterprise is illustrated using key economic performance indicators (EBITDA, EBIT, EBT from profit and loss accounts). The sensitivity of the company to abolishing BesAR is evident through the change in these business figures. The absolute level indicates limits for the company. It is assumed that higher electricity costs will not be passed onto the consumer via the product price, but are manifested directly as a decline in profits.

For the selected example, it is assumed that the company has full privileges with regard to electricity costs and this is then compared with paying the full EEG surcharge for 2014. Although the privileged status is certainly not fully applicable to all delivery points, there is insufficient data to refine the calculation approach.

The electricity price sensitivity of the company under consideration makes it clear that the payment of the full EEG surcharge (also on autogeneration) influences the margins more than a 20% increase in labour costs. The sensitivity analysis presented here suggests that besides material cost and product price, the price of electricity plays a relevant role in terms of the company's profit. However, because the material cost is indexed to the price of copper in the case of cathode copper, this represents a very high, fixed, non-controllable cost block. One must also consider that, in addition to cathode copper, other products such as sulphuric acid or silver are refined, which contribute significantly to turnover. Overall, it remains unclear to what extent higher electricity prices can be compensated by or passed on to the premium product price.

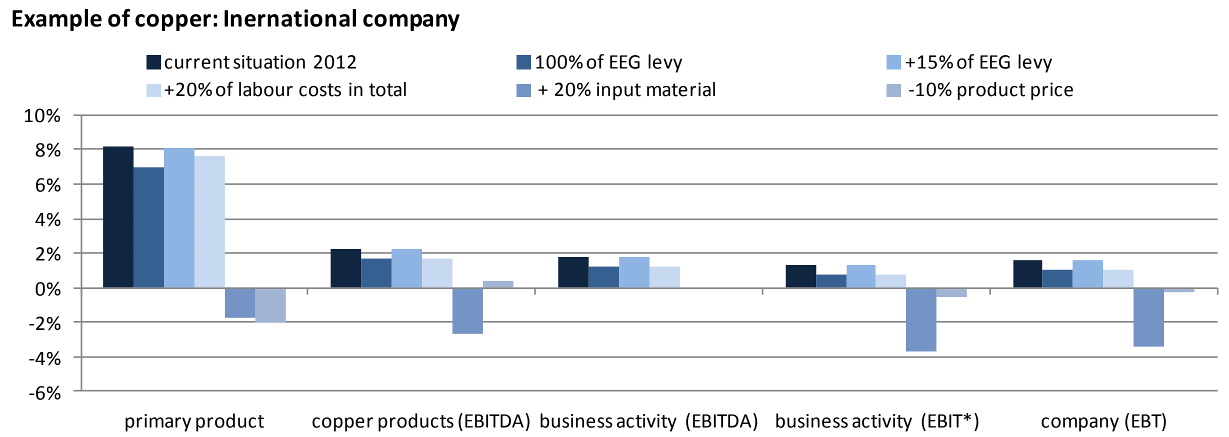


Figure 15: Results for a company from the copper sector

Source: own depiction

Competitiveness on industry level

The impact of electricity prices on the industry's competitiveness is measured via the change in product prices, demand, and production. The analysis examines the effect on product prices and production in the case of abolishing the BesAR only for the industry under consideration. This assessment is based on aggregated industry data (input-output table from the Federal Statistical Office and trade data from the UNComTrade database) and the assumption that companies can pass on higher electricity prices fully via the product price. Because of a lack of data, the non-ferrous metal industry is examined as opposed to the copper industry.

Under this assumption, the results of the applied input-output and trade modules for the non-ferrous metal industry show an increase in product prices of 4.7% for the energy-intensive companies in the industry and of 0.2% for non-energy-intensive companies. The consequence of this assumed increase in product prices is roughly an 18% drop in exports, a 5% decline in domestic demand and an approximately 17% reduction in production.

Conclusion

Copper is traded on the world market and therefore international prices apply. Global competition is intense. Therefore, the integration of additional costs in prices, such as higher electricity costs, is only possible if the degree of value added is high and customer tailored, premium products are produced.

Overall, the environmental regulations in Germany are considerably stricter than in other countries and increase the cost of copper production significantly. Copper can still be produced here because Germany is still regarded as a technology pioneer in the fields of resource and energy efficiency as well as copper quality. This quality advantage is currently compensating for higher electricity costs and expenses, as the company case example suggests. At sectoral level, declines in production can be expected if the BesAR is abolished and electricity prices are passed on. Due to inter- and intra-industrial linkages the price effects could also affect other industries.

According to an industry representative, long-term planning security is an important aspect in order to guarantee the payback of investments and thus enable further investment. Marginal surcharges on electricity prices are not a problem, but surcharges equivalent to the current EEG surcharge, for example, are not marginal. It is important to note that the relative, and not absolute, price of electricity (compared to competitors) is decisive. Further plus points are the security of electricity supply and the proximity to customers and markets as well as staff quality. Another important point raised in interviews was the financial transaction tax that could be incurred for the hedging of materials and exchange rates and could also be associated with greater costs for businesses.

4.4 Paper industry

The paper industry includes the manufacturing of wood and pulp as well as finished paper products. The production of processed paper and paper products is only marginally included in the analysis, since this processing is significantly less energy-intensive.

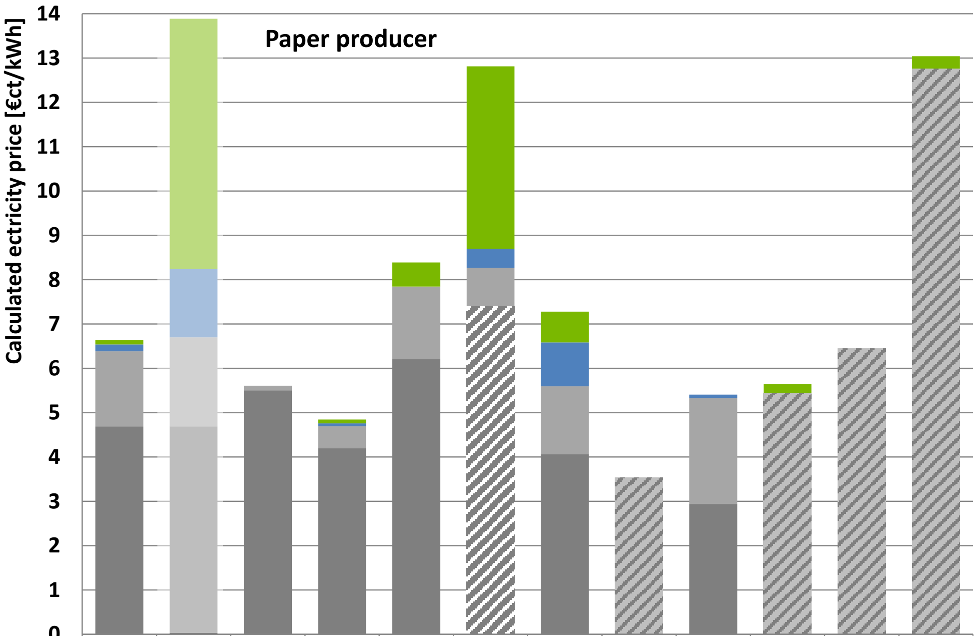
The energy demand basically depends on the required pulp quality for the type of paper produced: packaging paper requires the lowest energy input; newsprint medium energy input, and graphic and tissue paper products require high energy input.

