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Carbon Leakage: A barely perceptible process

January 23, 2014

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Germany pursues ambitious energy and climate policy objectives and is thus a trailblazer in these fields internationally. However, the faltering UN climate protection process shows that other countries are not following Germany's lead or are moving at a slower pace. We shall show that a barely perceptible process of de-industrialisation has already begun in energy-intensive sectors in Germany. CO_2 emissions are shifting from Germany to other countries.

Investments in the "Energiewende" have led to higher energy prices (especially for electricity) over the past few years. German industrial users have to pay roughly 26% more for electricity than the EU average. Germany's cost disadvantage vis-à-vis the United States is much more pronounced. Since early 2007, electricity prices have risen by close to 48% in Germany, while they have gone up by "only" 38% in the EU as a whole.

Companies from energy-intensive sectors have been holding back on investments in Germany for several years now. They only invested more in their facilities than they wrote off on them in a mere two years of the last 17. As a result, the energy-intensive industrial sectors reported an over 11% decrease in net fixed assets between 1995 and 2011, while the other sectors posted an almost 5% increase.

If energy prices in Germany continue to rise faster than in other countries, our calculations suggest that energy-intensive companies will see their sales fall by 2-6%. This would correspond to an absolute decline of somewhere between EUR 5 bn and EUR 16 bn per year.

Applied to the CO_2 emissions of those industries, this would translate into a decline of the order of a good 3 to roughly 10 million tonnes per year. This equals about 0.4-1.3% of Germany's total CO_2 emissions. At the same time, rising foreign investment in the energy-intensive sectors suggests that the CO_2 emissions of German companies abroad are going to increase. On a global scale, the emissions will continue to rise anyway.

At the end of the day, this points to the dilemma associated with a national climate policy drive. Climate change is a global externality. Excessively high energy prices or climate policy regulations in one country will lead in the short-to-medium term not to globally falling CO_2 emissions, but merely to their being shifted abroad (carbon leakage).

Germany's energy and climate policies should take these correlations into consideration. In order to stop the barely perceptible process of de-industrialisation and carbon leakage, Germany should either join forces with Europe to achieve faster progress and more stringent targets in international climate protection or else curb its own pace. At the very least, Germany has to seek to make its Energiewende more efficient. Moreover, energy-intensive companies are going to require exemption regimes in the future, too.

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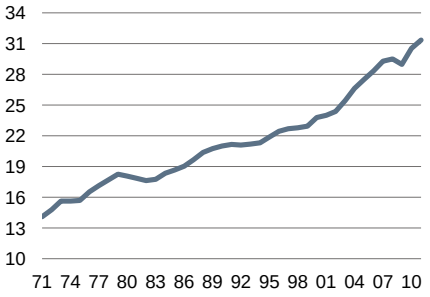
NACE codes by industrial sector 1

NACE code	Sector
C	Manufacturing
10	Food
11	Beverages
12	Tobacco processing
13	Textiles
14	Clothing
15	Leather and related products
16	Wood products
17	Paper and paper products
18	Printing and reproduction of recorded media
19	Coking and oil refining
20	Chemicals
21	Pharmaceuticals
22	Rubber and plastics
23	Building materials
24	Metal production
25	Metal products
26	Data processing equipment
27	Electrical equipment
28	Mechanical engineering
29	Automotives
30	Other vehicle manufacturing
31	Furniture
32	Other manufacturing

Source: Federal Statistical Office

Global CO_2 emissions on the rise 2

Energy-related CO_2 emissions, bn tonnes



Source: IEA

1. Introduction

By international standards, Germany pursues ambitious climate and energy policy objectives. However, the increases in German energy prices over the past few years have unleashed a heated debate over the costs of what is known in Germany as the Energiewende.[1] It is becoming increasingly obvious that the current policy fervour and mix of instruments can be accompanied by disadvantages for domestic businesses and for Germany's future as an industrial base, especially since the rest of the world remains reluctant to act as quickly on climate or energy policy. It is not only energy costs that have risen. The uncertainties related to the general energy-policy framework have also grown. In addition, given the fluctuations in power generation associated with renewables considerable effort and expense must now be devoted to ensuring the security of supply. On balance, we see a risk that Germany's competitiveness as an industrial location will suffer in the medium to longer term. It is likely that firms from energy-intensive sectors in particular will hold back noticeably on investment in Germany. Instead, an increasing share of their investment is probably going to flow abroad; both trends have already been observed in the past, as we shall show in this report. All in all, this can lead to the weakening of the industrial value chain in Germany. Ultimately, this trend will also result in CO_2 emissions being shifted from Germany to other countries, the buzzword being carbon leakage.

Our basic hypothesis is that – no matter whether it is referred to as carbon leakage or de-industrialisation – this is a barely perceptible process. In other words, we do not expect industrial facilities in Germany to be mothballed as a short-term response to rising energy prices and rebuilt abroad. Rather, we believe that in future (energy-intensive) companies will tend to decide against the home market when making investment decisions on maintenance and expansion. This can lead to creeping erosion of the production base in the affected sectors. Especially since Germany's manufacturing sector has performed very much more successfully than its European peers over the past few years, the time is ripe to issue a warning that such a process could occur. After all, there is no guarantee that the success story of German businesses or of Germany as an industrial location will continue. Indeed, what will be needed is unbroken business efforts and an intelligent legal framework to maintain the country's competitiveness in future.

2. International and national energy and climate protection policies show different levels of ambition

The recent UN climate conference in Warsaw saw the reconfirmation once again that progress in international climate protection policy is very limited and virtually imperceptible for outside parties. Over the past few years tangible progress has mainly been made in hammering out details (e.g. forest protection and funding measures for developing economies to make adjustments to climate change). True, the participants have not lost sight of the overarching objective of reaching agreement on legally binding as well as demanding carbon emission reduction targets for as many countries as possible. However, the going will no doubt be tough. At the end of the day, the international community reaffirmed in Warsaw that by 2015 it wanted to agree an "outcome with legal force" designed to cover emission reduction targets for all countries and come into effect in 2020. Just how ambitious these reduction targets will be, and how binding, are just two open issues of many that will still have to be clarified over

[1] See Auer, Josef et al. (2013). Energiewende 2.0 – don't risk competitiveness. Deutsche Bank Research. Standpunkt Deutschland. Frankfurt am Main.

