SRU German Advisory Council on the Environment

Environmental Report 2016 - An integrated approach to environmental policy: The way forward

Chapter 2:

Ambitious climate protection and industrial competitiveness

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Section 2

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2 Ambitious climate protection and industrial competitiveness

2.1 Introduction

89. Germany has traditionally been a major industrial nation with a robust export sector. The German manufacturing sector has great weight in the EU, in that it accounts for an above-average share of the nation's gross value added (22 per cent). Hence, the German industrial sector is a major employer and a major driver of the country's affluence. However, it currently also accounts for around 30 per cent of Germany's energy consumption. The sector's direct emissions (excluding indirect emissions resulting from the use of purchased electricity and intermediate input) account for around 20 per cent of the nation's greenhouse gas emissions. In view of the ambitious energy and climate policy goals being pursued under the federal government's *Energiewende* (energy transition), Germany's industrial sector has a key role in achieving the attendant goals. Industry's part to play is to reduce the sector's energy consumption and greenhouse gas emissions by improving energy efficiency as well as to develop marketable energy-efficient and environmentally benign products and processes.

90. Fears have been expressed by industrial sector stakeholders that the *Energiewende* could place companies that operate in Germany at an economic disadvantage and undermine their competitiveness at the international level, by virtue of climate and energy policy burdens engendered by rising energy costs and unforeseeable regulatory framework conditions. The public debate on this issue has thus far centred on the potential economic risks for the German industrial base (e.g. putting industrial value chains and innovation clusters at risk) as well as the ecological risks entailed by carbon leakage (see item 122) that could stem from ambitious energy and climate policies.

However, for the industrial sector energy costs are only one of numerous location factors that in many cases (depending on the industry in question) may be a lower-priority criterion. A strong SMU sector, highly skilled workers, cooperative arrangements and networks for R&D, a high capacity for innovation (particularly for technology development), and a high level of internationalization are only some of the competitive and location factors that Germany has going for it. Structural change in the industrial sector and offshoring in a number of industries are oftentimes driven by fundamental economic developments, rather than being the consequence of an excessive energy policy burden: for instance, the growing international division of labour and the rapid development of emerging economies are leading to the emergence of increasingly important non-domestic markets, which in turn are attracting production capacity.

Nonetheless, with rising energy costs, Germany could potentially become an unprofitable location for the manufacture of some energy-intensive products. Hence the national and European Union measures aimed at avoiding carbon leakage and maintaining competitiveness are justified in some cases. However, given that the large scale regulatory relief granted to the industrial sector entailed by this goal could undermine incentives to reduce energy consumption, these measures need to be reviewed with a view to potential reform options in order to ensure that they are suitable for their intended purposes.

91. Ambitious national and EU energy and environmental policies will open up opportunities for companies to develop innovative technologies, and thus gain a competitive advantage in international markets for "green" products (see chapter 1). Germany has historically pursued relatively ambitious environmental policies, and has even managed to strengthen its position as a competitive industrial nation with a robust export sector. The German economy has often benefited from these ambitious environmental policies, in that comparable ambitious environmental policy instruments have been adopted subsequently in other countries, too – thus enabling German companies based on their competitive advantage to position themselves, at an early stage, in the relevant markets with innovative technologies.

Ambitious energy and climate policies can spur innovations particularly in the field of energy efficiency. These innovations can open up business opportunities for technology suppliers, while at the same time reducing industry's energy costs. That said, Germany's industrial sector has thus far failed to satisfactorily take advantage of the opportunities provided by ambitious efforts to improve energy efficiency – which are of key importance against the backdrop of a decarbonization strategy. Although the relevant potentials, barriers, drivers, and instruments to promote industrial energy efficiency are all well known, the economic potential in this regard has yet to be fully leveraged.

92. The present chapter discusses the tension between environmental and industrial policy; it addresses the issue whether ambitious environmental policies undermine Germany's international competitiveness or, on the other hand, rather strengthen German industry. This issue is discussed in terms of energy and climate policy, with a main focus being on the central role played by industrial energy efficiency. The main concerns borne constantly in mind by the German Advisory Council on the Environment (Sachverständigenrat für Umweltfragen – SRU) in assessing the industrial ramifications of ambitious energy and climate policies are, apart from the economic impact of such policies, above all their environmental impact both domestically and globally. Chapter 2.2 contains an analysis of the structure of Germany's industrial sector and the role played by energy costs in it. Chapter 2.3 discusses the possible risks of relocating production and of carbon leakage that could be induced by unilateral climate policies.

Chapter 2.4 discusses the prospects of Germany's industrial companies optimizing their energy efficiency in response to rising energy prices. Also discussed in this regard are the opportunities for technology leadership that innovations in the field of energy efficiency could generate. Chapter 2.5 discusses possible options for reforms of the regulatory relief provisions in the realm of both the EU emissions trading system (EU ETS) and national energy policy levies. Chapter 2.6 concludes and describes prioritized recommendations for possible further action.

2.2 Energy costs in the German industrial sector

2.2.1 The German industrial sector

93. Germany is historically an industrial centre and one of the world's major industrial nations. The manufacturing sector is a vital part of the German economy, in terms of value creation, employment, and incomes. In recent years, this sector has consistently contributed to gross value added (production value minus intermediate input, i.e. the value created solely via production processes) on a high level, i.e. between 22 and 23 per cent (EU average for 2012: 15 per cent); around 18 per cent of Germany's entire workforce is employed in the industrial sector. Moreover, with a share of 30 per cent, the German industry makes the largest contribution to the gross value added of the European industrial sector, followed by the industries of Italy, France and the UK (Eurostat 2014b; Statistisches Bundesamt 2015b). In terms of GDP, Germany is the world's fourth largest economy, after China, the US and Japan (IMF 2014). In 2012, Germany's industrial sector generated turnover amounting to €1.74 trillion, 45 per cent of which was achieved abroad (Statistisches Bundesamt 2015a). Exports are one of the major drivers of German economic growth. Germany is the world's third largest export nation, accounting for 7.7 per cent of worldwide goods exports, after China (11.2 per cent) and the US (8.4 per cent) (2012 figures; WTO 2013).

The relatively low level of net capital investments on the part of German industrial companies is sometimes regarded as an early indicator of Germany's impending de-industrialization as the result of climate and energy policies (BDI 2015; VCI 2014). Whereas writedowns exceeded investments during the economic crisis of 2009 and 2010, this trend has now been reversed, with net capital investments of €5.9 billion (in 2014). However, this represents a mere 0.2 per cent of GDP. In particular, certain energy-intensive industries are currently still registering negative net investments (Statistisches Bundesamt 2015c).

94. Germany's manufacturing sector consumes around one third of the nation's final energy, with 75 per cent of this energy being used for heating purposes (AGEB 2015). This sector also accounts for the lion's share, i.e. 47 per cent, of the country's net electricity consumption (AGEB 2014; BDEW 2015). In 2012, the manufacturing sector generated process related emissions of around 63 million tons CO_{2eq} as well as direct energy related emissions of around 121 million tons CO_{2eq} (UBA 2015). Hence, Germany's industrial sector is directly responsible for more than 20 per cent of the country's greenhouse gas emissions, thus making it the country's second largest emitter, after the energy sector. Indirect energy related emissions attributable to electricity purchases by industrial companies come in addition. Germany's industrial sector has reduced its direct energy related emissions and its process related emissions by 35 per cent, relative to 1990 levels. These carbon emission reductions were largely achieved until 2005, among others through economic restructuring. Since then, the sector's emissions remain widely constant (UBA 2015).

95. Germany's industrial sector is diversely structured, i.e., it has a complex specialization structure. It has, above all, developed a well-positioned SME sector that makes a major contribution to the stability and value creation of the German industry as a whole. The German industrial sector to some extent still has closed value chains, but also participates in the international division of labour (see section 2.3.2). Hence it is necessary to adopt a differentiated view of the country's industrial sector. In terms of energy consumption, roughly the following two classes of companies can be distinguished:

– Companies whose energy consumption is average or below average and whose energy cost ratios are relatively low, without regulatory exemptions being granted.

– Energy-intensive companies and processes whose energy costs are reduced by virtue of preferential regulatory treatment, with a view to preserving their international competitiveness.

2.2.2 Differing relevance of energy costs

96. In 2012, the average share of energy costs for German industrial companies was 2.1 per cent of gross output – a figure that has remained widely constant in recent years (Statistisches Bundesamt 2014b; BMWi 2014a). Certain high-turnover industries that are also major employers have relatively low shares of energy costs relative to gross output, e.g. the manufacture of motor vehicles and the mechanical engineering industries (0.8 and 1 per cent respectively). Hence rising energy costs are unlikely to have a major impact on the competitiveness of companies in these industries.

And then there are industries that are classified as energy-intensive. In the manufacturing sector, these industries are paper/cardboard; glass/glass products; nonmetallic minerals; basic chemicals; metal production; non-ferrous metals; and foundries. These industries account for 12 per cent of Germany's industrial gross value added (Statistisches Bundesamt 2014a). However, these energy-intensive industries account for 64 per cent of industrial final energy consumption – and thus account for the lion's share of industrial greenhouse gas emissions (ROHDE 2013; UBA 2015). It is necessary to adopt a differentiated view within these industries as well, in that only certain products or processes are particularly energy-intensive, e.g. ethylene and chlorine production in the basic-chemicals industry. Inasmuch as energy-intensive industries are responsible for the major portion of overall industrial energy consumption and carbon emissions, robust incentives to increase energy efficiency and reduce carbon emissions are needed for these industries. But such incentives need to be realized in a manner that avoids carbon leakage risks that are a matter of concern particularly for energy-intensive industries (see chapter 2.3).

Fuel prices

97. Hard coal and petroleum are energy sources that are traded internationally and whose prices are formed in the global market – and are thus similar in various regions of the world. But on the other hand, consumer prices for energy vary from one country to another, owing to differences in taxation and other price elements that are determined by government policies. Price formation for the line-dependent energy sources, gas and electricity, is different in principle: besides domestic taxes and levies, their prices are influenced by regional and technical factors.

98. Electricity costs currently account for nearly two thirds of total energy costs in the German industrial sector, up from only slightly more than half in 2000 (BMWi 2014a). A comparison of final customer electricity prices in European Union member states reveals that, for German industrial companies, these prices are higher than the EU average (Eurostat 2014a). However, the actual comparability of prices between the various member states suffers from a lack of uniform requirements for electricity price reporting.

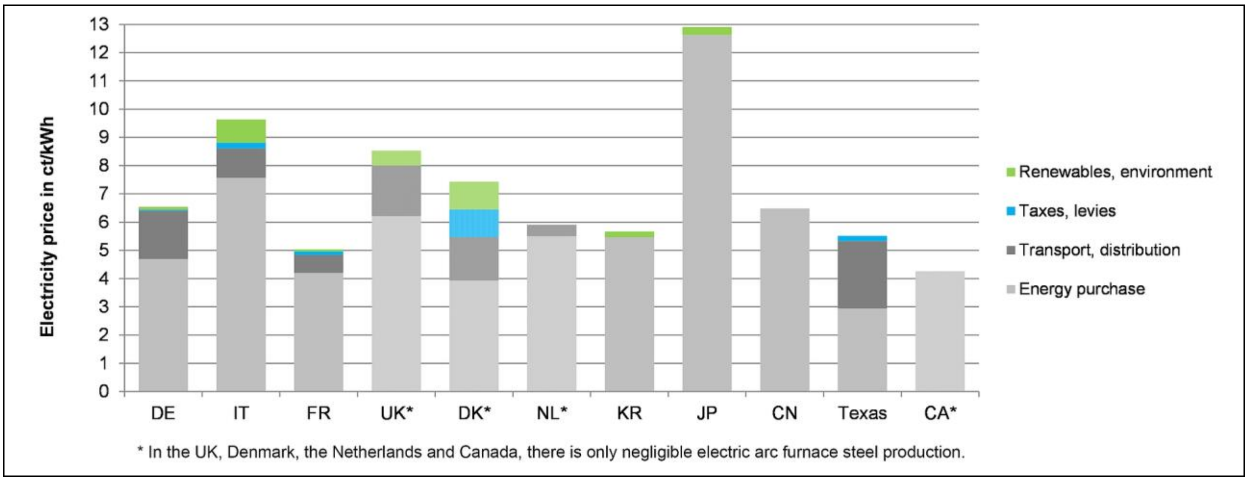
99. The effective electricity price for industrial customers varies, and is determined by the extent to which tax, levy and surcharge relief is granted (e.g. renewables surcharge or grid fees). The extent of such relief increases as absolute levels, intensity, and continuity of electricity consumption rise (BMWi 2014c; GRAVE und BREITSCHOPF 2014; KÜCHLER and WRONSKI 2014; GRAVE et al. 2015). Relatively speaking, large industrial customers regularly pay considerably lower taxes, levies, fees and the like than SMEs; the latter oftentimes do not reach the thresholds that have been set for such relief. Larger companies, on the other hand, exceed these thresholds and can thus profit from the attendant privileges (see item 156, 178). For example, under the special compensation provisions of the German Renewable Energy Act (EEG), electricity-intensive companies are required to pay the full amount of the EEG surcharge for the first gigawatt hour, before the relief from the renewables surcharge takes effect (Article 64 EEG 2014). This can become particularly problematic in cases where companies of varying sizes manufacture comparable products, as is the case with paper manufacturing for example (FRIEDRICHSEN and AYDEMIR 2014).