In Germany, Italy, the Netherlands, France and the United Kingdom, the production of wood and pulp, paper, cartons and cardboard (NACE 17.1) accounted for a share of 0.5%-0.8% in the gross value added of the manufacturing sector in the years 2008-2010.

Comparison of electricity prices of the industry

Because electricity and heat are needed in the paper industry, virtually all large and medium-sized enterprises have their own mostly heat demand-lead CHP plants. The rest of the electricity is purchased on the power exchange or OTC. Although participation in the electricity market would be possible by offering balancing energy or via the regulation for interruptible load, it is very costly. Therefore, the interviewed companies do not trade directly on the electricity exchange.

Estimates of electricity price components are based on a fictitious company with electricity consumption of around 400 GWh per year and without autogeneration. As the following Figure 16 shows, the companies in many countries pay hardly any levies or taxes. Therefore, the cost of energy supply ultimately determines the price of electricity. Germany is in the middle of the range in this regard. According to information from the companies, electricity purchase prices in Germany may be similar to those in China. One company claimed that the prices they pay are similar to market prices. This means German electricity prices are lower than the prices in the UK and Italy, but higher than those in Scandinavia and Russia, which strategically keeps its prices below those of Germany.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	0.10	5.65	0.00	0.09	0.54	4.11	0.70		0.00	0.20		0.28
Taxes and levies	0.15	1.54	0.00	0.06	0.00	0.43	0.99		0.08	0.00		
Transmission and distribution	1.69	2.01	0.11	0.49	1.64	0.86	1.53		2.39	0.00		
Energy procurement	4.69	4.69	5.50	4.20	6.21	7.41	4.06	3.53	2.94	5.45	6.45	12.76

Texas is used to represent the United States, Quebec for Canada

Figure 16: Electricity price components for an example company without autogeneration

Competitiveness at the level of products and companies

The extent to which the price of electricity is reflected in the product price and thus can affect the competitiveness at product level is represented by the electricity costs per tonne of paper. Figure 17 depicts electricity costs for products with different material structures as well as costs with and without privileged electricity prices.

The product price varies according to the quality delivered. The overall picture shows that the margin to cover further costs such as the cost of capital (i.e. machinery, buildings) would be relatively low if the full EEG surcharge were paid, especially for pulp-based production.

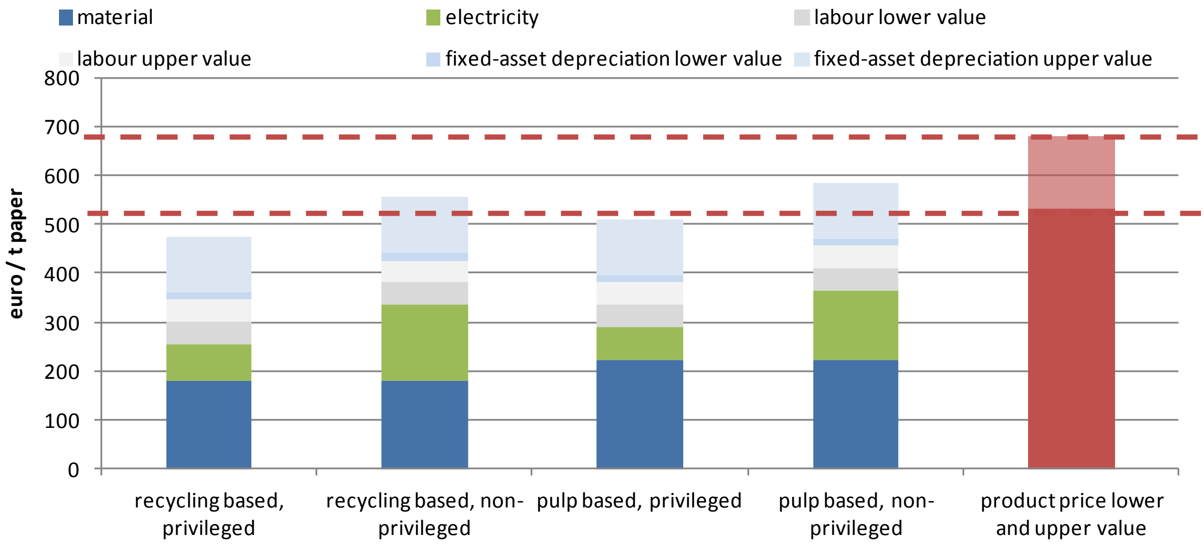


Figure 17: Comparison of product prices and electricity costs considering capital costs (depreciations), labour costs and costs for raw materials

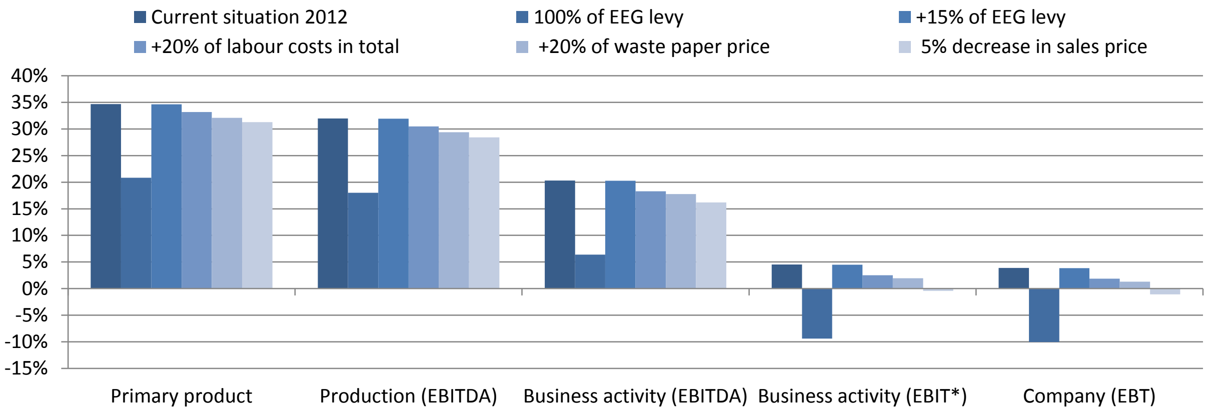
Source: own calculations based on various sources (annual and environmental reports). Note: further costs for example for additional material or services are not quantified and illustrated.