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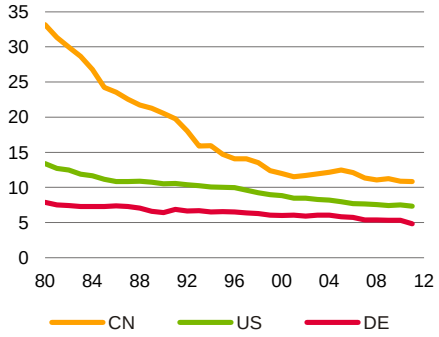
Energy intensity falling worldwide 3

Energy consumption per unit of GDP (based on real USD and purchasing power parities), '000 Btu*

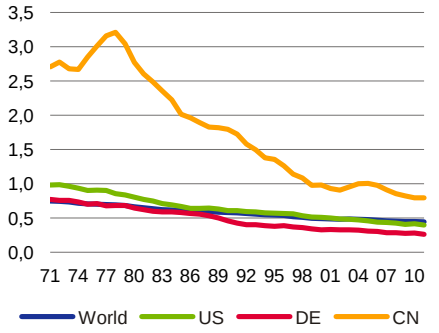


* British thermal unit

Source: Energy Information Administration

CO_2 intensity in China roughly three times as high as in Germany 4

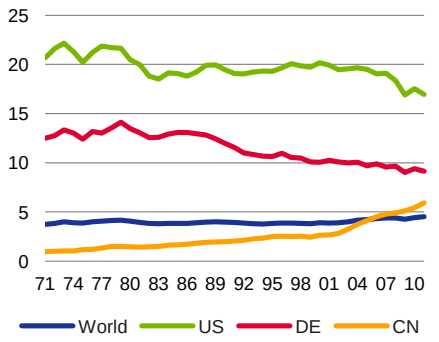
CO_2 emissions per unit of GDP (based on real USD and purchasing power parities), kg



Source: IEA

China catching up 5

CO_2 emissions per capita, tonnes



Source: IEA

the next few years. Thus it remains to be seen how much substance the targeted climate agreement will have.

EU is a trailblazer in international climate protection

Given the outlined developments in climate protection policy it has to be noted, on sober reflection, that the EU is still pursuing the most ambitious climate protection targets by international standards. The EU intends to reduce its CO_2 emissions by 20% versus the base year 1990 by 2020 and by 40% by 2030. Due to the European economic crisis at least the goal for 2020 may be easier to reach than was anticipated only a few years ago, because the recession went hand in hand with lower emissions. Nevertheless, that crisis has caused immense economic costs, which is why the resulting carbon savings are certainly not to be assessed as a cost-free "windfall profit".

Outside the EU only a few countries have committed to ambitious, quantitative carbon reduction targets. The US attracted considerable attention in summer 2013 when President Obama unveiled that country's Climate Action Plan. He reasserted the previously announced target of reducing US CO_2 emissions by 17% versus 2005 by 2020. However, in relation to the base year 1990 commonly used in international climate policy talks this is merely a reduction target of just under 2%. In fact, 2005 was the year when the US had its highest carbon emissions on record. Since the end of the last decade the US's absolute CO_2 emissions have been on the decline. This is partly due to the exploration and development of unconventional natural gas deposits, which has resulted in gas being substituted for coal in power generation. Moreover, the average fuel consumption of US vehicles has declined over the past few years – so fuel consumption has fallen as well.

China banking on efficiency targets

Up to now, China has merely – or at least! – pursued efficiency targets, rightly pointing to its lower GDP per capita in comparison with the developed economies: China says it wants to reduce its specific carbon emissions per unit of GDP by 40-45% versus 2005 by 2020. However, China has extremely cheap options for reducing the country's carbon intensity or raising its energy efficiency. Despite substantial progress over the past few years, China still produces roughly three times as much carbon for every unit of GDP as Germany. Its energy intensity is more than twice as high as in Germany. So China will primarily be acting in an economically rational manner if it uses energy less wastefully in future. When all is said and done, China's absolute CO_2 emissions and also its per capita emissions will continue to climb for the time being. China has now overtaken France in terms of emissions per capita and nearly reached two-thirds of the German level.

Is a climate policy breakthrough in the offing?

Not only the Warsaw climate conference has shown that international climate protection negotiations have become somewhat bogged down. Ultimately, the only marginal progress is a simple reflection of the real situation. After all, global carbon emissions have increased by more than 28% in the past decade alone and thus much more than in the two preceding decades; the main drivers of this trend were the emissions of the emerging markets. Since 2006, China has overtaken the US as the biggest emitter of greenhouse gases and is now responsible for more than 25%. The German share of global energy-related carbon emissions, by contrast, has shrunk steadily over the past few years, coming to only 2.4% in 2011.

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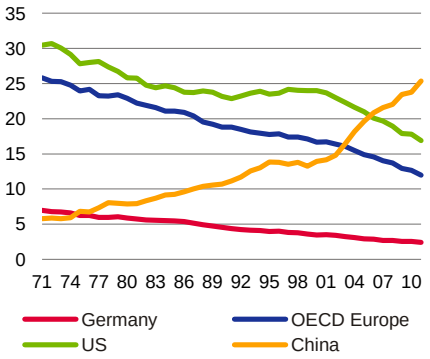
China accounts for largest share of global CO_2 emissions 6

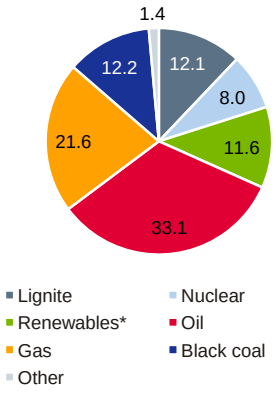
Shares in global energy-related CO_2 emissions, %



Source: IEA

Oil, coal and gas are predominant 7

Share in primary energy consumption, DE, 2012, %

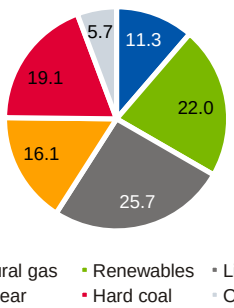


*Bioenergies account for over 60% of renewables

Source: AG Energiebilanzen

Renewables already in second place 8

Share in gross power generation, DE, 2012, %



Does not total 100% due to rounding

Source: AG Energiebilanzen

As things stand today, there is little to suggest that the next UN climate conference will achieve any fundamental breakthrough. Really ambitious, absolute and legally binding carbon reduction objectives are scarcely to be expected in the US or China for the time being. As in the past, the two countries will probably continue to focus on the other's responsibility and pragmatically gear their targets to what is economically feasible. On the one hand, both countries are investing – regardless of international climate policy progress – in renewable energy sources and technologies to boost efficiency. In 2012, these two countries accounted for roughly 58% of all newly installed windpower capacities. On the other, they are falling back on cheap, locally available fossil fuels (in the US currently to an increasing degree on natural gas, and in China on still dominant coal).[2] Going by the official climate targets (absolute CO_2 reduction) the EU will nonetheless probably remain the trailblazer in international climate protection policy. Nothing about this assessment is about to change even though within the EU there is considerable controversy over the future direction of climate policy. This holds, for example, with regard to reforming the EU Emissions Trading System, the pace of renewables expansion and a tightening of current and future climate protection targets that some parties, such as NGOs, do not consider ambitious enough.