Electricity-intensive large companies normally incur lower than average specific electricity procurement costs per megawatt hour. Electricity prices are either negotiated bilaterally by utilities and major electricity consumers, or the latter purchase their electricity either directly or via intermediaries on the electricity exchange. Electricity-intensive large companies pay wholesale prices, which tend to follow the prices on the electricity exchanges (EEX futures trading; EPEX spot market). Both spot market and futures trading prices are trending downward in the European Union (BMWi 2014a; GRAVE and BREITSCHOPF 2014; PESCIA and REDL 2014).

The end-customer electricity prices for companies that use more than 150 GWh of electricity annually are subject to numerous privileges, and thus will normally be considerably lower than average industrial electricity prices. But as these actual (i.e. reduced) prices are not incorporated into government statistics, published studies are based solely on estimated figures – thus resulting in inadequate transparency concerning the electricity price burden of the companies in question. The SRU recommends that an aggregated and anonymised database be established for industrial electricity prices, in a manner that complies with data privacy laws, with a view to bridging the current transparency gap and enabling competition-related considerations to be better factored into relief schemes. A recent study (GRAVE et al 2015) analysed industrial electricity prices (net of granted regulatory relief) for an exemplary electric-steel company (127 MW, 572 GWh, electricity costs account for 22 per cent of gross value added) in each of the following countries: Germany, The Netherlands, France, the UK, Italy, Denmark, the state of Texas in the US, Korea, China, and Japan. The study found that for all of these countries, the lion's share of electricity prices is accounted for by direct purchasing costs in terms of wholesale electricity prices (see Figure 2-1). German electricity prices lie somewhere in the middle relative to EU prices. In Texas and Korea, prices are lower, whereas the prices in Japan are substantially higher. A comparable analysis of chlorine alkali electrolysis reveals that German chlorine manufacturers pay below-average electricity prices. Only in France and the USA do chemical companies pay lower electricity prices than their German counterparts (GRAVE et al. 2015). In the absence of price relief, the exemplary German companies that formed the subject of the study would pay more than double for electricity, relative to the prices they now pay. This could jeopardize the competitiveness of their products. However, it is not possible to reach general conclusions concerning the impact of these factors on the competitiveness of different industries (ibid.).

Figure 2-1

Comparison of electricity prices paid for electric-steel production



SRU/UG 2016/Figure 2-1; data source: GRAVE and BREITSCHOPF 2014

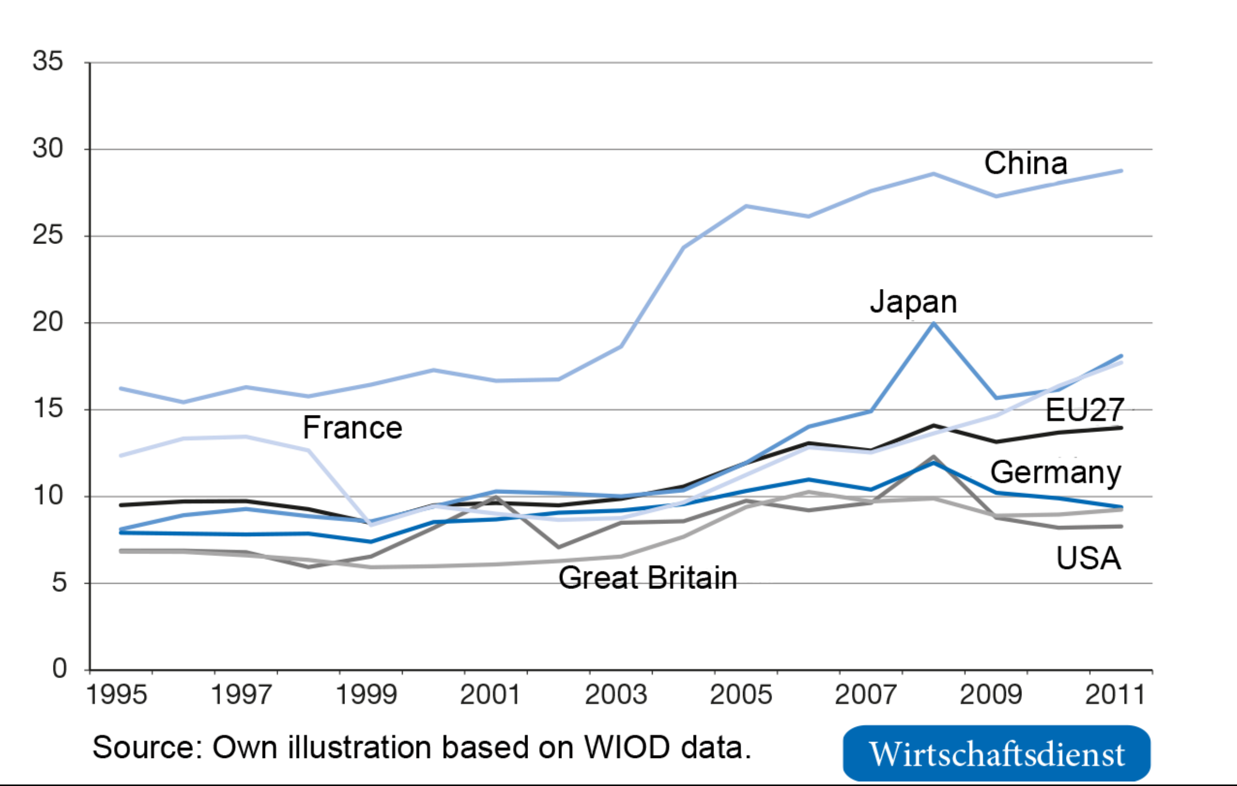
100. Although one would normally expect the expansion of renewables to drive down electricity-exchange prices by virtue of their low variable costs, phasing out coal-fired power plant capacity could initially drive up these prices (see REITZ et al. 2014; r2b energy consulting and HWWI 2014; SRU 2015). Policy instruments should be designed in such a way that (a) they have a moderate impact on electricity prices; and (b) this impact is taken into account for the special arrangements granted to privileged companies. If wholesale electricity prices rise, the renewables surcharge will be lower, so that the final customer electricity price rise for non-privileged electricity customers would be lower than for privileged customers.

Energy unit costs

101. Energy unit costs are a more robust indicator of energy costs burden than energy carrier prices. “Energy unit costs” are defined as the cost of energy use per unit of gross value added (European Commission – Directorate-General for Economic and Financial Affairs 2014). Energy unit costs rose in the German industrial sector from 7.9 per cent in 1995 to 11.9 per cent in 2008, and declined to 9.4 per cent in 2011 (see Figure 2-2). Over time, energy unit costs in the German industrial sector have remained continuously below the EU-27 average, are comparable to the low energy unit costs in the US and the UK, and are substantially lower than the costs for several important competitors such as China, Japan, France and Italy (GERMESHAUSEN and LÖSCHEL 2015; LÖSCHEL et al. 2014a). Germany’s favourable position in terms of energy unit costs reflects the overall structure of the German industrial sector. Germany specializes in high quality products that create value. Owing to this specialization structure, German industrial companies are less affected by rising energy prices than, for example, enterprises in China, which manufacture more energy-intensive products that create less value. This underscores that rising domestic energy prices do not have a major impact on the international competitiveness of the German industrial sector as a whole. But such price rises can in fact negatively impact the competitiveness of certain products.

Figure 2-2

An international comparison of energy unit costs in the industrial sector



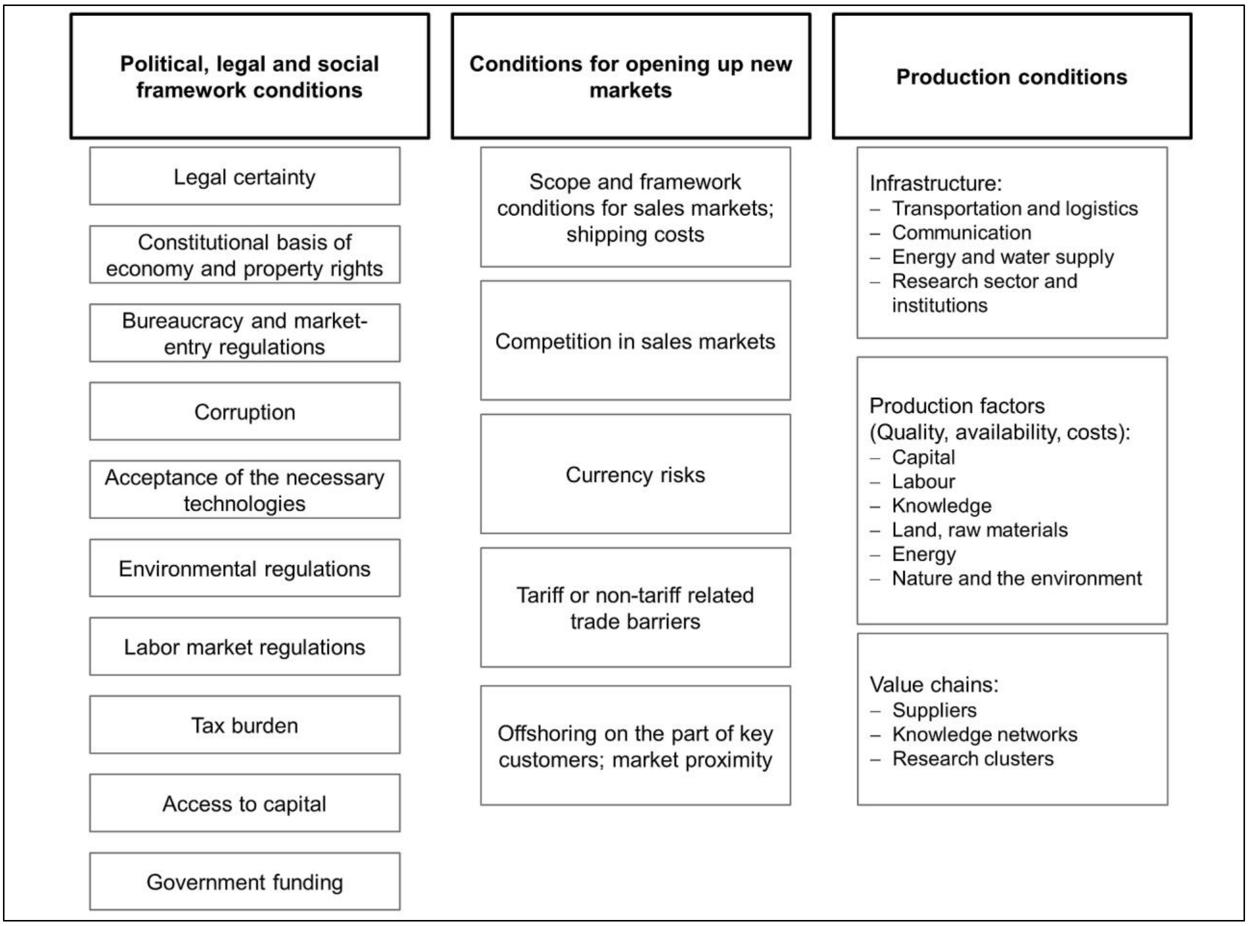
Source: GERMESHAUSEN and LÖSCHEL 2015

2.2.3 Industrial location factors

102. In Germany, a connection is often made between rising fuel prices and industrial-location disadvantages or a loss of competitiveness – and the related risk of declining production and employment. "Competitiveness" is generally defined as a company's capacity to prevail over its competitors in a given market. The factors that determine a company's competitiveness hinge only partly on the characteristics of the company in question; a company's competitiveness is also strongly affected by regulatory frameworks such as environmental policy (MECKE 2015; GAWEL and KLASSERT 2013). Energy costs are only one of a number of criteria when it comes to selecting an industrial location (see Figure 2-3).