The competitiveness of an enterprise is illustrated using key economic performance indicators (EBITDA, EBIT, EBT from profit and loss accounts). The sensitivity of the company to abolishing BesAR is evident through the change in these business figures. The absolute level indicates limits for the company. It is assumed that higher electricity costs will not be passed onto the consumer via the product price, but are manifested directly as a decline in profits.

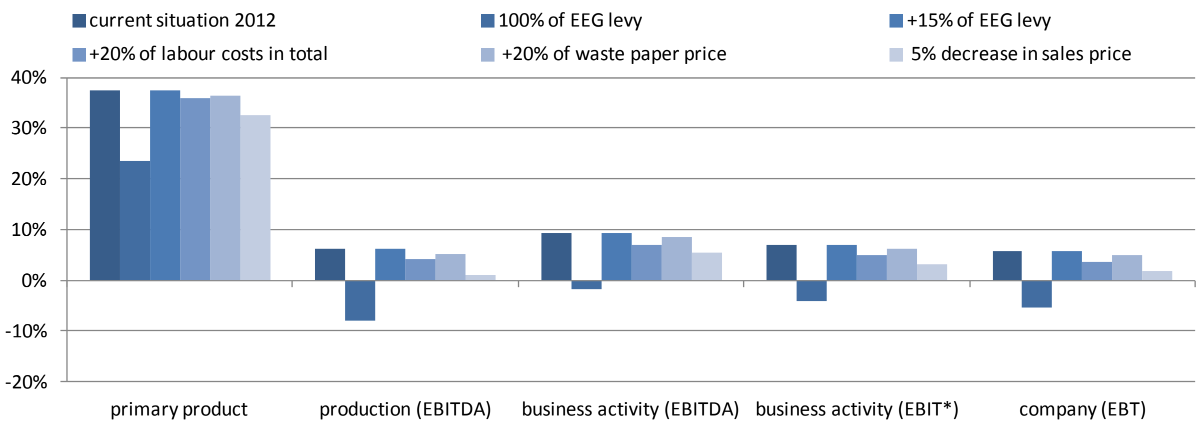
The results of three companies in the paper industry are presented below. Two of the companies under consideration are subsidiaries of large international corporations and the third company is a subsidiary of a European company. The assumed increase in the EEG surcharge applies to the total electricity input, i.e. from autogeneration as well as from the public grid. Company 1 charges a slightly higher price for its product (high proportion of waste paper) than company 2, which uses more pulp for its paper production. Company 3 mainly uses wood chips (Thermo Mechanical Pulp) with a high water content and therefore requires a relatively large power input.

If these companies had to pay the full EEG surcharge, all of them would write red numbers. Company 2 could report a return on capital of around 12% if they had to pay about 20% of the EEG surcharge, while Company 1 would only be able to pay 0.5% return on capital. Overall, only Company 2 would be able to compensate the increase in electricity costs to a certain extent due to its good sales or by partly passing on costs to customers.

Case 1: Subsidiary of an international group



Case 2:



Case 3: Subsidiary of an European company

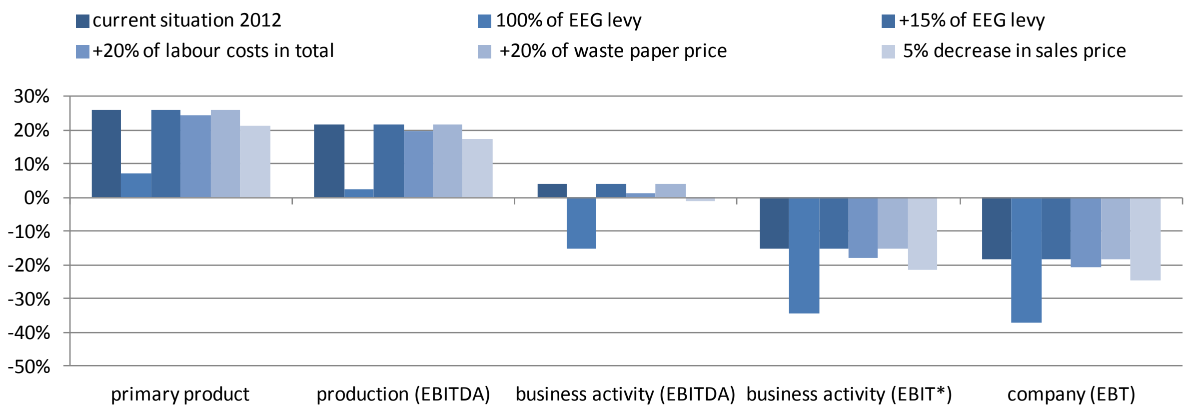


Figure 18: Results of the three companies from the paper industry (Source: own calculations)

Competitiveness on industry level

The impact of electricity prices on the industry's competitiveness is measured via the change in product prices, demand, and production. The analysis examines the effect on product prices and production in the case of abolishing the BesAR only for the industry under consideration. This assessment is based on aggregated industry data (input-output table from the Federal Statistical Office and trade data from the UNComTrade database) and the assumption that companies can pass on higher electricity prices fully via the product price.

Under this assumption, the modelling results of the applied input-output and trade models show an increase in average product prices of about 5% for electricity-intensive companies in the industry and by 0.5% for the non-energy-intensive ones. The consequence of this assumed increase in prices is a 15% drop in exports, almost 5% reduction in domestic demand and about 11% reduction in production.

Conclusion

Depending on the type of paper product, there could be either high price competition if there are very few or no differentiation possibilities, such as paper for food the food industry, or quality competition, e.g. for special types of paper. Although paper is traded internationally, trade between (supranational) regions dominates. In contrast, the trade of hygiene-related paper products is limited due to the high transportation costs. This is not the case for primary paper products (e.g. pulp).

The analyses reveal a high sensitivity of corporate profits to electricity prices, but to varying degrees. At sectoral level, significant declines in demand and production are expected. However, these analyses only reflect the results obtained with aggregated data. The paper industry has a particularly high variety of products, production steps and procedures, and company structures, etc., so that an analysis of individual cases would provide a more accurate picture.