Germany's Energiewende is a go-it-alone strategy in the EU

Within the EU, Germany has struck out on its own with the Energiewende. No other industrial country is pursuing such ambitious energy and climate protection targets. The commitment to phase out nuclear energy by 2022 made following the Fukushima reactor catastrophe in spring 2011 is only one of many – in most cases – demanding targets. Germany says it wants to lower its carbon emissions by 40% versus 1990 by the year 2020, and by at least 80% by 2050. This target is to be achieved partly by expanding the role of renewable energies:

— The share of renewables in final energy consumption is to be boosted to at least 18% in 2020 and 60% in 2050 (2012: roughly 12%).

— In the electricity sector, the share of renewables in gross power generation is to increase to 40-45% in 2025, 55-60% in 2035 and at least 80% in 2050 (2012: about 22%).

These climate targets cannot be achieved without boosting energy efficiency. This is why Germany is also pursuing many efficiency objectives:

— Primary energy consumption is to be reduced by 50% (vis-à-vis 2008) by 2050; by that time, power consumption is to fall by 25%.

— The refurbishment rate for existing buildings is to be increased from about 1% now to 2% per year. Afterwards, primary energy requirements for buildings are to decline by 80% by 2050.

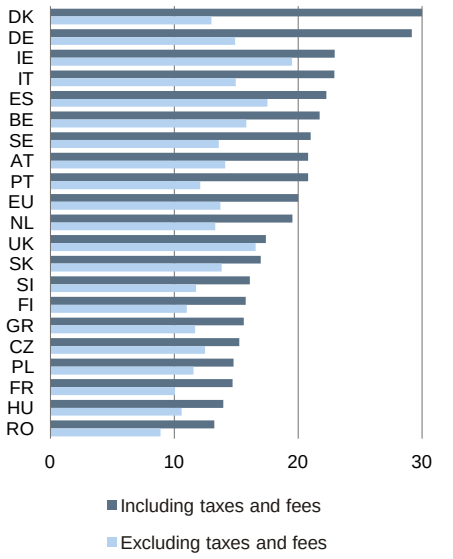
— In transport, final energy consumption is to shrink by 40% (vis-à-vis 2005) by 2050.

Contrary to what is often suggested in the media, Germany's Energiewende is more than just phasing out nuclear power and expanding renewables in the electricity sector. It is striking that nearly all the climate and energy policy objectives stem from the "before Fukushima" period and have not been changed since, or at least not significantly. Thus, the Energiewende is not a new topic. Germany's Energiewende is attracting considerable attention internationally. All the same, most of the countries have so far tended to be wait-and-see

[2] See Auer, Josef (2013). The new global power plant order: Unconventional and green energies are driving change. Deutsche Bank Research. Current Issues. Frankfurt am Main.

Electricity price (incl. taxes) particularly high in Denmark and Germany 9

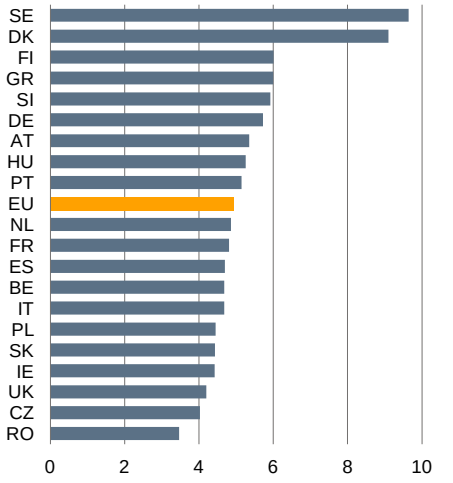
Household electricity prices, 2013, cents/kWh



Source: Eurostat

High gas prices in Scandinavia 10

Price of natural gas for industrial users, 2013, cents/kWh



Source: Eurostat

observers and have not (yet) switched to the German model. Germany is thus a trailblazer in climate protection, but few are following its lead.

3. Energiewende resulting in higher energy costs

With its demanding energy and climate policies, Germany is following something of a tradition. After all, it is quite common for Germany to have stricter environmental targets and ecological standards as well as higher energy taxes than other countries. In the past this has often benefited the German economy. Because whenever other countries followed suit with similar regulations at a later date, German companies stood ready with technologies to position themselves in the new markets. In many cases this has led to net positive effects for local value creation and the labour market. It is no coincidence that German companies rank as world leaders in environmental technology as well as resource and energy efficiency.[3]

Germany is pursuing more than one objective with its energy and climate policies. In connection with the development of innovative products and advances in technology – with renewable energies, for instance – there are hopes of creating jobs and value added at home and/or tapping new export markets. Moreover, the aim is to reduce dependence on energy imports and finite fossil fuels whose prices will probably remain high and indeed climb in the long term; this independence is to go hand in hand with greater autarky and security of supply. In this respect, the reduction of carbon emissions and Germany's contribution towards climate protection are, so to speak, the bond linking energy and climate policy objectives.

These objectives are worthwhile per se, but so far Germany has had minimal success in meeting them. The available energy and climate policy instruments are not being deployed efficiently enough and are not properly coordinated with one another. For example, Germany's Renewable Energy Sources Act (EEG) conflicts with the EU Emissions Trading System. In our opinion, market principles and competition generally play too small a part.[4] Policymakers are neglecting the efficiency potential in the buildings segment.

Energiewende's gross costs exceed EUR 30 bn per year, …

In order to meet the cited objectives there needs to be investment in renewable energies, conventional power plants, power grids and storage facilities, energy-efficient buildings and alternative propulsion technologies. In a 2012 report we estimated that the required investment would total at least EUR 30 bn per year.[5] A few months ago, the German Institute for Economic Research (DIW) put the annual figure at EUR 31-38 bn (excluding the transport sector).[6] So, on balance, the Energiewende is linked with huge costs that will ultimately have to be borne by energy consumers. Thus, it is no wonder that the cost debate surrounding the Energiewende has intensified of late.