Figure 2-3

Industrial location factors



SRU/UG 2016/Figure 2-3; data source: BERLEMANN and TILGNER 2006

103. A vast number of indices and surveys attest to the fact that the location quality and international competitiveness of German industrial companies are high (above average), notwithstanding the fact that the methods used and the underlying assumptions vary to some degree (European Commission 2014b; Deloitte 2012; CALAHORRANO et al. 2012; GRAVE et al. 2015; and as regards the German economy in general: The World Bank 2013; SCHWAB and SALA-I-MARTÍN 2014; EY 2015; VÖPEL and WOLF 2015; MILLER et al. 2014; A.T. Kearney 2014; IMD Business School 2015; GWARTNEY et al. 2015). Germany's main economic strengths are as follows:

– A stable regulatory framework (a high degree of legal certainty, market-based ground rules, little corruption, robust anti-monopoly instruments, transparency)

– Intense integration in national and international networks

– A strong technology orientation and high-quality products

– Innovative strength and outstanding R&D capabilities

– A modern, efficient and reliable infrastructure

– A robust SME sector

– A highly skilled workforce and an educational system that combines occupational training and classroom teaching ("duale Ausbildung").

104. The above mentioned studies arrived at critical assessments concerning the following factors:

– Demographic change; a possible shortage of skilled workers in the future

– Complex bureaucracy (particularly for SMEs), as manifested by strict labour-market regulations, and the German tax system

– Costs attributable to red tape, taxes, salaries, energy

– Policy-planning uncertainty entailed by the *Energiewende*

– Declining level of government investments in the country’s infrastructure.

105. All things considered, Germany offers numerous advantages as an industrial location and thus enjoys an above-average favourable position on the international playing field.

2.2.4 Foreign activities

106. Globalization of the economy, and of the societal and policy spheres, has increased over the past two decades. With regards to the economy, developing countries and emerging economies are in general growing more rapidly than established industrialized economies (LANG et al. 2015). Hence the declining (in relative terms) market shares of the latter are mainly attributable to the rapid growth of developing countries and emerging economies. Moreover, established industrialized countries grow from a much stronger baseline in terms of industrial production levels. For example, in 2014 per capita GDP in Germany amounting to USD 47,773 was around six times higher than in China (USD 7,571) and 30 times higher than that of India (USD 1,607). And if up-and-coming developing countries and emerging economies have a higher per capita GDP growth rate (e.g. China’s is 7.3 per cent compared to Germany’s 1.6 per cent), Germany’s absolute per capita GDP growth amounting to USD 764 is considerably higher than that of China amounting to USD 553 (IMF 2015a; 2015b). What’s more, the growth experienced by emerging economies opens up new markets for the export products of industrial nations such as Germany; and this in turn strengthens Germany as an industrial location.

107. The German industrial sector is well positioned internationally. The level of internationalization activities of German companies has risen since the mid 1990s, peaking in 2003 (ZANKER et al. 2013). Whereas (in absolute terms) German intersectoral foreign direct investments rose, the relative importance of the manufacturing sector in this regard has declined (see Table 2-1).

Table 2-1

German foreign direct investments

	2000	2012	Trend
German foreign direct investments (in billions of euros)	520	1.162	↑
– of which investments made by German manufacturers	34 %	23 %	↓
– of which investments in offshore manufacturing capacities	24 %	16 %	↓

SRU/UG 2016/Tab. 2-1; data source: Deutsche Bundesbank 2015

Offshoring first and foremost involves company-specific decisions that also hinge on intra-industrial linkages and on product related factors (GRAVE et al. 2015). According to a representative survey of German manufacturers, around 20 per cent of the aggregate production capacity of German industrial firms is located abroad. Foreign activity correlates positively with company size; whereby four out of every five German companies with more than 1,000 employees now have production capacities abroad (ZANKER et al. 2013).

108. More than half of all foreign production capacities has been established in member states of the European Union, mainly in Eastern Europe. The remaining capacities are mainly in Asia (primarily China) and North and Central America (ZANKER et al. 2013; DIHK 2014).

109. Surveys have shown that establishing foreign production capacities are less of a disadvantage to German domestic locations (LANG et al. 2015; ZANKER et al. 2013; DIHK 2014). Two-thirds of the respondents stated that foreign production bolsters their German locations, or even makes them more secure. However, this does not apply to small companies: for every second firm production abroad results in in the elimination of domestic production (LANG et al. 2015). In this context, investments made in Germany tend to be conservation and modernization investments (62 per cent), whereas foreign investments are made for the purpose of establishing new capacity or expanding existing capacity (54 per cent) (ibid.).

110. It is rare for all business activities to be offshored. Activities involving a high level of skill such as R&D and company management are for the most part carried out in Germany, as is the lion’s share of production operations. Activities that need to be carried out in close proximity to foreign customers, or that require relatively simple preliminary work are increasingly being offshored (LANG et al. 2015). Thus, industries whose products entail a high proportion of relatively unskilled manual labour such as the makers of data processing devices, electrical devices, and lenses, as well as companies in the garment industry, are among the most offshoring-intensive branches (ZANKER et al. 2013).

111. The main reasons for a company to invest in offshore locations are lower production costs than at home as well as market access and the opportunity to open up new markets. Regional markets tend to expand rapidly in up-and-coming developing countries and emerging economies. Foreign locations enable German companies to open up new markets and circumvent export barriers. In such settings, companies also invest in the establishment of marketing and customer service organizations. For example, direct contact with key customers is crucial; also, proximity to customers makes it easier to manufacture products that are tailored to the needs of specific customers (ZANKER et al. 2013; DIHK 2014; GRAVE et al. 2015). Hence manufacturing cost is gradually becoming less important as a reason for companies to invest abroad (ZANKER et al. 2013; DIHK 2014; LANG et al. 2015).

One out of every four offshoring projects is ultimately relinquished. Among the main reasons why German companies return home are the following: problems with production quality; low productivity; underestimated costs for internationalization activities (ZANDER et al. 2013).

112. All things considered, it is clear that the industrial sector is a major asset for Germany, in terms of employment, economic growth, and standard of living. Industrial competitiveness is a complex phenomenon comprising manifold relevant factors. In this regard, electricity and carbon emission allowance prices play a relatively minor role for non-energy-intensive companies. Germany is very well positioned and well regarded, relative to other international players. Establishing production facilities abroad by German companies appears to bolster parent-company competitiveness rather than to be a sign that Germany is in the process of deindustrialization.

2.3 Carbon leakage risks: a possible consequence of ambitious climate policies?

113. Fears have been regularly expressed that the German energy transition and ambitious EU climate policies could pose a threat to Germany as an industrial location, meaning that ambitious energy and climate policies could potentially weaken the structure of the domestic industrial sector and lead to offshoring (HEYMANN 2013; 2014; KEMPERMANN and BARDT 2014). Besides declining economic capacity and rising unemployment, evolutions of this nature are also associated with undesired environmental consequences in the form of carbon leakage (AICHELE and FELBERMAYR 2011; 2012; 2015). These concerns will now be addressed by, first, describing the theory of energy cost-related offshoring and carbon leakage risks. This theory will then be discussed in light of the available empirical evidence which, as yet, is lacking valid proof of the occurrence of any significant offshoring or carbon leakage effects. Factors and mechanisms will also be briefly discussed that need to be taken into account when assessing the overall effectiveness of unilateral European Union or national climate policy measures.

2.3.1 Possible offshoring paths

114. Climate and energy policies can potentially drive up production costs for domestic industrial goods. Such climate policy-induced production cost increases can be the consequence of direct energy consumption pricing (e.g. via emissions trading or increased taxes and levies) or of regulations requiring that production processes be modified (The World Bank 2015a, p. 12 ff.). Insofar as domestic industrial goods are in competition with goods produced abroad that are not subject to equally stringent climate policy measures, the price competitiveness of the domestic goods – or their profitability (if the increased costs are not passed on to customers) – will suffer. This can lead to offshoring. A rough distinction can be made between two different paths to offshoring, according to their nature and timeline. Furthermore, a distinction between direct and indirect effects needs to be made.

Short-term offshoring: the production path

115. The first path pertains to climate policy-induced regional relocation of production activities within existing production capacities – a path that mainly unfolds in the near to middle term (MARCU et al. 2013). Energy policy-related increases in variable production costs can lead to a reduction in domestic production volume and capacity utilisation of the industries in question – and to a rise in production activities in foreign countries whose climate policies are less stringent.

Long-term offshoring: the investment path

116. The second path that can lead to the offshoring of industrial value creation is the investment path (MARCU et al. 2013, p. 4; The World Bank 2015a, p. 15; REINAUD 2008, p. 31). This path involves offshoring induced by changes in investment activities resulting from unilateral climate policy measures. If such measures weaken the competitive position of domestic goods and reduce the return on investment of domestic production capacities, domestic replacement or new investments may be avoided, and investments may be made instead in countries with less stringent environmental regulations. Whereas the aforementioned offshoring via the production path constitutes a response to changes in short-term production costs of existing capacities, offshoring via the investment path unfolds against the backdrop of longer-term investment cycles. As previously noted, decisions concerning new production facilities and replacement investments involve far more factors than just energy prices (see section 2.2.3).

Indirect offshoring effects resulting from weakened value chains

117. Apart from offshoring risks for industries that are subject to direct exposure to rising energy prices, concerns are often expressed relating to potential risks arising from indirect effects that could result in long-term weakening of the German industrial sector (KEMPERMANN and BARDT 2014; HEYMANN 2014;

FELBERMAYR et al. 2013; BARDT 2014). Indirect effects could affect both upstream and downstream domains of the value creation chain. It is thought that one of the main drivers of the enduring success of the German industrial sector is its tight integration within domestic value chains, which plays a key role in ensuring high product quality and facilitating innovation (LANG et al. 2015; BARDT and KEMPERMANN 2013; BDI 2013). Thus, indirect threats to competitiveness and subsequent offshoring risks could also arise from negative effects on such value chains. Individual elements – particularly energy-intensive sectors – exiting the value chain could have an adverse effect on Germany's economic capacity and capacity for innovation (KEMPERMANN and BARDT 2014; BARDT 2014). This holds true in particular for innovations which develop – from a systemic perspective – in innovation clusters along the value chain. However, the aforementioned tight integration of the German industrial sector within domestic value chains could also be regarded as a counter-argument to the theory that energy-intensive industries will respond to rising energy prices by offshoring (NEUHOFF et al. 2013; LANG et al. 2015, p. 15; IEA 2013, p. 279). Offshoring production capacity would rob companies now integrated within domestic value chains of their system advantages.

118. Offshoring risks can also arise in cases where the sectors that are directly affected by rising energy prices are not directly exposed to international competition – that is, if the goods they produce are not widely traded in international markets. If the rising production costs of energy-intensive intermediate products are passed through downstream the value chain, the international competitiveness of downstream sectors that are themselves not (directly) energy-intensive may suffer (FELBERMAYR et al. 2013; AICHELE et al. 2014). In many industries, the indirect costs entailed by intermediate products exceed the direct energy costs (LÖSCHEL et al. 2015, p. 94 ff.).

119. The risk that rising energy prices will lead to offshoring is not solely dependent on the level of international competition in the industries directly affected, but also on the levels of competition in industries that further process the intermediate products becoming more expensive (FELBERMAYR et al. 2013). In view of the other advantages of production locations in Germany, the risk that companies will move their production offshore owing to moderate cost increases in some value creation domains can be regarded as relatively low. Moreover, it should also be recalled that industrial value chains are in any case already highly internationalized. As noted in section 2.2.4, there is no evidence that this internationalization has weakened Germany's manufacturing sector; indeed, the opposite appears to be the case.