According to industry representatives, positive location factors of the German paper industry include the proximity to the market, but also the supply of waste paper and qualified personnel, although paper is a capital-intensive product. Proximity to the market or to water is positive because transport costs are an important factor. Negative location factors are the electricity prices and the high degree of planning uncertainty caused, for example, by uncertainties concerning the energy policy. In addition, there were complaints made about the high administrative efforts associated with the application procedure for derogations.

4.5 Chemical industry

The chemical industry is characterised by a large variety of processes and products. In multi-stage and multi-branched supply chains, complex and very different processes produce more than 30,000 products. It is difficult to describe the chemical industry statistically because many chemical companies combine different processes and products. Due to the high electricity demand, the focus of this study is on the production of chlorine and oxygen in the group "manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics in primary forms and synthetic rubber in primary forms".

Chlorine is a key component of the chemical industry and represents an important part of the value chain within the industry. It is, for example, a raw material for the manufacture of plastics. Chlorine production is one of the most electricity-intensive production processes in the chemical industry. Approximately 50 percent of production costs are attributable to the required electricity (VCI 2012). The chemical industry is dependent on a high quality supply of electricity. A complete failure of electricity supply to installations in, for example, the chlor-alkali electrolysis, would be very costly.

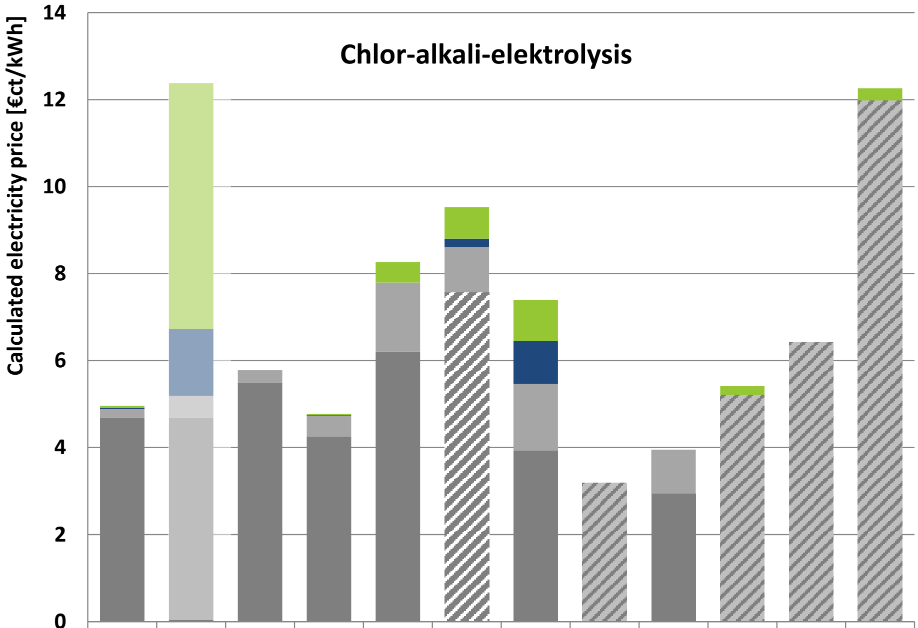
Germany is by far the leading chemical producer in Europe and is ranked globally in fourth place behind China, the US and Japan. In 2011, basic chemicals alone contributed around 5% - and the whole chemical industry around 8% - to the gross value added of the manufacturing sector in Germany. In the manufacturing sector in Germany, the chemical industry accounts for 3.3% of all companies and 5.4% of the workforce. Chlorine-based chemistry is directly or indirectly responsible for around 60% of sales in the chemical industry.

Comparison of electricity prices in the chemical industry

Two fictitious companies are used for the international comparison of electricity prices in the industry. The first company is a chlorine producer with an annual electricity consumption of 650 GWh, with no autogeneration, 90 MW installed capacity, 8000 full load hours, and a current cost intensity of 50% of gross value added. The second company is a small industrial gas producer with an annual consumption of around 950 MWh, with no autogeneration, an installed capacity of 152 MW, 6240 full load hours, and an electricity cost intensity of 20% compared to its gross value added.

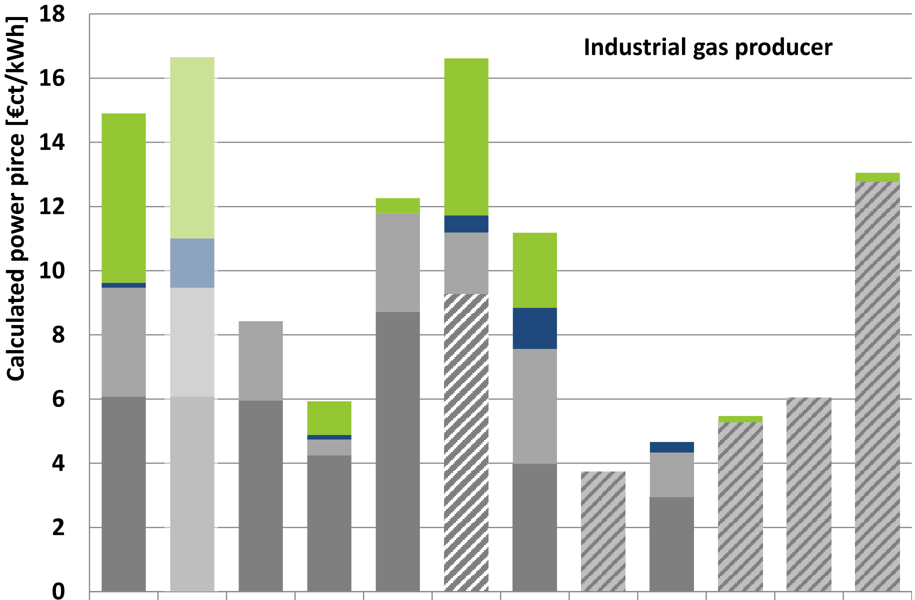
As Figure 19 and Figure 20 depict, electricity supply price are the crucial component of the electricity prices for chlorine gas producers. Countries in North America and France pay the lowest prices. Germany is at the lower end of the middle range. In contrast, the levies and network charges for small industrial gas manufacturers affect the price of electricity significantly, at least in Germany, Denmark, the UK and Italy (Figure 20).