[3] See Roland Berger Strategy Consultants (2012). GreenTech made in Germany 3.0. Environmental Technology Atlas for Germany. Published by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Berlin.

[4] Critical analysis of the targets of the Energiewende and of the instruments deployed can be found in Weimann, Joachim (2013). Rettet die Energiewende? Warum eigentlich? In Wirtschaftsdienst. Heft 11. November 2013. Hamburg.

[5] See Auer, Josef and Eric Heymann (2012). Germany's energy turnaround: Challenging for municipalities and municipal utilities. Deutsche Bank Research. Current Issues. Frankfurt am Main.

[6] See Blazejczak, Jürgen et al. (2013). Energiewende erfordert hohe Investitionen. In DIW-Wochenbericht 26/2013. Berlin.

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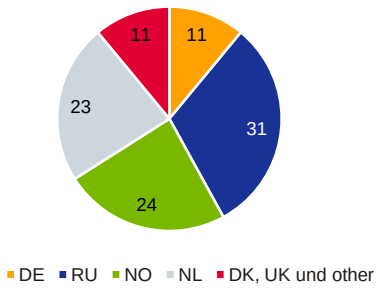
… but net effects are decisive

Natural gas: Imports dominate supply 11

Suppliers of gas to Germany by country, 2012*, %

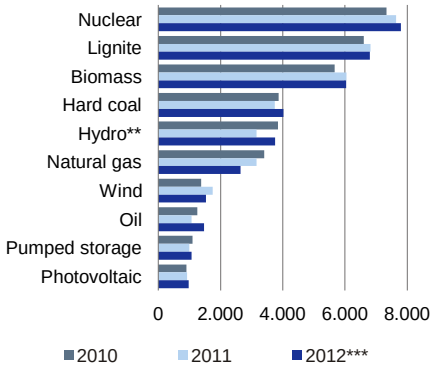


*Provisional, in some cases estimates

Source: BDEW

Major differences 12

Annual full-load hours* in the power industry by type of generating plant, DE



* Significant changes in output during the year are taken into account
** Run-of-river and storage reservoir
*** Provisional figures

Source: BDEW

To arrive at an overall assessment it is necessary to set the costs of the Energiewende against any potential positive economic effects. In the following we shall outline some of the interdependencies:

— The Energiewende can indeed reduce dependence on fossil fuels and/or their importation. However, trade relations with the suppliers of fossil fuels are not a one-way street, as Germany exports machinery and vehicles to these countries, for instance. Moreover, if natural gas is to play a larger role in the energy supply in future – at least as a bridge technology during a transition period – but the exploitation of unconventional gas deposits at home (buzzword: fracking) continues to be regarded negatively, Germany will remain dependent on imports for this type of fuel. However, the number of countries that are potential suppliers of natural gas could increase in future.[7]

— It also has to be considered that company and household energy bills can be reduced if energy-saving measures are implemented and the efficiency targets discussed above are actually attained. However, this argument is also undermined by the fact that energy bills would be even lower following the implementation of efficiency measures if energy prices did not rise at the same time (e.g. via government intervention). What no doubt does apply, however, is that (not only) Germany has substantial commercially viable energy-saving potential still waiting to be tapped. Higher energy prices can be an incentive to exploit this potential.

— A further correct argument is that the cost of producing electricity from renewables has in some cases dropped sharply over the past few years thanks to advances in the technology. However, there is a catch here, too, because efficient integration of renewables will require additional investment in new and "smarter" grids, flexible, baseload-capable generating stations and also storage facilities in future.[8] Most of the costs incurred here are ultimately due to the ongoing expansion of renewables. On top of this, the decline in the cost of generating electricity is partly offset by the fact that renewables still account for very low full-load hours. To illustrate: despite their priority feed-in Germany's photovoltaic systems still only show annual average utilisation of just over 10%. It is correct, however, that the lower cost of producing electricity has turned renewable energies into an attractive alternative for many countries with more favourable climatic conditions. Such countries thus benefit indirectly from the incentive system in Germany.

— One further price argument is related to trading activities on electricity exchanges. Renewables-based electricity is generated at very low marginal costs. At the same time, the electricity price quoted on the exchange is based on the marginal cost principle. This means that the rising share of renewables is increasingly driving generating stations with higher marginal costs out of the market. Over the past few years this has led to price erosion on the electricity exchange. The Federal Statistical Office says that the exchange price has fallen by about 65% in Germany since 2007. But since the investment costs for renewables are funded via the EEG levy, which most electricity consumers have to pay with their power bill, the lower exchange-based price is of virtually no relevance to most customers.

— Finally, the often cited positive employment effects attributed to investments in the Energiewende are qualified by the fact that these are due to a

[7] See Auer, Josef (2010). Gas glut reaches Europe: Major impact on prices, security and market structure. Deutsche Bank Research. EU Monitor 75. Frankfurt am Main.

[8] See Auer, Josef (2012). State-of-the-art electricity storage systems: Indispensable elements of the energy revolution. Deutsche Bank Research. Current Issues. Frankfurt am Main.

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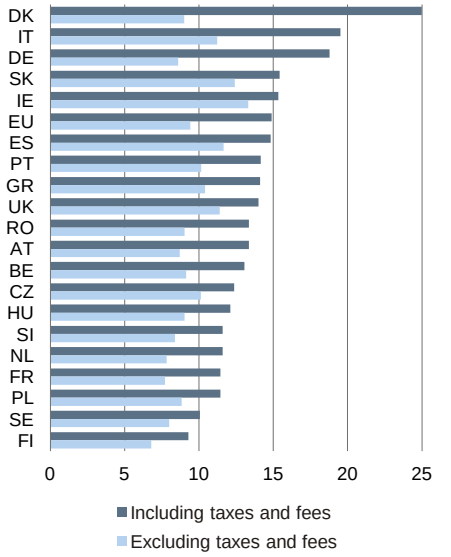
German industrial power prices among highest in Europe 13

Electricity price for industrial users*, 2013, cents/kWh

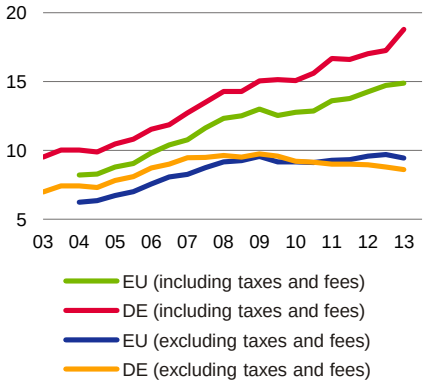


* Annual power consumption between 500 and 2,000 MWh

Source: Eurostat

Taxes and fees driving electricity prices in Germany in particular 14

Electricity price for industrial users*, cents/kWh

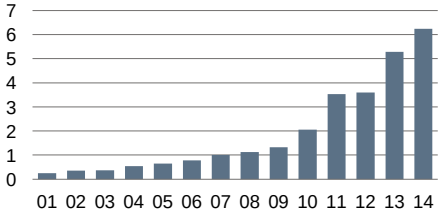


* Annual power consumption between 500 and 2,000 MWh

Source: Eurostat

EEG levy escalating 15

Cent/kWh



Source: German Federal Ministry for the Environment

significant degree to government subsidies. So one must constantly ask what sort of employment effects could have been achieved in other areas instead by using the same funds. Moreover, since labour reports often refer to the gross job effects, it would also be appropriate to take account of the extent to which jobs were lost in other sectors.