120. Even though it appears to be questionable whether such inter-sectoral effects could engender deindustrialization risks in case of (moderate) energy price increases, the economic interdependence of domestic value chains should henceforth be given greater weight in assessing the impact of energy policy measures. Sound knowledge of the indirect effects of rising energy costs on industrial competitiveness is essential when it comes to minimization of offshoring risks by means of targeted regulatory relief and the concurrent preservation of incentives to use energy more efficiently. Hence, further research is needed in this area.

2.3.2 Impact on global greenhouse gas emissions: carbon leakage risks

121. From a climate protection perspective, the main yardstick for the assessment of both national and EU energy and climate policy measures is their impact on global greenhouse gas emissions. Hence, the sections that follow discuss how global greenhouse gas emissions could unfold in the course of economic adaptation to changes in climate policy. The interaction between unilateral climate policies and emission levels outside of the regions subject to climate policy regulations is discussed in terms of carbon leakage.

Definition of carbon leakage

122. Carbon leakage means an increase in greenhouse gas emissions which, while resulting from region-specific climate policy measures, occurs outside of the regions that are subject to climate policy regulations. A measure for the strength of this effect can be found in the Intergovernmental Panel on Climate Change's definition of carbon leakage (IPCC 2007, p. 224), according to which the emission increase outside of the regulated regions should be considered in relation to the emission reductions that are achieved in domestic regions subject to regulations.

Key to determining carbon leakage effects is the existence of a causal relationship between (a) the domestic and foreign changes in emission levels that are taken into consideration; and (b) the climate policy measures that are undertaken in the relevant regulated domestic regions. Hence, the carbon leakage rate attributable to (regional) efforts to reduce greenhouse gas emissions constitutes a metric for their relative effectiveness from a global standpoint.

$$Carbon\ Leakage\ Rate = \frac{\Delta Emissions\ abroad\ (outside\ the\ regulated\ region)}{-\Delta Domestic\ emissions\ (inside\ the\ regulated\ region)}$$

Regulatory gaps and carbon leakage

123. While offshoring and carbon leakage can generally occur in regions where unilateral climate policy measures are undertaken or reinforced, such evolutions are essentially seen as problematic in cases where unilateral measures accentuate differences in climate policy ambition between regions that have direct or indirect trade relations with each other (The World Bank 2015a, p. 11).

In light of the Paris Agreement, it is no longer possible to speak in terms of Germany or the EU going it alone in the climate protection arena. Climate policy activities are also on the rise in many non-EU countries, which is underscored not least by the nationally determined (emission mitigation) contributions that came out of the Paris process. Noteworthy in this regard are the latest developments in China and the US, which are the world's two largest economies and key trading partners of Germany and the EU. Besides a vast number of other measures, climate policy activities outside the EU often involve the pricing of greenhouse gas emissions, via the establishment of emissions trading systems for instance (The World Bank 2015b). Apart from domestic emissions trading systems such as those found in New Zealand and South Korea, regional emissions trading systems are currently being established (or are in the planning stages) in China and the US, which account for the lion's share of worldwide greenhouse gas emissions. These regional trading systems could ultimately lead to (or in the case of China are intended to lead to) emissions trading at the national level. Hence, it seems reasonable to assume that carbon leakage risks attributable to domestic and EU climate protection efforts will diminish over time. As long as significant international differences persist in terms of climate policy regulations in the industrial sector, however, the risk of carbon leakage should be adequately taken into account in policymaking (see chapter 2.5).

Emission intensity: a determinant of the carbon leakage effect

124. In cases where production is moved offshore to regions with less stringent climate regulations, the extent of carbon leakage is determined by the manufacturing conditions in the relevant "target" locations. The key factors in this regard are (a) the energy-intensity of the production process, which is in turn mainly determined by the technology being used; and (b) the (marginal) greenhouse gas emission intensity of the energy supply. Taken together, these two factors constitute the greenhouse gas intensity of the production process. The higher the greenhouse gas intensity in the "target" location in question and the lower this intensity in the "home" location, the stronger the carbon leakage effect will be. In cases where for climate policy or other reasons industrial production is relocated to new, modern factories abroad, or if the energy supply there is less greenhouse gas-intensive (e.g. because electricity is being supplied via hydropower), relocation may result in the decarbonization of industrial production. Owing to rapid economic growth in many emerging economies, the production facilities there are often equipped with the best available technologies (IEA 2015; NEUHOFF et al. 2014). Particularly in cases where production is relocated from regions whose energy mix entails a high degree of coal use, offshoring may well lead to the decarbonization of production (BOSCH and KUENEN 2009). Given the aforementioned definition of carbon leakage, even in such cases one has to still speak of carbon leakage. This is because normally at least part of the reductions in domestic emissions will be offset by increased emissions abroad, although a net reduction in global greenhouse gas emissions will be achieved.

Carbon leakage via the energy price path

125. Apart from carbon leakage attributable to offshoring via the production and investment path, (cross-sectoral) carbon leakage effects can also occur via the energy price path. A climate policy-induced reduction in domestic demand for fossil-fuel energy reduces the price of such energy; this can at the same time lead to an increase in fuel sales outside of the regions subject to climate policy regulations (PAROUSSOS et al. 2015, S. 208; The World Bank 2015a, p. 15). Carbon leakage via the energy price path is no industry-specific mechanism, but instead occurs largely without regard for the sector in which the domestic use of fossil energy resources is reduced as the result of climate policy measures. Inasmuch as this section mainly focuses on the risk of offshoring and the ecological implications thereof, this carbon leakage path will not be discussed further below.

2.3.3 Domestic mitigation measures and carbon leakage via EU emissions trading

126. The effectiveness of individual climate policy measures is also determined by their interplay with the general climate policy framework. In particular when it comes to national measures, their interplay with the EU Emissions Trading System (EU ETS) is of paramount importance. The EU ETS sets caps for greenhouse gas emissions from stationary installations in the industrial and electricity generation sectors. With a binding cap, reduced greenhouse gas emissions on the part of the German industrial sector would be neutralized by additional emissions from other emitters that fall within the purview of the EU ETS and that use those emission allowances that become available. Hence, national mitigation measures would have no net impact on aggregate EU emissions. In other words, national measures to reduce industrial greenhouse gas emissions would, via the EU ETS that leads to intra-EU carbon leakage, exhibit a carbon leakage rate of 100 per cent at a minimum. In cases where domestic industrial emitters are relocated to countries outside the scope of the EU ETS and where they are not subject to another cap, global greenhouse gas emissions would increase – even if industrial production processes in such "target" countries were relatively climate friendly.

127. However, in light of the current state of and foreseeable reforms in the EU ETS, the validity of this line of argument needs to be called into question (SRU 2015). Given the current massive surplus in the allowances market (expected to persist in the coming years), the EU ETS cap is at present not a binding restriction (EEA 2014; Agora Energiewende 2015). Hence when it comes to the current and foreseeable medium-term market situation, allowances that become available as the result of reduced industrial emissions in Germany would not be used by other emitters within the EU ETS, but would instead further swell the total surplus. Thus, in the near to medium term, greenhouse gas emissions in the European Union would effectively fall.

In the future, elevated allowance surpluses will be transferred to an EU ETS Market Stability Reserve (MSR) that will also allow such surpluses to be placed back on the allowances market in case allowances are in relatively short supply (European Parliament und Rat der Europäischen Union 2015; European Commission 2014e). The MSR is intended to correct imbalances in the allowances market, with a view to ensuring stable framework conditions and a flexible and economically efficient path to emissions reduction (GILBERT et al. 2014). A larger stock of allowances in the MSR would also give EU climate policy additional room for manoeuver in terms of permanent additional emission reductions. A full reserve would make it easier to set ambitious objectives for the EU ETS. If stricter climate goals lead to fewer allowances being issued, returning MSR allowances to the market would enable avoiding a steep rise in allowances prices and thus in emissions reduction costs. And while, in such a case, actual emissions would exceed the tightened (future) emissions goals for the EU ETS sectors, total cumulative emissions would still decline by virtue of the fact that filling up the MSR implies over-fulfilment of earlier goals. By bringing forward the (additional) emission reductions, the MSR mechanism would lead to a cost-reducing smoothing out of the mitigation path (GILBERT et al. 2014). Alternatively, MSR allowances could be permanently taken out of circulation, instead of being put back on the market in their entirety. Thus, the textbook argument – that additional efforts to reduce greenhouse gas emissions in the German industrial sector would in the best case scenario be ineffective on a global scale, or could even be counter-productive due to carbon leakage – is no longer valid in the context of a differentiated view.

2.3.4 Relevance of carbon leakage risks

128. Determining carbon leakage rates is a highly complex undertaking, as regards the methods used and the amount of data involved. Studies of the actual relevance of carbon leakage effects have yielded widely differing results. The majority of the quantitative studies aimed at estimating the potential scope of carbon leakage are based on models whose results are largely determined by the assumptions made. Besides economic parameters used for these models, the results are essentially driven by the exact design of climate policy instruments as well as assumptions on measures taken to reduce carbon leakage. Hence, estimated carbon leakage rates vary widely (HEALY et al. 2015; PAROUSSOS et al. 2015; The World Bank 2015a, p. 18 ff.), from an overall negative carbon leakage effect (i.e. a multiplier effect attributable to unilateral climate policy), to rates upwards of 100 per cent, equivalent to a global emissions increase. However, very high carbon leakage rates have only been found using extreme modelling assumptions (e.g. perfect substitutability of domestic by foreign industrial production). The majority of the results are considerably lower than 25 per cent, which would mean that only a fraction of domestic reductions in greenhouse gas emissions would be neutralized by an emissions increase abroad. However, it is not possible to reach general conclusions concerning the intensity of carbon leakage effects. What is needed instead is an analysis that factors in the exact design of climate policy measures and their specific contexts.

129. Initial evaluations of both of the EU ETS trading periods that have been completed reveal no significant carbon leakage attributable to offshoring industrial activities (PETRICK and WAGNER 2014; BOLSCHER et al. 2013; GRUBB et al. 2009; BRANGER et al. 2013; The World Bank 2015a, p. 24 ff.; 2015b, p. 59 ff.; HEALY et al. 2015). In view of the relatively short time horizon involved, these results are mainly relevant for production leakage; but for conclusive results concerning investment leakage, a longer period of review will be needed. However, owing to the generous emission allowance allocation rules for the industrial sector and the low allowance prices that prevailed during most of the period in question, it is not possible to draw any general conclusions from the results of the studies. But there appears to be a tendency for ex-post studies to find that carbon leakage is lower than projected by ex-ante studies (HEALY et al. 2015; The World Bank 2015a; 2015b, p. 58 ff.). This may be caused by the latter studies tending to underestimate the potential for mitigating greenhouse gas emissions, and to overestimate the related mitigation costs and price elasticities.

With a view to the German *Energiewende*, there is as yet no robust evidence that fears of steady deindustrialization of Germany and accompanying carbon leakage are justified; nor is Germany's growing trade surplus consistent with a deindustrializing economy. And while the observed investment reluctance in the German manufacturing sector (Statistisches Bundesamt 2015c) merits greater attention, there is as yet no robust evidence of a causal relationship between this phenomenon and the *Energiewende*. As with the EU ETS, when evaluating the impact of the *Energiewende* it should be borne in mind that the German industrial sector has been granted various forms of relief. When it comes to making investment decisions, for the vast majority of German industrial companies, stable energy policy frameworks appear to be of greater importance than moderate differences in energy costs. Accordingly, when it comes to domestic relief provisions, legal certainty and a stable regulatory environment count for more than relieving energy policy-related burdens to the highest possible extent.

130. Quantitative analyses of carbon leakage impacts generally face numerous methodological and data related difficulties. For example, estimating carbon leakage risks for industries that are only indirectly – via supply chains – affected by climate policy measures is particularly challenging. Moreover, empirical analyses struggle to clearly distinct between the impact of energy and climate policy on the one hand and general economic globalisation trends on the other (e.g. increased international division of labour, or accelerated shifting of sales markets into rapidly growing emerging economies). This can easily result in the carbon leakage impact of ambitious climate policies being overestimated (DECHEZLEPRÊTRE and SATO 2014).