In an internal analysis, a big German chemical company compared its own power costs at different locations without distinguishing between sources (autogeneration/external supply). In this rough comparison, electricity prices in the US are about 50% lower than in Germany. Another company reported that electricity cost levels in the US are about 60% of Germany's electricity cost levels, while the cost level in the Netherlands is about the same.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	0.05	5.65	0.00	0.03	0.47	0.73	0.95		0.00	0.2		0.28
Taxes and levies	0.03	1.54	0.00	0.01	0.00	0.19	0.99		0.01			
Transmission and distribution	0.20	0.50	0.28	0.49	1.59	1.04	1.53		1.01			
Energy procurement	4.69	4.69	5.50	4.25	6.21	7.57	3.93	3.18	2.94	5.21	6.41	11.98

Figure 19: Electricity prices for the chlor-alkali-electrolysis [ct/kWh]



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	5.28	5.65	0.00	1.05	0.47	4.89	2.33		0.00	0.2		0.28
Taxes and levies	0.16	1.54	0.01	0.14	0.00	0.54	1.29		0.33			
Transmission and distribution	3.39	3.39	2.44	0.49	3.07	1.92	3.58		1.39			
Energy procurement	6.08	6.08	5.96	4.25	8.72	9.27	3.98	3.73	2.94	5.27	6.05	12.77

Figure 20: Electricity prices for a producer of industrial gases [ct/kWh]

Competitiveness at the level of products and companies

The impact of electricity prices is shown by comparing product price and electricity costs using chlorine as an example. A particular challenge in this context is that chlorine itself is not traded as a product, but is processed within a company into a large variety of semi-finished or finished products, for example, plastics, serial products, or high-tech products. For this reason, there is no uniform global price for chlorine. Nevertheless, a "price" can be estimated, which is used for internal calculations within companies. For Western Europe, this price is €288-383/t for liquid chlorine.

The graph below shows the production cost per tonne of liquid chlorine, which includes raw materials, power and labour costs. The costs outside of the electricity costs are averages from annual and environmental reports. The costs were differentiated for two chlorine production methods: The membrane process, which is the most widely used type of chlorine production in Germany, and the amalgam process which is far behind in second place.

Regardless of the production method, chlorine production is, on its own, even in privileged companies, barely profitable, if at all. At current prices, electricity costs account for about 40 to 45% of production costs. If the special equalisation scheme were abolished, the costs for electricity would more than double.

Figure 21: Components of production costs for chlorine

The competitiveness of an enterprise is illustrated using key economic performance indicators (EBITDA, EBIT, EBT from profit and loss accounts). The sensitivity of the company to abolishing BesAR is evident through the change in these business figures. The absolute level indicates limits for the company. It is assumed that higher electricity costs will not be passed onto the consumer via the product price, but are manifested directly as a decline in profits.

Due to poor data availability, the competitive analysis was only carried out for one company as an example. It represents the German part of an international group. The data are based on the annual report and the environmental report for 2012. Figure 22 shows how the company's profit margin would change for 2012, if certain elements of the production costs and prices were to change. The analysed division includes the production of chlorine, the company level comprises only the German part of the international company.

The result for 2012 shows a negative margin for chlorine production. Production only becomes profitable in the division after the product has undergone further processing. The relative changes in the profit margin show the large effects of privileges. If the EEG surcharge were to increase to the full tariff of 6.2 ct/kWh, the margin would be significantly below 50%. If labour costs or the costs of raw materials were to increase by 20%, the internal losses of chlorine production would double. Also, chlorine is a relatively price-sensitive product - if the product price increases by about 5%, the losses are significantly reduced. At the division and company level, changes in the production costs of chlorine would only have minor effects. This is due to the strong diversification of production.

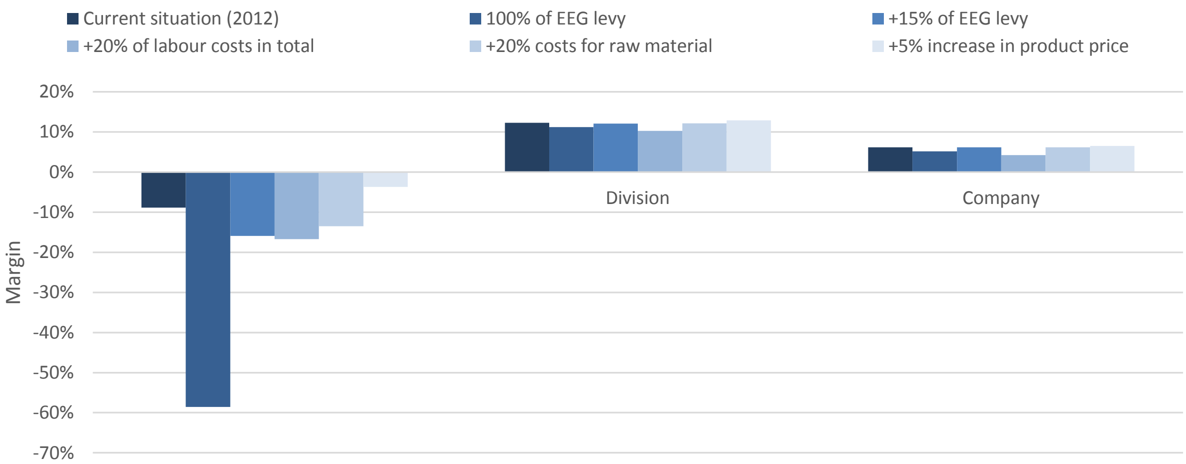


Figure 22: Costs analysis for one chemical company

The example company shows the situation of one big diversified company, although chlorine is often produced in chemical companies with smaller product portfolio, e.g. at PVC production sites. In companies with a smaller product portfolio, higher electricity costs have stronger impacts on the companies' results. In those cases, higher electricity costs in the chlorine electrolysis might lead to negative results for the whole company.

Competitiveness on industry level

The impact of electricity prices on the industry's competitiveness is measured via the change in product prices, demand, and production. The analysis examines the effect on product prices and production in the case of abolishing the BesAR only for the industry under consideration. This assessment is based on aggregated industry data (input-output table from the Federal Statistical Office and trade data from the UNComTrade database) and the assumption that companies can pass on higher electricity prices fully via the product price.

Under this assumption, the modelling results of the input-output and trade modules show an increase in average product prices by 4% for the energy-intensive companies in the sector and by 0.7% in the non-energy-intensive ones. The consequence of this assumed increase in product prices is roughly a 3.5% drop in exports, 1% reduction in domestic demand and about 4% reduction in production. These relatively small changes in the chemical industry are due to the fact that, although a majority of electricity-intensive products are components of various end products, these final products themselves are no longer electricity-intensive. In total, the chemical industry reaches a much higher total electricity consumption than the other key industries, so that its share in total privileged electricity is high but still low compared to its turnover.