Empirical evidence: German energy costs are higher than average

If we switch from this rather theoretical approach to an analysis of how energy prices have developed, the conclusion is clear: Germans pay among the highest energy prices in the world, and these have increased at an above-average pace over the past few years. This holds especially for electricity prices. There is also no denying that the main reason for the increases in the electricity price over the past few years has been government intervention. The key factors have not been European instruments such as the Emissions Trading System, which currently does not particularly burden industrial companies given the eroding price of emission allowances[9]. Instead, national measures are the dominant factor. One noteworthy measure is the subsidisation of renewables via the EEG levy, which in 2014 alone is likely to raise over EUR 23 bn. Electricity consumers who do not enjoy any exemptions will see the EEG levy increase to more than 6 cents/kWh this year. What this boils down to is that now and probably also in the next few years the cost burdens on the German economy are set to outweigh the benefits. Several facts show this clearly:

— Electricity prices including taxes and charges for household customers totalled over 29 cents/kWh in Germany in H1 2013, according to Eurostat. Only in Denmark was the price slightly higher (30 cents/kWh). The gap to third place (Ireland) is already more than 6 cents/kWh, or roughly 27%. Household power prices are nearly twice as high in Germany as they are in France, and exceed the EU average by 46%.

— Industrial users in Germany had to pay close to 19 cents/kWh for power in H1 2013 (special-rate customers pay lower prices). This puts Germany in third place in the EU. Here, too, Denmark holds top spot, followed by Italy. The German electricity price exceeds the EU level by roughly 26% and that of France by 64%. Since the beginning of 2007, electricity prices – including taxes and charges – have risen by close to 48% in Germany; the increase in the EU as a whole was "only" 38%. Interestingly, the electricity price actually fell by 9% before taxes and charges in Germany during the given period.

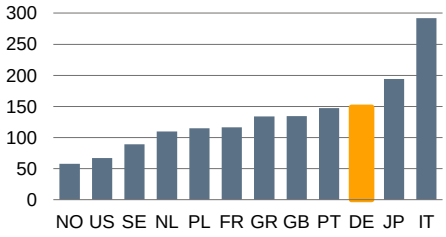
— The rates charged to industrial customers are high in Germany also in comparison with non-European countries. Going by the definition used by the International Energy Agency (IEA), which differs from that of Eurostat, electricity prices in Germany exceeded the US level by about 150% in 2012.

— The price of natural gas for industrial users is also higher in Germany than the EU average. But in this case the premium is more moderate than for electricity, at just under 16%. The difference to the US is much more pronounced. Thanks to the unconventional gas deposits there the gas price has tended to fall in the US – even though demand has risen – since the end of the last decade. According to statistics published by the International Monetary Fund (IMF) the price of natural gas is more than 200% higher in Germany than in the US. This price difference is of course partly attributable to the fact that with natural gas – unlike oil – there is still no functioning world market that would make such differences unlikely. Given the low

[9] Three key factors play a part in the price erosion. First of all, the European economic crisis has resulted in lower demand for CO_2 allowances. Second, the inflow of allowances from international projects outstripped expectations. Third, past allocations of trading allowances were very generous. As a result, there is now an oversupply of allowances and prices are lower accordingly.

German industry has relatively high electricity costs 16

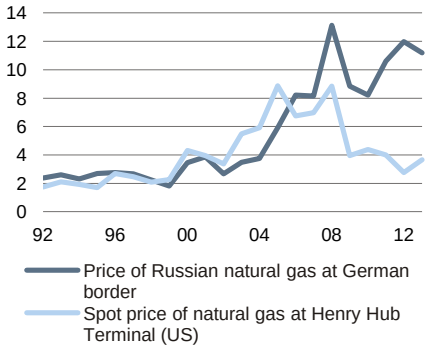
USD per MWh, 2012



Source: IEA

Natural gas: Much cheaper in the US than Germany 17

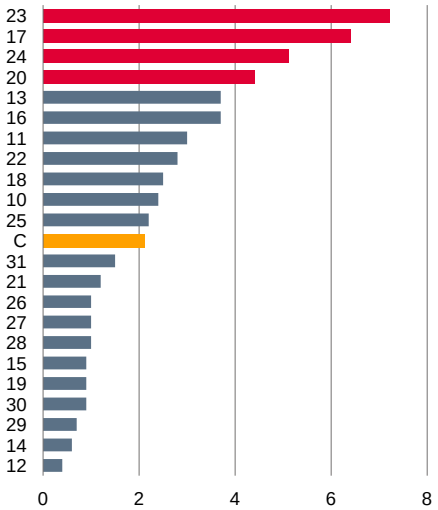
USD per million metric BTUs



Source: IMF

Building materials and paper are particularly energy-intensive 18

Share of energy costs in gross production value by sector*, 2011, Germany, %



* According to NACE code; in some cases the cost shares are much higher in certain subgroups

Source: Federal Statistical Office

prices, the US is currently an attractive location both for energy-intensive companies and for companies that use natural gas as a key production factor.

As a consequence of rising energy prices households have less money at their disposal for other consumption purposes; this loss of purchasing power hurts retailers, for instance. In the corporate sector there is less financial scope for, say, investment activity, profit distributions and wage hikes.