2.3.5 Global emission reductions attributable to the diffusion of technology

131. This chapter has thus far focused on the risk of "positive" carbon leakage resulting from manufacturing and investment offshoring in regions with less strict environmental regulations. In this regard, "positive" carbon leakage means that greenhouse gas emissions rise abroad as the result of domestic climate policies. However, unilateral climate policies can also result in a reduction of greenhouse gas emissions in countries with less stringent environmental regulations, and thus can exert a negative carbon leakage effect (BARKER et al. 2007; GERLAGH and KUIK 2014; GOLOMBEK and HOEL 2004). Ambitious unilateral energy and climate policies often induce technological progress (NEWELL et al. 2006; POPP 2002; POPP et al. 2010) which, by dint of technology diffusion, can have a positive impact on the environment at global scale. In countries that are in the vanguard of progressive climate policies, energy-saving and climate-friendly technologies are being developed and undergo cost degression. Once such environmentally benign technologies become beneficial (from an enterprise standpoint) in regions with lower energy prices and that do not set a price on greenhouse gas emissions, their global diffusion accelerates. In emerging economies in particular, such phenomena can bring about tremendous improvements (so called leapfrogging) for production technologies (DECHEZLEPRÊTRE et al. 2011; GLACHANT et al. 2013). Such spill-over effects from innovation are especially prevalent for "clean" technologies and in energy-intensive industries (DECHEZLEPRÊTRE et al. 2013). In view of the rapidly growing demand for energy-intensive products in emerging economies, technology diffusion can open up a vast emission reduction potential. Retarding the current pace of innovation in Germany and the EU through the adoption of hardly ambitious climate policies might slow the pace of technological progress toward more climate friendly production methods at the global level as well.

132. Eventually, the relationship between ambitious climate policies (including in energy-intensive industries) and carbon leakage impacts is not as straightforward as is often assumed. Domestic emission reductions brought about by ambitious industrial sector climate policies by no means need to be ineffectual at the global level on account of the economic responses and carbon leakage effects they trigger. Decarbonization of industrial production would be well within reach both domestically and internationally if technological innovations were catalysed by ambitious climate policies, and if offshoring were prevented by targeted relief for domestic industries. In this case, unilateral climate policies on the part of Germany and the European Union would even generate multiplier effects via the technology path. The industrial-sector economic opportunities that are opened up by climate policy induced technological leadership are discussed in sections 2.4.2 and 2.4.3.

2.4 Policy options I: energy efficiency as a potential driver of competitiveness for the German industrial sector

133. The impact of rising energy prices on competitiveness is determined, among other factors, by the extent to which companies are able to respond to energy price increases by reducing their energy consumption. Hence this section addresses the following issue: What kinds of opportunities does implementing energy efficiency measures, in response to ambitious energy and climate policies, open up for manufacturers to enhance the competitiveness of the industrial sector and for Germany as a production location? The German industrial sector tends to regard energy cost savings resulting from energy efficiency more as a ripple effect of their investments than as a factor that can increase productivity and maintain economic competitiveness. However, industrial energy efficiency can in fact be regarded as an "energy resource" (IEA 2014a). By increasing their energy efficiency, companies can reduce both their energy consumption and energy costs, strengthen their competitiveness and at the same time further the cause of climate protection (ECEEE 2014; IEA 2014b). This leads to new markets and business segments for providers of energy efficiency technologies and services (IEA 2014a).

German industrial companies have in the past leveraged existing energy efficiency potential, but at the same time have largely failed to fully exploit the attendant numerous business opportunities (see section 2.4.1). Although many investments in energy efficiency potentially generate a high internal rate of return and are thus cost efficient, German industrial companies are reluctant to implement such investments owing to a number of barriers. Section 2.4.2 discusses the economic advantages of energy efficiency when it comes to enhancing competitiveness, and analyses the barriers that remain in connection with the current policy instruments. The need for reform of such instruments that emerges from this analysis is intended to address the remaining barriers and market failures (most of which are hardly ever noticed, if at all) and at the same time set the stage for the use of positive factors in a targeted fashion.

2.4.1 Evolution of energy efficiency in the German industrial sector

134. Germany's industrial sector currently accounts for around 30 per cent of the country's total final energy consumption (BMWi 2015). The government has set a goal, for 2050, of increasing final-energy productivity (i.e. the ratio of gross value added to adjusted final energy consumption) by 2.1 per cent annually across all sectors, relative to 2008 (BMWi and BMU 2010; assumption in the corresponding study: 0.8 per cent annual GDP growth; see SCHLESINGER et al. 2010). This would cut the consumption of primary energy by around half in 2050.

Over the past two decades, the German industrial sector has steadily increased its energy efficiency by an average of around 1.3 per cent annually based on gross value added (excluding intermediate input), and by around 1.9 per cent based on gross output (including intermediate input, material use, use of commercial goods, wage labour and so on) (LÖSCHEL et al. 2014b). However, this positive development only emerges from the statistics if structural effects are disregarded. Focussing on more recent developments (i.e. over the past decade), a breakdown of the relevant factors clearly shows that improved energy efficiency is attributable solely to structural effects induced by factors such as (a) the shifting of demand to less energy-intensive industries between 2000 and 2008; and (b) the economic crisis between 2008 and 2010 (SCHLOMANN et al. 2014). Assuming the existence of an industrial sector with a constant structure, adjusted for the monetary value of structural effects and thus focussing on technically induced energy efficiency progress, the study (SCHLOMANN et al. 2014) even found a marginal (0.1 per cent) annual increase in energy intensity from 2000 to 2012. Moreover, a comparison of energy efficiency in Germany and other European Union countries (likewise assuming an industrial sector with a constant structure) shows that the energy efficiency of the German industrial sector is close to the European Union average, but is by no means in the vanguard of energy efficiency (Enerdata 2015).

2.4.2 Economic advantages of energy efficiency

135. Companies tend to improve their profitability if they implement energy efficiency measures and/or sell products and services that are energy efficienct (see section 2.4.3). Companies that implement energy efficiency measures in order to reduce their energy costs become more competitive by virtue of the cost reductions attributable to such measures; while at the same time the reduction in their carbon footprint aids the cause of climate protection. If a company ramps up its capital investments, then capital use supplants energy use. The company optimizes its energy productivity and benefits over the long term from energy cost reductions (PEHNT et al. 2009). Companies that deal extensively with end customers in particular can also benefit from the improved corporate image stemming from an increased energy efficiency (JOCHEM et al. 2014). Moreover, synergies can occur between improved energy efficiency and reduced material use, emission reductions, or greater production capacity. For companies, energy efficiency measures can engender strategic competitive advantages, and can mitigate the impact of rising energy prices and the dependency on changing-policitical framework conditions (such as laws and regulations).

Reduced energy consumption helps to improve security of energy supply and reduce dependence on imported energy – which in turn reduces companies' vulnerability to energy price fluctuations (IEA 2014a). Taken together, all of the aforementioned effects translate into an increase in aggregate economic productivity, and improvement in the German industrial sector's foreign trade situation. Second-round and multiplier effects such as increased income tend to induce other positive economic effects as well (PEHNT et al. 2011). However, actual reductions in energy consumption hinge on both direct and indirect rebound effects. Direct rebound effects are brought about by changes in user behaviour such as more frequent use of an energy efficient automobile (see item 197); whereas indirect rebound effects are attributable to changes in consumption patterns such as purchasing an additional product (BMUB 2015; for an overview see SORRELL 2007 and van den BERGH 2011). However, quantifying and evaluating the scope of such effects, particularly of the indirect rebound effect, is a challenging task.

2.4.3 New markets: a potential boost to domestic value creation

136. According to the International Energy Agency (IEA), a strong growth is expected in energy efficiency markets (IEA 2014b). In addition, a BMUB (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety) report on green technology classifies the energy efficiency market as one of the six leading markets in the run-up to 2025 (BÜCHELE et al. 2014). On the supply side, ambitious energy efficiency policies can boost innovation; whereby energy efficient capital goods can open up new markets and enable the manufacturers and suppliers of such goods to strengthen their market positions at an early stage, via quality leadership (ECEEE 2013). The government has been helping German companies to leverage growth opportunities in foreign markets via a programme launched in 2007 known as *Exportinitiative Energieeffizienz* ("Energy efficiency export programme"), which assists companies via dedicated agencies (BMWi and BMUB 2014a). According to an evaluation of this program, it has had a positive overall effect thus far, ascribed by companies in particular to the slogan *Energieeffizienz* ["energy efficiency"] – *Made in Germany* (FINKEL et al. 2013). In light of rising resource prices in the medium and long run as well as increasing international efforts to curb global warming that are also expected to boost the growth of energy efficiency markets), the currently sizeable market shares of German manufacturers provide a solid foundation for these companies to enhance quality leadership and further revenue growth in the various fields of technology (see item 17). Tapping into these new markets early on will enable German manufacturers to gain price and cost advantages by virtue of learning curves and economies of scale resulting from the size of their domestic markets. And this will in turn strengthen the medium and long-term market positions of German companies both at home and abroad, it will have a positive impact on their competitiveness (LEHR et al. 2012; WALZ et al. 2008; BEISE and RENNINGS 2005). This will also provide them with a sound basis for further growth, including in other technological fields.

2.4.4 Factors that promote or hinder the realization of economic energy efficiency potentials

137. Energy efficiency enables industrial companies to respond to rising energy prices in promising ways – and can at the same time boost their competitiveness. That said, the considerable bottom-line benefits that are offered by energy efficiency potential across sectors are not being exploited as regards both cross-cutting technologies and highly heterogeneous industrial processes. Numerous studies have investigated the scope and evolution of energy efficiency potentials in the industrial sector. Whereas some conservative or reference scenarios that are predicated on a business-as-usual perspective find that energy demand is rising, numerous German and international studies, whose results vary according to the sector being investigated, nonetheless demonstrate the existence of considerable untapped energy efficiency potentials (BRAUNGARDT et al. 2014; PEHNT et al. 2011; GRAICHEN et al. 2011; SEEFELDT et al. 2007; AGRICOLA et al. 2013; FLEITER et al. 2013). And while the data and premises for these studies vary (in that differing industries, timelines, interest rates and definitions of “potential” are used as a basis for calculations related to economic measures or for assumptions concerning policy measures on which scenarios are predicated), thus precluding direct comparisons of these studies, they nonetheless come to similar conclusions. Taken together, tapping into all of the energy efficiency potential in the German industrial sector could more than halve its energy consumption by 2050. The economic potential in this regard is not evenly apportioned, but instead depends on the technologies involved and varies from one industry to another.

138. Based on a business-as-usual assumption meaning that no further relevant policy measures will be taken, energy demand in the European Union is seen as rising in the run-up to 2050 (BOßMANN et al. 2012). But exploiting existing economic energy efficiency potentials in the German industrial sector could halt rising energy demand. However, an increase in total industrial energy demand cannot be avoided in the long run merely by moderately increasing energy efficiency. What is needed instead is to pursue the goal of decoupling energy intensity from economic growth, by means of ambitious and above all mandatory energy saving targets – and thus generate significant energy savings. Assuming that best available technologies can be disseminated on a large scale and that new organizational, product and process innovations can be achieved, greater energy efficiency allows for low cost realization of substantial potentials in terms of reducing carbon emissions and the consumption of energy resources (IEA 2009).

Barriers

139. In view of the substantial economic energy efficiency potentials involved, the question arises as to why these have not been fully exploited, despite their benefits for companies’ profitability. In the literature, there is a broad consensus concerning the current discrepancy between the implementation of energy efficiency measures that are seen as being economic in nature (i.e. constituting an achievable goal) and the extent to which such measures are actually implemented (i.e. the status quo). This phenomenon is referred to as the energy efficiency gap (JAFFE und STAVINS 1994; SORRELL et al. 2011; 2000). The barriers that mainly cause this phenomenon vary across branches of industry and according to company size.

In small and medium-sized companies, a lack of information is a primary barrier, which can take the form of factors such as inadequate knowledge of process details, or lack of knowledge about energy consumption and ways to increase energy efficiency. Moreover, smaller companies tend to lack staff who are experts on energy related matters, and for capacity reasons tend to focus on their core businesses (GRUBER and BRAND 1991). Oftentimes other investment priorities or a lack of capital for the implementation of energy efficiency measures prevent companies from taking action (FLEITER et al. 2012). And when it comes to making capital investment decisions, the methods used by many companies to evaluate potential investments are often questionable. Focusing mainly on how long it takes an investment to pay off and on the amount of the investment often leads to a situation where even economic measures whose internal rate of return is upwards of 30 per cent are not implemented (JOCHEM et al. 2010).