Based on statistical data it is not possible to quantify effects of higher electricity prices on selected parts of the chemical value chain or intermediate products. If the electricity intensive production of chemical base materials is subject to higher electricity costs, the production might be relocated to other countries. Due to the strong interdependencies of single productions processes and the close, companies might in this case decide to shift or outsource further processes of the same value chain to other countries, independently from their electricity intensity. This might in turn lead to significantly higher costs along the value chain and might weaken the industrial competitiveness of German industry even more than estimated in the input-output models.

Additionally, the chemical industry is strongly linked to other industries. Potential electricity price increases could have negative effects on value chains of other sectors. The production of steel in blast oxygen furnaces, for example, inputs a large share of oxygen from the chemical sector. And a large share of the production costs of oxygen are electricity costs. Therefore, an increase in electricity costs of oxygen production would have a direct effect on the production of blast oxygen steel.

Conclusion

Competition in the chemical industry is fierce and an increase in electricity prices would threaten the competitiveness of individual processes or products. The extent to which this would lead to the relocation of production is difficult to estimate. The company and product analysis show that, with the given product prices, negative margins can be expected and no company would accept this long term. It is to be expected that relocation of electricity intensive base products leads to further relocations in the value chain and that effects would be much stronger than in the estimations. Those value chains comprise production in the boundaries of the chemical sector as well as in other sectors, for example the steel industry.

The analysis at industry level shows the limits of the predictability of electricity price effects. Since energy-intensive intermediate products are used in the production of less energy-intensive (end) products, only small changes in demand and production are noticed in the latter. However, if the production of electricity-intensive intermediate products ceases, these are not expected to be substituted by imported products. Instead, the production of (end) products is expected to be relocated because of close intra-industrial ties.

In interviews, important location factors mentioned for the chemical industry were especially the proximity to the European market and customers as well as good standards of education and qualified staff. According to the statements, there are always problems with recruiting young engineers. The supply security of energy and resources, good infrastructure and logistics, and research cooperation and political stability are seen as advantages.

In terms of energy policy, the exemption criteria (2013) for German companies have been acceptable to the chemical industry, but there is a risk that high policy costs might be passed through to the industry in the future and the electricity costs for the industry might increase. Energy-intensive processes are likely to be outsourced to the United States primarily because of the lower energy costs there. Significantly lower costs for raw materials and energy are also the reason for relocation to the Middle East (Saudi Arabia). Reports are that the chemical industry's investments in Europe are being drastically reduced under increasing electricity prices. At the same time, the good condition of existing facilities was mentioned as a positive location factor for Germany. Because production is very capital-intensive, relocation would be associated with very high costs. Interviewees expressed their desire for a clear and reliable energy policy framework. A clear framework is an important aspect for long-term investments. Another frequently expressed wish was the simplification of the application procedure in Germany for exemptions.

4.6 Textile industry

The production of textiles normally consists of three steps: spinning, weaving and textile finishing. The production of one individual company can only rarely be clearly allocated to one of these manufacturing processes. Depending on the final product, the production process of a particular company usually consists of an individual mixture of different steps. The end products of the textile industry include apparel fabrics, home textiles and technical textiles which include industrial textiles and functional clothing.

The sector plays a very minor role in industrialised countries. The textile industry is the smallest examined sector both in terms of production (0.68% of total sales in the manufacturing sector in Germany) and absolute power consumption.

Compared to the other analysed sectors, the privileged as well as the non-privileged electricity consumption of the textile industry is low in both absolute and relative terms (less than 1% of the electricity consumption in the manufacturing sector).

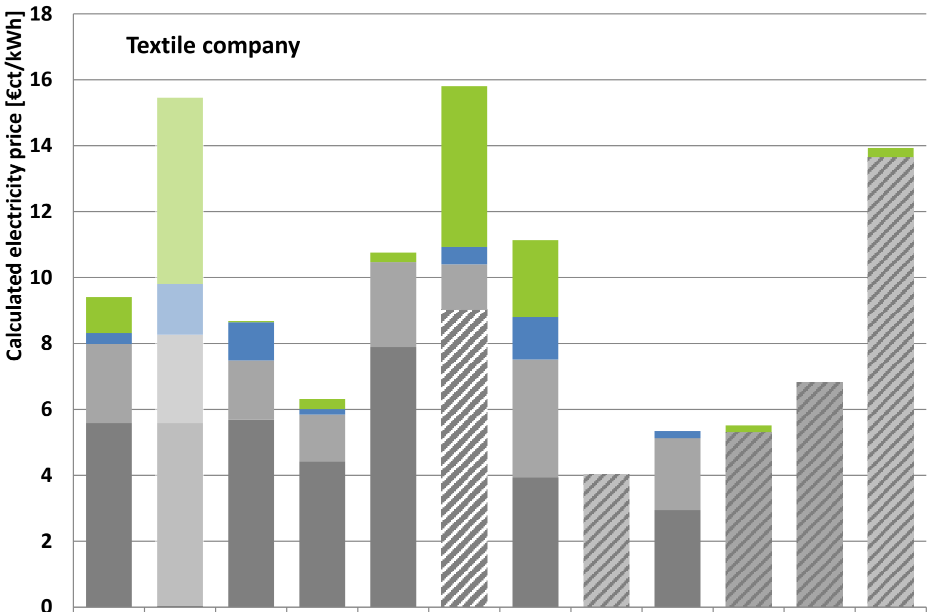
Data availability on the power consumption in textile production is poor because the sector is not very concentrated and the total power consumption of the individual companies is relatively low. Even information on the electricity intensity of individual products is not available. A company's power consumption is highly dependent on the process and the final product involved. The electricity intensity of different yarns varies considerably depending on the type and process. As a result, the average electricity intensities of the subclasses vary widely. Spinning, weaving and fleece manufacturers meet the criterion of having high electricity costs compared to gross value added. In contrast, other subclasses are well below the threshold of BesAR, so that they have to produce at considerably higher electricity prices.

Comparison of electricity prices of the industry

To compare electricity prices, a fictitious spinning company is used that consumes around 8.4 GWh of electricity per year, has no autogeneration, an installed capacity of 1.6 MW and approximately 5250 full load hours of electricity.

The results show that this type of company is partly entitled to privileges in Germany as in other countries. Without these privileges companies might be heavily burdened in Germany. The electricity intensity of many German textile companies is close to the threshold value of electricity costs compared to gross value added. If a company falls below the value of 14, in future 16% of electricity costs compared to gross value added, electricity prices are about 4 ct/kWh higher than for companies exceeding the threshold (c.f. first and second column in Figure 23). This situation might have negative effects on investments of textile companies and undermine their ambitions to increase energy efficiency, especially if potential savings in electricity consumption leads to falling below the value threshold for the BesAR.