4. High energy prices trigger reluctance to invest, loss of value added and carbon leakage

Given the rising cost of energy it is little wonder that most German companies regard the Energiewende to be largely a drag on business. This is documented by various surveys. For example, according to a DIHK (Association of German Chambers of Commerce and Industry) survey in 2013 nearly 33% of all German companies thought the Energiewende had a negative or very negative impact on their competitiveness. By contrast, only 15.6% of them thought the Energiewende had a positive or very positive impact on their own competitiveness. With industrial companies, the contrast is sharper still: in this case over 50% of companies believed the Energiewende had a negative or very negative effect. Conversely, merely 11.6% regarded the Energiewende's influence on their competitiveness as positive or very positive.[10]

Energy-intensive sectors[11], in particular, reported being hurt by further increases in energy prices. Note that many companies from these sectors still benefit from exemption regimes today. One of the main reasons given for their existence is to maintain international competitiveness. The benefits and arrangements include a reduced EEG levy, exemptions from the grid fees, a lower cogeneration (CHP) levy, tax breaks and peak load levelling in respect of the electricity and energy tax (eco-tax), the free allocation of CO_2 allowances and compensation for extra costs related to emissions trading. However, there are more and more political signals that the special arrangements are likely to be cut back in future. The new government is probably going to do away with or reduce several exemptions. Moreover, the EU has launched state aid proceedings owing to the favourable terms on the EEG levy.

On balance, there is a growing likelihood that in future the exemption regimes will at least no longer be as generous as now. After all, in the past they were unable to prevent energy prices in Germany – also for energy-intensive companies – from rising more quickly than the EU average. And since there is no doubt that these sectors with export ratios of between 30% (building materials) and 57% (chemicals and chemical products) are pitted against international competitors, rising energy costs will – ceteris paribus – erode their ability to compete with companies from abroad. The fact that energy prices are of key importance to the commercial success of companies with high energy consumption in particular is evidenced by a joint KfW Group and ZEW (Centre for European Economic Research) survey of companies which operate facilities in Germany that fall under the EU Emissions Trading System. In response to the question as to which factors were the most important for the cost efficiency of

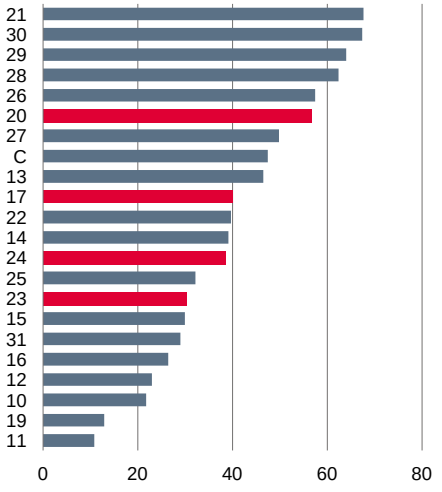
[10] See DIHK (2013). Unternehmen packen's an – Skepsis bleibt. IHK-Energiewende-Barometer 2013. Berlin. Difference to 100%: Neutral assessment or assessment not possible.

[11] When we speak of "energy-intensive sectors" in the following, we are referring to the following industries: paper and paper processing (NACE code 17), chemicals and chemical products (20), building materials (23) and basic metals (24). In 2011 they generated close to 16% of industrial gross value added in Germany (red bars in charts 18 and 19). What these sectors have in common is that their share of energy costs in gross production is more than twice as high as the manufacturing sector average. While this criterion also applies to subgroups of other industrial sectors (e.g. parts of food, textiles, wood and plastics), we confine our discussion to the four industrial sectors named above because of the better availability of the data required.

Carbon leakage: A barely perceptible process

Noticeable differences in export ratios 19

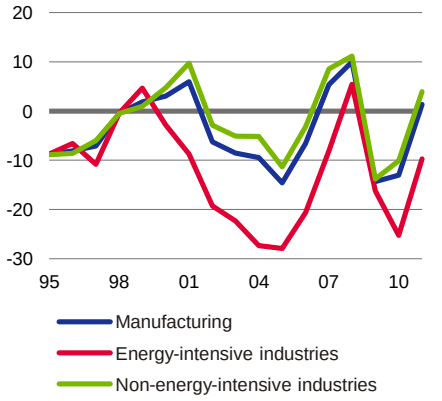
Share of foreign turnover in total sales by sector (NACE codes), 2012, DE



Source: Federal Statistical Office

Energy-intensive industries running facilities until they wear out 20

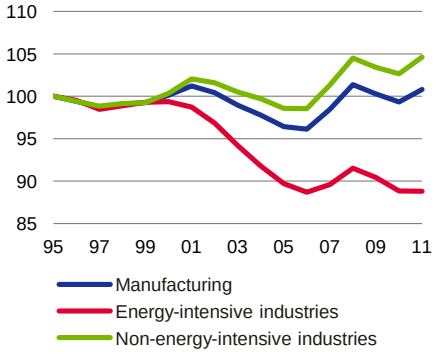
Net fixed capital formation as % of gross fixed capital formation



Source: Federal Statistical Office

Net fixed capital formation falling in energy-intensive sectors 21

Net fixed assets, 1995=100



Source: Federal Statistical Office

producing their biggest-selling product group, some 76% of the respondents cited energy costs. These were thus assessed to be the most important factor.[12]

Investment behaviour duly influenced already in the past

Investment decisions hinge on expectations about the future. With an eye to the Energiewende's objectives and possible adjustments to the exemption regimes most companies probably expect electricity prices in Germany to increase. Moreover, in the case of long-term investment decisions in particular, expectations about the security of supply and the reliability of the policy framework are crucial. Here, too, conditions in Germany have tended to deteriorate over the past few years. Of course, other important factors also shape investment decisions, such as wage costs, tax rates, untapped markets, tariffs and non-tariff trade barriers, local content rules and reduced exchange rate risks, and often these are more significant than the energy costs. However, the latter are frequently the decisive factor for energy-intensive industries. On balance, we expect companies from the given sectors to hold back on investment in the domestic market.

Even in the past when Germany had lower energy prices energy-intensive and non-energy-intensive industries were shown to differ significantly in their investment behaviour. For example, a look at the ratio of net to gross fixed capital formation finds that since 1995 net fixed capital formation in the energy-intensive sectors has only been positive twice. What this boils down to is that the energy-intensive industries in Germany only invested more in their facilities than they wrote off on them in a mere two years of the last 17. So this indicates that facilities are being run until they gradually wear out. With the non-energy-intensive industries, by contrast, there were six years in which more was invested than was written off. It is striking to note that even in 2010 and 2011, when German GDP expanded by a total of 7.5%, the energy-intensive sectors posted negative net fixed capital formation. Naturally, there are more reasons than just energy costs also for these diverging patterns (e.g. the respective capacity utilisation and demand situation). Nonetheless, the difference between the two groups is obvious.