Apart from cross-sectoral barriers, there are also sector-specific obstacles to the implementation of energy efficiency measures that are often attributable to process-specific factors (e.g. changes in the compound-energy supply of integrated smelting works). Regulatory uncertainty and risk aversion can also cause companies to be reluctant to implement energy efficiency measures (ROHDIN and THOLLANDER 2006). This holds true in particular in connection with the uncertainty, feared by companies, in the production related context of energy efficiency measures, e.g. concerns about untoward product or process attributes, quality problems, and problems with production processes.

Driving factors

140. Apart from the numerous barriers that make companies reluctant to implement energy efficiency measures, some studies have also identified factors that promote the realization of such measures. These studies are based on interviews and quantitative surveys (CAGNO und TRIANNI 2013; THOLLANDER et al. 2013; ROHDIN and THOLLANDER 2006) that in some cases yield subjective assessments on the part of respondents. The institutional and organizational factors that promote energy efficiency are as follows: the existence of an energy management and efficiency benchmarking system; a commitment to efficiency on the part of management; management sensitivity to energy related matters; and highly motivated employees who are interested in energy related matters (ibid.). Other factors that come into play in terms of investment decisions and the degree of motivation in energy issues are socio-psychological factors such as the extent to which stakeholders such as staff members in charge of energy issues, purchasing agents and machine operators are accepted in a social group (JOCHEN et al. 2010). Other key factors that promote energy efficiency measures include the following: a long-term strategy for energy related matters (ROHDIN and THOLLANDER 2006); synergies between improved energy efficiency and other corporate goals (e.g. reducing emissions and material use); positive impacts on a company's image.

2.4.5 Legislative framework for energy efficiency policies

141. For industrial companies affected by rising energy prices, improving their energy efficiency makes good sense, as doing so offsets energy price increases and enables them to remain internationally competitive. On the one hand, policy makers can remove barriers to the realization of energy efficiency measures, via suitable measures and instruments – which in turn advances the implementation of economic energy efficiency measures. On the other hand, companies still need to be committed to such measures and to self-organization; whereby companies can – cost effectively, on their own, and without government assistance – roll out economic energy efficiency measures that promote competitiveness. The following section discusses the policy framework that is needed in order to unlock energy efficiency potentials in light of the barriers discussed above. This section also makes recommendations as to how Germany's current policy mix can address both aspects – namely self-regulation of the business sector and suitable policy measures for its regulation.

142. In light of the current situation, it appears highly unlikely that the energy efficiency goal adopted by the European Commission, entailing a 20 per cent reduction (relative to projections) of primary-energy use by 2020 (European Commission 2007), will be reached, particularly since (unlike the other two goals) it was not possible for this one to be made mandatory. The 2012 Energy Efficiency Directive (2012/27/EU) was intended to provide a major impetus that would result in the closing of this gap (European Commission 2012b). Germany's 2014 *Nationaler Aktionsplan Energieeffizienz* (NAPE; National Action Plan on Energy Efficiency; not to be confused with NEEAP), which is currently being implemented in stages, was adopted so as to enable Germany to (a) comply with its obligation to implement the Energy Efficiency Directive (2012/27/EU); and (b) bridge Germany's energy efficiency gap (BMWi 2014b). Nonetheless, because Germany failed to report full transposition of the Energy Efficiency Directive, in June 2015 the European Commission had launched an infringement procedure ("Commission refers Greece to Court and gives Germany a final warning regarding the transposition of the Energy Efficiency Directive") (European Union press release, 18 June 2015).

143. It is clear, in light of the long-term outlook for the European energy policy, that there is room for manoeuver in terms of greater efforts regarding energy efficiency policy. The goal set by the Energy Efficiency Directive of reducing energy consumption by 1.5 per cent annually in the run-up to 2020 does not go far enough. The 2030 EU energy and climate policy framework, which was adopted in the fall of 2014 (European Commission 2014c), is likewise not ambitious enough, in that it mandates an indicative and non-binding goal of 27 per cent reduction in primary-energy consumption (SRU 2013). Furthermore, the calculation of this goal based on projected reference energy consumption levels is largely predicated on the calculation's discount-rate and economic growth assumptions (HERMELINK and de JAGER 2015). The SRU feels that in doing this, the European Union is missing a golden opportunity to improve energy efficiency. The European Commission will be reviewing this 20 per cent goal in 2020 and may have occasion to raise it to 30 per cent (Europäischer Rat 2014). If the European Union and the German government are really serious about achieving a steady reduction in primary-energy consumption, a reliable political pathway – i.e., ambitious energy efficiency policies – combined with mandatory energy efficiency goals, is urgently needed.

2.4.5.1 Policy instruments for energy efficiency and options for their design

144. Germany currently has numerous energy efficiency policy instruments in place, some of which can be traced back to the Energy Efficiency Directive. They comprise various regulatory and economic instruments, as well as information and funding programmes aimed at utilizing energy efficiency potentials. Inasmuch as Germany is unlikely to reach the EU energy efficiency goal by 2020 (SCHLOMANN et al. 2014), it is urgently necessary that the current mix of policy instruments will be updated and rendered more stringent and rigorous. Moreover, greater efforts need to be made by the industrial sector, which accounts for a huge proportion of Germany's energy consumption. The government's National Action Plan on Energy Efficiency (NAPE) takes the aforementioned factors partly into account, and represents an attempt to consolidate energy efficiency goals, policies and responsibilities (BMWi 2014b). The goal for 2020 that has been set by the government is unlikely to be met, even if the NAPE measures, which pertain to the industrial sector as a whole as well as households, trade and services sectors and buildings, are implemented. Even the report by the *Expertenkommission zum Monitoring-Prozess „Energie der Zukunft"* ("Energy of the future" panel of experts on energy policy monitoring) casts doubt on the adequacy of the NAPE-mandated measures aimed at bridging the energy efficiency gap (LÖSCHEL et al. 2015). Nonetheless, the NAPE does propose some new energy efficiency policy approaches, such as competitive tenders and the establishment of 500 energy efficiency networks by 2020. If such measures are designed ambitious enough, they can go a long way toward reducing industrial energy consumption (BMWi 2014b). Likewise relevant in this regard are (among other things) (a) the top runner strategy for product labelling; and (b) requiring, by December 2015, all large companies (defined as non-SMEs) to carry out an energy audit – a measure which would (in addition to the aforementioned energy efficiency networks) do more to reduce energy consumption than any other measure, as can be inferred from the relevant scientific reports (SCHLOMANN et al. 2014). Although the most recent NAPE related developments in the realm of energy efficiency policy are a step in the right direction, reaching the goal that has been set for 2020 will hinge on timely implementation of the various measures. Such measures that have yet to be implemented (as at copy deadline in December 2015) include competitive tenders, and the top runner program. The only way for these measures to make the desired contribution to achievement of the said goal is to implement them in a timely manner.

In the SRU's view, energy and environmental management systems as well as energy efficiency networks should be introduced in conjunction with benchmarking and data gathering and compiling. This would create incentives for the effective use of energy and environmental management systems as well as energy efficiency networks, and would go a long way toward ensuring that price privileges are tied more robustly to ambitious measures on the part of beneficiaries. It is good to see that the pilot phase of the competitive tenders will be launched, and an evaluation of this phase should be conducted with a view to determining which lessons have been learned, and how the program needs to be optimized (see item 148). Although a detailed analysis and evaluation of the various policy options within the NAPE framework lie beyond the scope of this report, the SRU will now, nonetheless, outline a few of its recommendations in this regard.

Energy management systems in conjunction with benchmarking

145. As early as 2011, the SRU advocated introducing mandatory implementation of energy management systems (EMS's) for industrial companies, in a manner that takes company size and energy intensity into account (SRU 2011, item 410; also see FLEITER et al. 2013). Given the not yet sufficient diffusion of EMS's to date (fewer than 3,500 ISO certificates for such systems were issued in Germany in 2014), the SRU would like to reaffirm this recommendation. EMS's provide tools to capture and monitor the energy consumption of individual companies, help identify energy efficiency measures (SCHULZE et al. 2016), and positively influence the extent to which energy efficiency is prioritized by a given company (SIVILL et al. 2013). These considerations have been taken into account in Germany to a certain degree via implementation of Article 8 of the Energy Efficiency Directive. By virtue of the mandatory energy audits for non-SMEs mandated by the Energy Services Act (EDL-G), it provides an alternative path to implementation of EMS's (BAFA 2015). By law, around 50,000 companies are required to carry out mandatory energy audits (Deutscher Bundestag 2015). The SRU expressly recommends that such companies avail themselves of the opportunity to undertake a mandatory energy audit in conjunction with an EMS rollout, or upon becoming part of an energy efficiency network (BAFA 2015).

Among other things, the quality of the related set of tools is crucial for the implementation of energy efficiency measures; it should be used in conjunction with well-founded knowledge and clear and understandable information, as well as impartial expert advice, with a view to overcoming the barriers to implementation. Actually, the problem here does not lie with a lack of information, but rather with the fact that the right information is not made available to the right target audiences and that companies have to invest considerable effort in figuring out what the information actually means (FLEITER et al. 2013). Thus it is crucial that information and advice be provided (particularly for SMEs), and that the government monitor all such activities. Making information available reduces searching and transaction costs, and promotes transparency concerning the co-benefits of energy efficiency measures (IEA 2014a). Moreover, qualified staff who are aware of the importance of energy efficiency are of particular importance. Hence, Germany's dual system of occupational training and classroom instruction and the relevant university and professional training programmes need to take energy efficiency issues into greater consideration than is currently the case.

146. Benchmarking (company-internal and –external comparisons) can play an important role in energy management. In order for robust sector and process-specific benchmarks to be established, stakeholders in the industrial and business consulting sectors (and where appropriate public administrations) need to cooperate closely and in mutual trust, in order to achieve a high degree of representativeness and homogeneity in the group of companies on the one hand and to ensure data confidentiality on the other (RATJEN et al. 2013).

Learning energy efficiency networks

147. As mentioned above, Germany's National Action Plan on Energy Efficiency (NAPE) mainly involves the establishment of 500 energy efficiency networks by 2020. To this end, in early December 2014 a project known as the Initiative Energieeffizienz-Netzwerke (Energy efficiency network initiative) was launched, and an agreement was reached between the government and Germany's various business associations concerning this launch (BMWi 2014b). The SRU expressly supports such network approach that is based on self-organization of the business sector. PALM and THOLLANDER (2010) showed in their study that differences in corporate culture result not only in differing assessments of the barriers to energy efficiency in the industrial sector, but also in differing assessments of sources of information. Many of the respondents surveyed during this study noted that the expertise of their own colleagues was highly important; and thus knowledge sharing is essential in such settings, and should be encouraged. Moreover, in the interest of reducing transaction costs and gaining greater knowledge about saving energy and ways to put such knowledge to practical use, companies form what are termed *Lernende Energieeffizienz-Netzwerke* (LEEN-Netzwerke; Learning energy efficiency networks), in which 10 to 15 companies in a particular region jointly improve their energy efficiency by sharing their experiences in this domain and learning from each other (GIGLI and DÜTSCHKE 2012; MAI et al. 2014). This approach, which was pioneered in Switzerland, entails the following: providing network participants with advice during the start-up phase in conjunction with an energy review; elaboration of a joint energy efficiency target for the network as a whole; holding regular meetings for purposes of experience sharing and annual progress monitoring. The LEEN management system provides a minimum standard for the establishment and operation of such networks (JOCHEM et al. 2010). Initial empirical evaluations of LEEN networks show that network members invest more in energy efficiency measures and achieve twice as much progress in energy efficiency, relative to industry averages. Moreover, a majority of network members feel that the benefits of membership far outweigh the cost and effort (KÖWENER et al. 2014). At the same time, sharing ideas, problems and solutions in a structured manner and in conjunction with a learning process and knowledge transfer reduce searching and decision making costs (SCHMID 2004; MAI et al. 2014). In the past, competition for the best solutions involving companies and networks striving to meet specific energy efficiency targets has oftentimes even resulted in network goals being exceeded (KÖWENER et al. 2014).