A big advantage of locations in France are the lower electricity costs for textile companies as well. German companies work mainly with annual contracts for their electricity supply and do not actively participate on the power exchange.



	DE	(DE)	NL	FR	UK	IT	DK	CA	US	KR	CN	JP
Renewables and environment	1.09	5.65	0.04	0.32	0.30	4.88	2.33		0.00	0.2		0.28
Taxes and levies	0.32	1.54	1.16	0.17	0.00	0.53	1.29		0.23			
Transmission and distribution	2.40	2.68	1.79	1.42	2.58	1.38	3.58		2.18			
Energy procurement	5.59	5.59	5.69	4.42	7.88	9.02	3.93	4.04	2.94	5.31	6.82	13.65

Figure 23: Comparison of electricity price components for textile companies (Source: Own calculations)

Competitiveness at the level of products and companies

The products of the textile industry range from simple yarns to complex woven fabrics for special applications. The textile industry in Germany has specialised in niche products. The competition is thus decided by quality. The companies are intensely focussed on customer requirements and produce small quantities. An analysis of competitiveness at product level fails because of the lack of comparability of products and production processes.

The German textile companies are relatively small. Since they are not represented on stock exchanges, they do not publish environmental and annual reports. It is not possible to analyse the effects of electricity price increases on the competitiveness of individual companies.

Competitiveness on industry level

Since the share of the textile industry benefitting from privileged electricity prices is around 1%, it is not possible to the model the impact of electricity prices. The results are too low to be visible.

Conclusion

The textile association "Textil+Mode" states that Germany's location advantages include a well-educated workforce, a well-developed infrastructure and innovations. 16 textile research institutes are exploring new applications for textiles, especially for technical textiles and in the construction industry. The institutes provide good staff training. The German textile industry is specialised in quality products. The state of the art spinning machines can be adapted to specific tasks. The lack of skilled workers is a threat to German companies.

The textile industry traditionally has strong international networks. Raw materials and products are traded globally. Global main rivals are China and Turkey, and, at the local level, the main competitors for German companies are French ones. There is an office of the China-Europe Textile Alliance (CETA) in China, Which acts as the gateway to the Chinese market for European textile enterprises.

The structural transformation of the textile industry in Germany was completed without subsidies. Labour-intensive sectors of the industry were relocated abroad. The remaining companies in Germany focus on innovative textiles, but only have a slight technological edge. According to the German textile association, the situation is currently changing in China, due to rising labour costs. The producers of cheap goods are said to be increasingly active in Myanmar.

German textile companies deal with functional fibres, yarns and specialty niche products. End products range from leisure wear (functional clothing), occupational clothing and home textiles to flame-resistant fabrics, such as car seat covers, sofas and for military applications. The competition from France is especially strong in technical textiles.

Roughly estimated, the German textile industry exports about 50% of its products to non-European markets and 50% to other EU countries. Domestic companies often buy yarns abroad and then export the finished goods.

Electricity intensities of German textile companies are often close to the threshold value for taking part in the BesAR. Increased energy efficiency might raise electricity prices for single companies significantly if the energy efficiency measures make them fall below the threshold value of the BesAR. A benchmark paper by the textile industry and six other associations on the topic of the EEG therefore calls for the energy transition to be financed from the federal budget. Because of high EEG-levies, the textile industry in Germany would no longer invest in Germany, but rather in France and Eastern Europe.

Energy efficiency potentials are assessed differently. While one company still sees potential for optimisation, other companies have already saved around 15% of energy consumption and up to 20% of electricity consumption.

5 Macroeconomic effects

In the analysis of macroeconomic effects, four scenarios give an indication, how changes in the exemptions would affect production, value added, employment, investment and foreign trade in a longer term. The calculations distinguish from previous analyses; they do not account for individual company data and annual effects but analyse macroeconomic variables and total effects aggregated for 48 sectors until the year 2020.

The scenarios show the impact of policy changes in electricity pricing on the overall economy in Germany (while electricity prices in the other countries remain unchanged). Average prices with and without exceptions are calculated for the sectors of the privileged and non-privileged industries: commerce, trade, services and households in Germany. Three scenarios are compared to a reference scenario that reflects the current legal situation. They show the impact for

- Abolition of the special equalisation scheme (BesAr)
- Abolition of all privileges (including current tax benefits),
- Reduction of electricity tax to the minimum levels set by the EU.

With the abolition of privileges, all consumers would pay the same rates of taxes and levies. Compared to the current regime, industrial electricity prices, in particular for the previously privileged company, would be much higher. This would lead to rising costs in the energy-intensive industries and thus to higher production costs. Competitiveness of energy-intensive industries in international trade would decrease both on the export and on the import side. Some of the effects of higher electricity prices accumulate over time through lower investment. Temporarily, companies could accept lower profits or even losses, but long-term they would shut down or stop production. With the abolition of exemptions in levies the purchasing power of households would simultaneously increase because the same total costs would be distributed to more consumers.

Both the ex-post 2013 (Figure 24) and ex-ante (Figure 25) results show that in total exemptions in industrial electricity prices bring benefits. In the scenario of the complete abolition of the BesAR, production costs increase by an average of up to 3.5%. For individual companies, the increase in production cost is significantly higher. Additionally, German exports in 2020 would be about 0.3%, or 4.7 billion euros lower in 2020 compared to the reference scenario. In the calculations the total overall effect on the gross domestic product (GDP) sums up to four billion Euro and 0.15% in 2020. On the labour market, total employment losses would range between 16-45 thousands in the year 2020 due to the abolition of the BesAR. In the whole manufacturing sector the effect of job losses would be around 8-35 thousand, in the energy-intensive industries about 8-23 thousand. With the abolition of all privileges in electricity tax and levies the model calculations show a loss of up to 104 thousand employees by 2020, of which more than 70 thousand in the manufacturing sector.

If the BesAR was abolished, the cost savings for households would amount to more than two billion euros annually. In addition, a part of the other industrial sectors (approximately 0.5 billion euros) and the commerce, trade and services sector (about two billion euros) would profit. This is reflected in higher private consumption. Over time, however, the consumption growth is weakening because the real income is lower.