As a result of the low investment activity, the energy-intensive industrial sectors reported an over 11% decline in net fixed assets between 1995 and 2011, while there was an increase of close to 5% in the other sectors. The differing developments are also mirrored in the modernity of the assets, that is the ratio of net to gross fixed assets. The reading for the energy-intensive sectors was roughly 2 percentage points lower than for the non-energy-intensive ones in 2011. Moreover, the modernity reading was 4 pp lower in 2011 than it was in 1995. On balance, there is a negative correlation between energy intensity and investment activity for the industrial sectors in Germany.

If energy-intensive industries had invested exactly as much in domestic plant as the manufacturing sector average, Germany's CO_2 emissions would have been higher than was actually the case. This suggests that deferred investment leads to a fall in carbon emissions at home via a "barely perceptible process". At the same time, the development of foreign direct investment by German companies in energy-intensive industries argues that CO_2 emissions in other countries have increased on the back of German business activities there. Since 1995, the stock of foreign direct investment in the energy-intensive sectors has in some cases increased considerably, so the empirical figures point to carbon leakage having already started in the past. This also shows that companies from energy-intensive sectors are not regarded per se as less appealing investment objects than companies from other sectors. Of course, many factors play a part in

[12] See KfW & ZEW (2012): KfW/ZEW CO_2 Barometer 2012. Frankfurt am Main.

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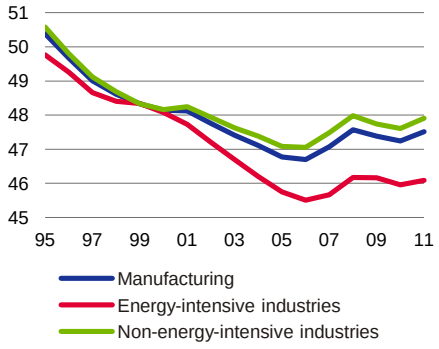
Sharp drop in modernity of energy-intensive sectors 22

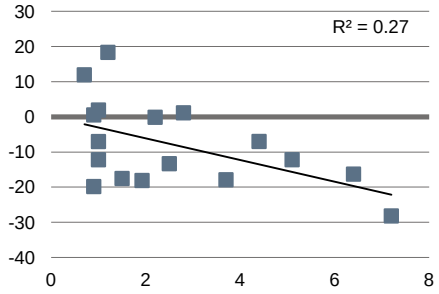
Net fixed capital formation as % of gross fixed capital formation



Source: Federal Statistical Office

Energy-intensive industrial sectors investing less in Germany 23

X-axis: Energy cost share* 2011, %
Y-axis: Net inv. as % of gross inv.**, %

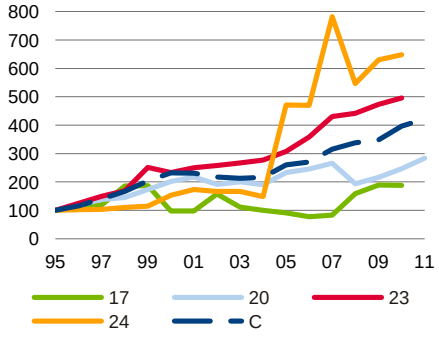


* Share of energy costs in gross production value in industrial sectors
** Average of the years1995 through 2011

Sources: Federal Statistical Office, Deutsche Bank

Foreign direct investment increasing 24

Stock of German corporate FDI by sector*, 1995=100



* Based on NACE codes; the NACE codes refer to the industrial affiliation of the foreign companies targeted for investment

Source: Bundesbank

investment decisions here too, and lower energy prices abroad were no guarantee in the past that the investments would be a commercial success.

Likelihood of decline in sales and domestic gross value added

Further above-average increases in energy prices in Germany are likely to leave energy-intensive companies facing declines in sales and gross value added (absolute declines or lower growth) going forward. A major reason for this is that the higher costs – ceteris paribus – also lead to higher product prices, resulting in lower demand (assuming demand is price elastic). Based on a rough-and-ready model and three different assumptions/scenarios we have calculated potential losses of sales for the energy-intensive industries.[13] In doing so we assumed that the downturns in all the industries are worse in their foreign markets than in their domestic market because price competitiveness is hit harder abroad than at home (foreign peers face smaller increases in energy costs). In the first scenario (small increase in energy costs in absolute terms and relative to foreign peers), we assumed that 1% of domestic sales and 3% of foreign sales are lost. In the second scenario the downturns assumed are 2% and 7.5%, respectively. In the third scenario (strong increase in energy costs in absolute terms and relative to foreign peers), we calculated sales declines of 3% at home and 10% abroad. We did not specify an exact year by which the sales declines would materialise. This will probably occur over the space of several years (catchphrase: barely perceptible process).

If these relative losses are set in relation to the absolute turnover of the four sectors in 2012, this would equal a total sales loss of roughly EUR 5 bn in the first scenario and about EUR 16 bn in the third. Taken together, they would span a range from just under 2% of total sales to just over 6%. The chemicals industry would probably register the biggest percentage loss because foreign sales are highly significant for that sector (over 2% in the first scenario and 7% in the third). Building materials would likely be the least vulnerable (between 1.6% and 5.1%); however, the sales declines would be significant here, too.

Admittedly, the meaningfulness of this calculation is partly impaired by the fact that it is based on simplified assumptions and disregards feedback or second-round effects as well as spill-over effects on other sectors. Nonetheless, we attach a very real probability to the possibility of sales declines – depending on the shape of the energy and climate policy regime. At any rate, they provide a point of reference for the general magnitudes to be discussed. In certain subgroups (e.g. those with a particularly high degree of energy intensity) the sales declines could prove to be even larger.

If the potential relative losses (from just under 2% to just over 6%) were applied to gross value added, the calculations outlined above would indicate declines of between EUR 1.5 bn and EUR 4.7 bn in domestic gross value added in the sectors affected. Here, too, second-round effects and interaction with other sectors are not taken into account.

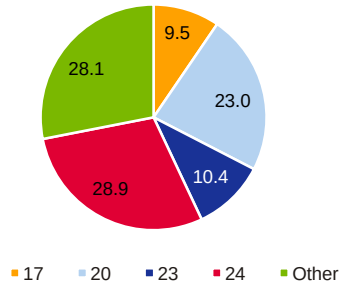
Declining CO_2 emissions in Germany

An interesting issue to look at now is the extent to which CO_2 emissions could fall owing to a potential decline in domestic gross value added in the four energy-intensive sectors analysed. To put this issue roughly into perspective we

[13] In this context, we confine our analysis to declines in sales and gross value added affecting the energy-intensive industries mentioned in footnote 11, knowing full well that such declines also lead to changes in economic activity in upstream and downstream industries and services (e.g. reduced demand for intermediate goods and transport services; possibly higher demand for substitute goods).