Energy efficiency networks could be an important instrument for opening up new markets (see item 139), by overcoming numerous barriers that existing policy instruments have yet to adequately address – and at the same time leveraging the factors that promote energy efficiency (see item 140). Hence, the SRU recommends that efforts to establish such networks be intensified and encouraged. That said, it is urgently necessary to bear in mind that only a structured and standardized procedure entailing the aforesaid components of network activities can ensure further empirical energy efficiency progress. Here, the LEEN standard could serve as a model. But it is also important to remember that focusing on voluntary participation will probably not suffice when it comes to establishing 500 networks. Tying network participation to the granting of exemptions or other financial incentives could result in more rapid propagation of this approach. Hence, in the SRU's view, companies should seize the opportunity of carrying out Energy Services Act (EDL-G) audits (BAFA 2015) in the context of an energy efficiency network. This would enable companies to benefit from the synergies and advantages of participating in a network – and thus, for example, from the following: setting specific energy efficiency goals; extensive information and experience sharing among subject experts; and establishing and widening their in-house energy expertise (Initiative Energieeffizienz-Netzwerke 2015).

Competitive tenders

148. Competitive tenders concerning measures aimed at improving energy efficiency are a recently under NAPE introduced market based instrument in Germany (BMWi 2014b). No detailed information is currently available as to how this instrument is being configured and applied in practice. In implementing this programme, the government could benefit from experience that has been acquired in Switzerland with a tendering model that has been in use for a number of years (WINKLER et al. 2012). An evaluation, performed after two years, of the programme tranches involving the issuance of open tenders at around six month intervals has shown that the Swiss model leverages, to only a limited degree, its putative advantages relative to other approaches to allocating government funding (PERRIN et al. 2012). The usability and cost effectiveness of this instrument are largely determined by instrument-design related factors such as the following (to name but a few): whether the tendering is open or restricted; whether or not funding can be cumulative; timelines; bidder portfolio diversity; bid evaluation criteria; measurement and verification of energy savings; payment modalities; sanctions; tender-related knowledge of stakeholders. The SRU recommends that the pilot phase of the tendering model be closely monitored, and that all tenders be comprehensively evaluated so as to allow for subsequent optimization of the instrument.

Quid pro quo for regulatory relief

149. The preferential treatment currently being accorded to industrial companies should be contingent upon appropriate quid pro quo measures of the beneficiaries, such as implementing an energy management system, joining an energy efficiency network, or implementing economic energy efficiency measures. Initial approaches in this regard have been realized via the following, for example: amendment of the special equalisation scheme of the German Renewable Energy Act of 2014 (EEG); the German energy and electricity tax laws known as EnergieStG and StromStG, respectively; and the related ordinance on ecotax caps (Spitzenausgleich-Effizienzsystemverordnung, SpaEfV). Under Article 64(1)(3) of the German Renewable Energy Act of 2014 (EEG), all companies are required to have implemented a certified energy management system in order to be eligible for preferential treatment. This also holds true for ecotax caps: in order for a company to get taxrelief, it must introduce a certified energy or environmental management system. The law also stipulates that SMEs can roll out alternative systems to obtain such tax relief. As from 2015, ecotax caps and the scope thereof are contingent upon whether the industrial sector achieves the agreed 1.3 per cent annual reduction in energy intensity (slated to be increased to 1.35 per cent later on); whereby this is verified via an annual scientific report (BMWi 2012). If this target is not reached, the accorded relief is reduced, or can be abolished altogether. Criticism from various sides has been levelled at the target values in this regard, on the grounds that the attendant calculations are adjusted solely for temperatures and business cycles, thus making it easy for companies to achieve these values with little effort, via in-house progress and structural change. In the SRU's view, it is essential that these processes be streamlined and made more rigorous, so as to promote real improvement in energy efficiency.

In Switzerland as a promising example, carbon emission tax reliefs are tied to the extent to which individual companies commit themselves to increasing their energy efficiency – an approach that can be regarded as a best-case example in terms of implementation (BfE 2014). This mechanism has resulted in greater diffusion of energy efficiency networks (referred to as energy models in Switzerland), with membership growing from around 20 companies in 2001 to nearly 2,000 in 2013 (EnAW 2013). Based on the empirical outcomes of energy models in Switzerland and energy networks in Germany, experts predict that in Germany, the impetus generated by making preferential treatment contingent on the quid pro quo of their beneficiaries could result in the establishment of as many as 700 energy efficiency networks in Germany by 2020 (JOCHEM et al. 2010). While the 500-network goal mandated by the German NAPE is a key stepping stone toward achieving this, businesses need to make specific rigorous implementation efforts to achieve this goal.

2.4.5.2 The need for consistent energy efficiency policies

150. Improving energy efficiency is crucial for successfully implementing the *Energiewende*. Achieving this goal will require sending an adequate price signal to the industrial sector. However, this will not be sufficient as regards adopting energy efficiency measures, in view of the existing barriers to the implementation of such measures and the little price elasticity. What is needed instead are long-term integrated energy efficiency policies, aimed at removing the barriers to the realization of pertinent measures, that are bolstered by mandatory energy efficiency targets (SRU 2013). In view of the heterogeneity of such barriers, there is no magic bullet that will allow the entirety of the existing energy efficiency potential to be unlocked cost efficiently. What is needed instead is a cohesive constellation of instruments that address non-economic barriers in particular, comprising regulatory standards, funding policy elements, and guidance and information programs; whereby current instruments that have proven their worth should be maintained, optimized and rendered more stringent. Additionally, new instruments such as competitive tenders could be piloted with a view to initiating a learning process. But it is also important to bear in mind that every new policy instrument encounters an existing constellation of policies, whose interactions and overlaps need to be taken into account beforehand. In many cases, however, policy makers can only provide information that incentivizes and supports implementation. What is likewise needed, however, are commitment and self-organization of the business sector; for after all, this sector is the locus par excellence of expertise, networks (by virtue of trade associations) and above all mutual trust – which plays a crucial role for SMEs. Of particular relevance when it comes to companies investing in energy efficiency are long-term planning certainty and stable policy frameworks.

2.5 Policy options II: targeted relief aimed at avoiding carbon leakage

151. In order to be able to reach the goals agreed upon in the Paris Agreement, policies that result in increased energy costs will probably be unavoidable (see Chapter 3.2). The existing energy efficiency potential would not suffice to offset a substantial rise in energy prices, particularly in energy-intensive sectors. Hence, substantially rising energy prices can jeopardize the competitiveness of companies that make highly energy-intensive products subject to international competition, and therefore entail the risk of carbon leakage. This will hold true if, owing to differences in the ambitiousness of climate policies and their implementation timelines, changes in energy prices attributable to government policy differ considerably between countries whose products are in competition with each other (see item 123).

In such situations, relief measures aimed at avoiding carbon leakage risks and preserving the competitiveness of industries that are particularly hard hit can, in principle, be justified. But such relief needs to be reasonable, and suitable for its intended purpose, and should not engender misguided incentives for not realizing available energy savings potential. The present section is structured as follows: First, basic principles for designing appropriate relief measures are described (section 2.5.1). Next, against this backdrop, current rules governing preferential treatment in the EU (section 2.5.2) and in Germany (section 2.5.3) are scrutinized, and possible reform options in this regard are highlighted. In doing so, the focus is mainly on the upcoming revision EU ETS, which is the EU's main climate policy instrument.

2.5.1 Criteria for designing relief

152. Both the EU ETS and German tax and levy systems grant industrial companies financial relief. As regards the upcoming reform of the EU ETS and of relief measures in Germany, general principles could be drafted, as a guidance for the European Union and the German government.

Effectively reducing the risk of carbon leakage

153. One of the main (and self evident) criteria for the evaluation of anti-carbon leakage instruments is their capacity to actually forestall carbon leakage. Such instruments need to reduce the climate policy related cost difference between domestic production and production in less stringently regulated countries – in cases where products are in competition with each other, particularly in terms of price. When it comes to production leakage risks, the impact of climate policy and relief measures on variable production costs is relevant, whereas the impact on (anticipated) long-term profitability is crucial for investment leakage (see item 115 f.).

Orienting eligibility criteria towards the anti-carbon leakage goal

154. That said, relief should be limited to industries and products where such cost differences entail a substantial risk of causing offshoring and carbon leakage. This applies to goods that are directly or indirectly (i.e. via processed goods) subject to international competition and whose production costs would be considerably higher in the absence of relief. If such relief fails to focus on the aforementioned factors, the positive impact of incentives to reduce emissions is at risk; in addition, public revenues may decrease – with the result that such revenue is no longer available for climate protection measures or needs to be offset via distorting taxes elsewhere.

Furthermore, the scope of relief could be keyed to the scope of carbon leakage risk, such that the extent of relief would increase with the extent to which a company's competitiveness is in jeopardy. In this way, targeting of preferential treatment could be improved. In addition, the pressure exerted by lobbyists in terms of defining which industries are eligible for relief could be eased, and the risk of distorting competition between industries could be mitigated; thus, drawbacks of a binary relief system (i.e. granting either full relief or none at all) in which the decision on being eligible or not has massive financial implications can be overcome.

Maintaining the allocative function of climate cost internalization

155. Relief should generate as little distortion of competition as possible and should avoid impairing the allocative efficiency of markets. Allocative efficiency requires that the prices of all goods reflect their climate costs, thus providing incentives to replace high emissions products by those with a smaller carbon footprint. Hence shifts in competitive positions among different goods in domestic markets induced by changes in climate policy – at the expense of more energy-intensive products – constitute a desirable adaptive response that does not warrant interventions.

Avoiding misguided incentives attributable to discontinuities

156. In the interest of avoiding distortion of competition and misguided incentives, energy consumption related discontinuities in energy levy burden should be avoided wherever possible. Misguided incentives are most prevalent in cases where relief is granted in conjunction with certain energy consumption or energy cost thresholds being exceeded. If the absolute amount of energy policy induced burdens decrease upon reaching such a threshold, companies whose energy costs are slightly lower than the threshold may be tempted to consume more energy than would otherwise be the case. In other words, an ecologically and economically counterproductive drop in energy efficiency could benefit a company's profitability.

In order to avoid such misguided incentives, insofar as possible the eligibility requirements for relief should be defined for specific products, processes and industries, so as to make it more difficult for companies to influence eligibility. This would also help to counteract distortion of competition within individual industries – for example between companies of differing sizes. Such distortion would occur in cases where a number of companies in a given industry reach the threshold that qualifies them for relief, whereas other smaller or more energy efficient companies remain below the thresholds and thus incur significantly higher specific energy costs.

Retaining incentives to improve energy efficiency

157. Granting relief in order to avoid carbon leakage should not result in the economic potential for reducing energy consumption and greenhouse gas emissions remaining unused. For preserving economic incentives to improve energy efficiency, it is important to send a robust marginal emissions price signal. This can be accomplished (in so far as practicable in administrative terms), in particular, by limiting privileged energy consumption via applying product-specific benchmarks. Such benchmarks would indicate energy consumption levels per ton of product eligible for exemptions (free allowances, respectively). Energy consumption and greenhouse gas emissions exceeding ambitious benchmarks would qualify for no exemptions at all, or to a considerably lesser extent. Making the scope of relief contingent upon product related benchmarks would also help to mitigate problems and misguided incentives arising from the (sometimes contentious) allocation of firms to industries as well as from distortion of competition between heterogeneous companies.

Making relief contingent on a quid pro quo

158. Regulatory frameworks should ensure that economic energy efficiency potentials are tapped. Sending a sufficiently robust marginal energy price signal can provide economic incentives for companies to tap their economic energy efficiency potential; it is also possible to require companies to take measures to improve their energy efficiency in exchange for relief (see item 149). In view of the aforementioned barriers to investments in energy efficiency, such quid pro quo arrangements would make sense even in the presence of the said price signal.

A somewhat lower-level requirement of direct quid-pro-quo arrangements would be requiring companies that are awarded relief to introduce an energy management system or equivalent measures. However, identifying economic efficiency potential using an energy management system does not necessarily ensure that such potential will actually be unlocked. Hence, companies could be required to implement economic efficiency improvement measures in exchange for being granted the maximum allowable relief. For this, it would be necessary to define an economic efficiency threshold at which such measures would become mandatory. The feasibility of such an approach at EU and national levels is to be further studied.