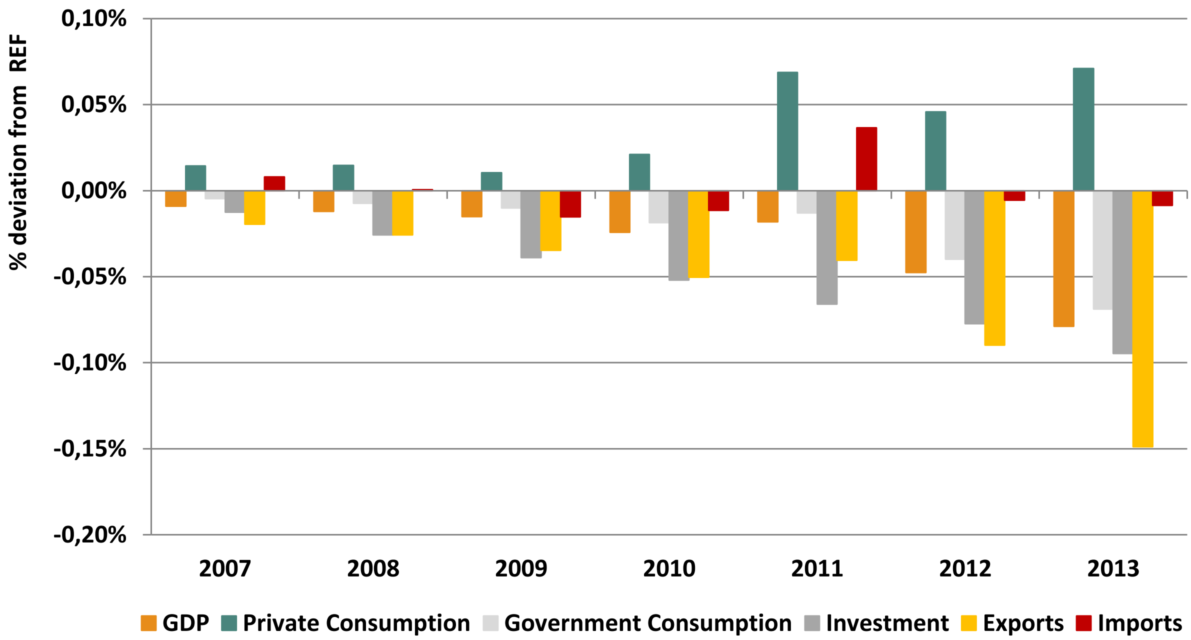


Figure 24: Effects of the abolishment of the special equalisation scheme (BesAR) on GDP and components ex post in comparison to the reference case, 2007-2013, in %

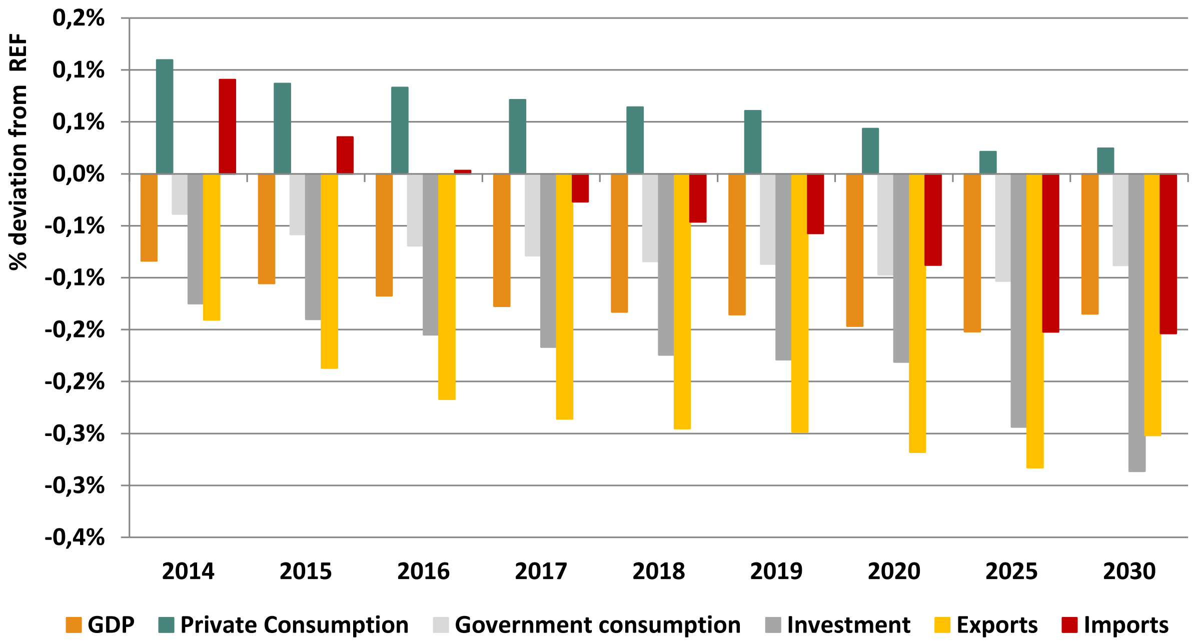


Figure 25: Effects of the abolishment of the special equalisation scheme (BesAR) on GDP and components ex ante in comparison to the reference case, 2014-2030, in %

The calculations for the other scenarios confirm these causal relationships. With complete abolition of all privileges the negative total effect on the gross domestic product sums up to about 0.37% and ten billion euros per year in 2020. If, however, the current tax is reduced to the minimum rates, the GDP could rise by about 0.19%, or €5.1 billion. At the state level, however, the loss of tax revenue would have to be financed by lower spending or higher borrowing in this case. Overall, this would lead to a reduction in total effects.

The determined macroeconomic effects are in line with other studies, however, the magnitudes of effects vary considerably. All studies map company-specific investment decisions, which depend on various criteria, to the sectoral level. Compared to studies commissioned by industry associations, which also consider autogeneration, the effects in this study are at the lower end. Differences in the outcomes of the assessments mainly depend on the direct impulses, which are triggered by higher electricity prices for energy-intensive industries. Major uncertainties concern the evaluation of immediate reactions in production and concerning the development of future investments.
Contrary to the analysis of competitiveness on the sectoral and the company level, the macroeconomic analysis does not focus on single subsectors or companies, but on the entire industry comprising 48 sectors. By aggregation, positive and negative extreme cases balance each other out, as shown for the copper and in the aluminium sector.

With omission of the current privileges, the induced negative effects in the model for privileged companies are mainly due to lower international competitiveness in price outweighing the positive effects of slightly lower prices for unprivileged consumers. From a macroeconomic point of view, existing exemptions for energy-intensive industries are economically positive.

ECOFYS Germany GmbH | Albrechtstraße 10 c | 10117 Berlin | **T** +49 (0)30 29773579-0 | **F** +49 (0)30 29773579-99 | **E** info@ecofys.com | **I** www.ecofys.com

ECOFYS Germany GmbH

Albrechtstraße 10 c
10117 Berlin

T: +49 (0) 30 29773579-0
F: +49 (0) 30 29773579-99

E: info@ecofys.com
I: www.ecofys.com