Energy-intensive sectors account for over 70% of final energy consumption 25

Share* in final energy consumption of mining and manufacturing sectors, 2011, DE, %

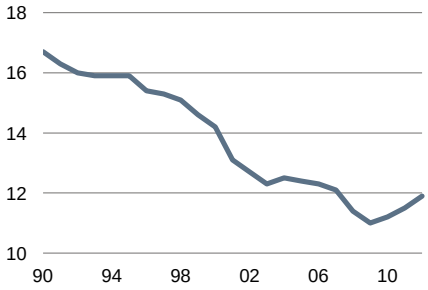


* Based on NACE codes; the combined mining and manufacturing sectors are responsible for 21.6% of final energy consumption in Germany

Source: AG Energiebilanzen

Manufacturing industry starting to regain importance in the US 26

Manufacturing's share in GDP (%)



Source: Bureau of Economic Analysis

applied the declines in value added estimated in the scenarios to the CO_2 emissions recorded in the individual sectors. Since there is no official data available on CO_2 emissions in a breakdown that dovetails with our sector definitions, we had to make do with a rough approximation. As a starting point, we took the figures for final energy consumption published by the Arbeitsgemeinschaft Energiebilanzen (AGEB), as these are available for the four energy-intensive sectors in question. We set Germany's entire CO_2 emissions against this final energy consumption reading and, to simplify matters, assumed that regardless of economic activity and energy source each unit of final energy consumption would result in the same CO_2 emissions, which is true on average. This means that, according to the AGEB, the energy-intensive industries accounted for 21.6% of final energy consumption in 2011 and thus – on a rough estimate – also for 21.6% of the CO_2 emissions in Germany (over 172 million tonnes of CO_2 in 2011).

Taking this simplified calculation, a 2% decline in domestic value added due to higher energy costs would be equivalent to an annual reduction of CO_2 emissions totalling 3.4 million tonnes. Given a 6% downturn in value added there would be over 10 million tonnes less CO_2 emitted. Based on Germany's total CO_2 emissions this would be equal to a reduction of 0.4% to 1.3% (second-round effects were disregarded). As discussed above, German companies' corresponding investment activity abroad is likely to boost CO_2 emissions in the respective locations. The recent announcements of plans by German chemicals companies to invest in the US might be considered as empirical evidence. So it appears that global CO_2 emissions are at the least unlikely to decline (and if higher transport volumes are factored in they may even increase).

5. Conclusion and outlook

If energy costs for industry keep rising faster in Germany than in other countries over the next few years, energy-intensive companies' reluctance to invest in new plant, which can be proved empirically, is set to continue. At the same time, these companies' investments abroad will tend to pick up[14], which is why value added and CO_2 emissions in Germany are likely – ceteris paribus – to decline, while those abroad increase.

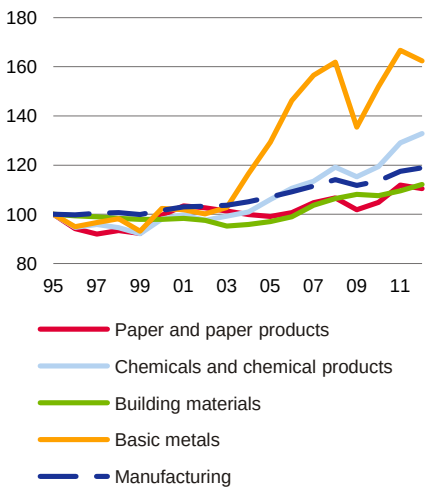
Germany has a vertically integrated industrial value chain. Energy-intensive companies are often found at the beginning of this chain. They deliver inputs to manufacturers of machinery and equipment, electrical equipment and motor vehicles, for instance, who are not energy-intensive producers per se. It is often to their advantage that these companies are located in close proximity to one another and form research alliances that are supplemented via close ties to universities and other research institutions. This integrated value chain is an important key to Germany's success as an industrial location.[15] If one link in the chain is weakened, this causes a strain on the other links. If, for example, energy-intensive companies invest less, their innovativeness may suffer in the medium term, which would have negative consequences for customers. Furthermore, rising energy costs will also result in higher purchase prices for the buyers of energy-intensive inputs. Thus, heavy strains on energy-intensive operations would also spill over onto downstream industries. Moreover, even the products on which Germany is pinning its hopes to provide positive stimuli for the success of the Energiewende or achieve greater energy efficiency (e.g. plastics reinforced with carbon fibre, which requires a very energy-intensive production process) are also hit by higher energy costs.

[14] See DIHK (2013). Auslandsinvestitionen in der Industrie 2013. Berlin.
[15] See Bardt, Hubertus and Hanno Kempermann (2013). Folgen der Energiewende für die deutsche Industrie. Cologne Institute for Economic Research (IW). IW-Positionen Nr. 58. Cologne.

Carbon leakage: A barely perceptible process

Sharp upturn in metal prices in particular 27

Producer prices, Germany, 2000=100



Source: Federal Statistical Office

All in all, the developments outlined in this report point to the dilemma associated with a purely national or regional climate policy drive: climate change is a global externality. Excessively high energy prices or climate policy regulations in one country will lead in the short-to-medium term not to globally falling CO_2 emissions, but merely to their being shifted elsewhere – at least in internationalised industries. Germany's energy and climate policies should take these correlations into consideration. In order to stop the barely perceptible process of de-industrialisation and carbon leakage, Germany should either join forces with Europe to achieve faster progress and more stringent targets in international climate protection or else curb its own pace. With regard to Germany's Energiewende at least, more market-based instruments need to be deployed and better account needs to be taken of their respective interaction with other factors. Furthermore, there is a need for greater coordination at the European level. The focus has to zero in more closely on the efficiency potential in the buildings segment in particular. There is no doubt that exemption regimes will have to apply to energy-intensive companies facing international competitors in the future, too.

Germany's new government addressed several of these aspects. However, the measures announced will probably not suffice to stop further increases in energy prices in Germany. The conflicting targets of demanding energy and climate policies and "affordable" (i.e.: stable or only moderately rising) energy prices quite obviously cannot be resolved for the time being.

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Printed by: HST Offsetdruck Schadt & Tetzlaff GbR, Dieburg

Print: ISSN 1612-314X / Internet/E-mail: ISSN 1612-3158