2.5.2 European Union level

159. The EU ETS is the primary EU-level climate policy instrument for the industrial sector. By requiring energy-intensive companies to surrender emission allowances commensurate to their greenhouse gas emissions, the system seeks to set prices for greenhouse gas emissions so as to create incentives to reduce them. In order to mitigate the risk of competitive disadvantages on global markets for the European Union's industrial sector (and the related carbon leakage risk), allowance allocation rules are set up in such a way that industrial companies are largely spared additional costs. Apart from being granted free allowances, particularly electricity-intensive industrial companies can receive financial compensation for the costs incurred indirectly via electricity prices resulting from emissions trading. The provisions to relieve the industrial sector from EU ETS burdens have come in for criticism that revolves around the criteria for defining carbon leakage prone industries, and the methods used to grant free allowances.

2.5.2.1 Critical assessment of carbon leakage criteria

The status quo

160. During the 2013-2020 emissions trading period of the EU ETS, emission allowances are being allocated based on classifications of emitting installations. Currently, a distinction is made between three emitter groups for the initial emission allowance allocation. Electricity producers are required to obtain their allowances at auctions. Industrial companies whose international competitiveness is deemed to be jeopardized by the (partial) auctioning of allowances are allocated the volume they need largely, though normally not completely, free of charge (DEHSt 2014). All other companies falling within the scope of the EU ETS initially receive 80 per cent of their need for allowances free of charge. This figure will be reduced to 30 per cent at the end of the current trading period, in 2020, and according to the recent Commission proposal for reform of the EU ETS (European Commission 2015b) will be fixed at this level for the time thereafter. A given company's need for allowances is calculated based on past production volumes, as well as product-specific benchmark carbon intensities.

161. Inclusion in the carbon leakage list – which contains the industries whose competitiveness is deemed to be at risk – is based on the relevant industry's trade intensity and on an EU ETS-related cost burden criterion. A given industry is eligible for inclusion on the list insofar as either its trade intensity or the additional costs it incurs due to emissions trading (pro rata to gross value added) exceed the threshold of 30 per cent. Cost increases in this regard comprise costs attributable to purchases of allowances that cover direct emissions, as well as indirect costs resulting from shifting emissions costs incurred in electricity generation. A given industry's trade intensity is defined as the sum total of exports and imports, divided by the sum total of imports and domestic production. A combined quantitative criterion is also applied, whereby industries whose trade intensity exceeds 10 per cent and whose cost burden is 5 per cent or greater are deemed to be at risk of carbon leakage. Furthermore, industries can also be added to the list based on a qualitative assessment whose criteria encompass the industry-specific market and profit picture, as well as emissions mitigation potential (see Directive 2003/87/EC). Based on these quantitative criteria and the qualitative assessment, around 60 per cent of all industries (which account for around 95 per cent of all industrial emissions under the EU ETS) have been included on the carbon leakage list (European Commission 2015a; de BRUYN et al. 2013, p. 5).

This very broad definition of a carbon leakage risk has come in for criticism (MARTIN et al. 2014; de BRUYN et al. 2013), particularly the one-dimensional thresholds. Neither higher proportional carbon costs nor a high level of trade intensity mean, in and of themselves, that a given industry is at any serious risk of carbon leakage. Hence, the risk in this regard can be presumed to be low for products with high trade intensity but whose carbon costs represent only a negligible portion of total production costs. If a product is hardly traded internationally for reasons such as high freight costs, a substantial cost increase is very unlikely to lead to offshoring. However, in such cases the possible impact on downstream value chains (resulting from cost-intensive intermediate input) that exhibit high trade intensity needs to be taken into account. The vast majority of the industries currently on the carbon leakage list qualify for it by virtue of the trade criterion. For many such industries, the additional costs they incur in foregoing free-of-charge allocation represent less than 1 per cent of gross value added (European Commission 2014d; 2014a). And even if the carbon emissions of such industries are for the most part relatively low, they nonetheless cumulatively represent some 25 per cent of total industrial emissions covered under the EU ETS (de BRUYN et al. 2013, p. 20).

Unlike the carbon leakage list for allowance allocation, the conditions under which compensation can be granted for electricity price increases under the EU ETS comprise a quantitative criterion only; it is up to the individual member states whether to grant such compensation. In order for a given industry to be eligible for electricity price compensation, it must either satisfy the composite criterion comprising trade intensity (10 per cent) and *indirect* (i.e. attributable to electricity prices) additional costs (5 per cent); or apply for being classified (based on a qualitative assessment) as being subject to carbon leakage risk European Commission 2012a).

162. Another point of criticism has been the manner in which additional EU ETS related costs are calculated. As was the case for establishment of the 2013-2014 carbon leakage list, allowance prices for the 2015-2019 period were predicated on €30 per ton CO_2 – despite the fact that both the current and projected allowance price for the next decade is far lower than this amount. Moreover, the cost burden calculations were predicated on a need for purchasing allowances that is greater than what appears to be realistic at present (de BRUYN et al. 2013, p. 23 ff.). The problem with the trade intensity calculation is that it fails to sufficiently factor in climate policies similar to EU policies in non-EU countries (ibid. p. 28 ff.). Climate protection measures similar to EU measures, adopted by non-EU states, eliminate the (substantial) climate regulation gap; and thus the trade intensity figure should be adjusted for trade with countries with likewise ambitious climate protection regulations.

Reform options

163. Hence, reform of the procedure for identifying leakage-prone industries should be predicated on realistic assumptions concerning the actual costs occasioned by emissions trading; moreover, focus should be put on trade relationships with non-EU countries whose climate policies are less stringent. Using such more reality based calculations for trade intensity and additional EU ETS cost burden, these criteria should also be applied more rigorously, so as to allow for elaboration of a carbon leakage list that more accurately reflects the actual risks involved.

Industries that are largely excluded from auctioning based on carbon leakage risks should be subject to international competition and be palpably impacted as to their costs. This reform would result in the criteria for free allowance allocation being more aligned with the criteria for electricity price compensation. The thresholds for automatic inclusion on the carbon leakage list should be stringent enough to avoid implicitly assuming that the competitiveness of the EU's industrial sector is in general at jeopardy. In the case of industries that do not reach these thresholds but for which the risk of carbon leakage cannot be ruled out, qualitative assessments based on standardized procedures should be carried out (GRAICHEN et al. 2013). This type of assessment could be used, for instance, for energy-intensive industries that engage in relatively little trade themselves, but whose downstream value chain competitiveness could be adversely affected by an emissions trading-induced cost increase (FELBERMAYR et al. 2013).

164. On 15 July 2015, the European Commission issued draft recommendations for reform of the approach for identifying the risk of carbon leakage, for the fourth trading period of the EU ETS (2021-2030) (European Commission 2015b). In principle, these recommendations constitute an improvement, in that they solely provide for a combined quantitative criterion, which is determined by multiplying trade intensity by CO_2 intensity (the latter being kilogram of CO_2 per euro of gross value added). If this figure exceeds 0.2 for a given industry, it is allocated allowances free of charge, in accordance with the maximum benchmark CO_2 intensity. If, in a given industry, this figure ranges from 0.18 to 0.2, this industry can also be allocated allowances free of charge, in accordance with the maximum benchmark CO_2 intensity – but subject to a qualitative assessment. For all other products that are not included on the carbon leakage list, free-of-charge allocation remains at 30 per cent of the benchmark CO_2 intensity.

In view of the very low threshold of the combined criterion, such a reform would not do much to sharpen the focus of the current anti-carbon leakage rules. While such a reform would cut down the list by around two thirds to circa 50 industries, this reduction would mainly affect industries with high trade intensities, but whose costs are barely affected by emissions trading. However, these industries represent only around 2 per cent of the industrial emissions covered under the EU ETS (European Commission 2015a).

Hence, this threshold value – which automatically entitles the industries that reach it to be allocated free allowances to the maximum extent – should be raised so as to make the carbon leakage list a more precisely targeted instrument and reduce windfall profits. Likewise, the impact assessment for reform of the EU ETS identifies a high to very high risk of carbon leakage only in cases of considerably higher figures for the combined criterion. Leakage-prone industries that fall short of an ambitious threshold value could still be included in the list via a qualitative assessment. This could once again apply to highly emission- and energy-intensive industries whose products are only indirectly subject to international competition, by virtue of downstream value chains (see item 117 ff.).

Moreover, the option (not proposed by the European Commission but positively assessed by the aforementioned impact assessment) of defining a number of carbon leakage risk classes could contribute to a more targeted protection against this risk. Such a tiered approach would allow the scope of free allowance allocations to be tied to the scope of the threats to competition that are determined (based on a number of thresholds), as is done in California's emission trading system, for example.

165. Also, recommendations for deeper reforms of the applied carbon leakage criteria should not be rashly dismissed and should still be subject to an assessment of their suitability. In this regard, the price elasticity of international trade flows, describing the extent to which allowance costs can be passed on without losing significant market share, would be a better indicator of a given industry's intensity of international competition (FELBERMAYR et al. 2013; AICHELE et al. 2014). Using such an indicator would allow carbon leakage risk to be downgraded for industries, for example, with high total trade intensity but relatively low price competition intensity owing to their product differentiation. However, determining and applying such an indicator would be considerably more complex and controversial.

2.5.2.2 Critical assessment of the allowance allocation method

The status quo

166. For companies that are classified as being at risk of carbon leakage, the amounts of certificates allocated free of charge during the third EU ETS trading period (2013-2020) are based on past production volumes and a product-specific efficiency benchmark. A procedure similar to that used for free allowance allocation is also applied to compensation for electricity cost increases attributable to emissions trading. The amount of compensation that member states can pay to the domestic companies affected is likewise determined by past production volumes and electricity consumption benchmarks.

In general, companies affected by emissions trading try to factor into their prices the production costs that are attributable to the requirement to surrender allowances. If passing on allowance costs is not possible without losing significant market share owing to stiff international competition, profitability of domestic production decreases insofar as the companies in question are required to purchase allowances. Hence, free allocation of allowances should avoid profit losses as well as the incentives for offshoring that result from such losses. However, owing to the fact that allowance allocation is not tied to the recent production volumes, incentives to factor in allowance costs and in some cases to put up with price induced sales losses and production cutbacks remain, by virtue of the fact that the certificates that become available can be sold. Hence the current arrangements governing free allowance allocation cannot completely eliminate production leakage incentives. This applies in particular to high allowance prices, in cases where allowance costs are high relative to profit margins and where companies have available unused production capacity abroad (i.e. outside the scope of the EU ETS) to which they can shift production. The threat of curtailment of free allocation for the next trading period will, however, reduce the incentive to fully factor in allowance costs, if doing so could potentially reduce current sales and production volumes. Moreover, the leeway for cutting domestic production will be limited by the fact that falling short of a specific production level will directly reduce the scope of free allowance allocation. If a company closes its domestic facilities, it automatically forfeits the right to be allocated free allowances – which in turn reduces the investment leakage incentive.

But if companies forego (full) passing on of the emissions price signal, the incentive to replace, on the demand side, energy-intensive products with their less energy-intensive substitutes will be reduced. All that will then be left are incentives for industrial companies to reduce their emissions through process optimization and (where applicable) fuel substitution, since the savings achieved by not purchasing allowances will be fully translated into profits. In the following, two alternative allocation methods will be briefly discussed, along with related complementary instruments, that address the problems with the current approach and that could replace it for the fourth EU ETS trading period (2021-2030).

Full auctioning and border adjustment measures

167. Border adjustments along with full auctioning of allowances constitute an alternative to free allowance allocation to industries deemed at risk of carbon leakage (BRANGER and QUIRION 2014; DISSOU and EYLAND 2011; KUIK and HOFKES 2010; BECKER et al. 2013; ISMER and NEUHOFF 2007; CONDON and IGNACIUK 2013; MONJON and QUIRION 2010). These measures involve price adjustments of imported and exported energy-intensive products for a carbon pricing element. In terms of the EU ETS, this element is constituted by the costs incurred by EU companies for obtaining allowances. In the interest of avoiding distortion of competition on domestic markets, products imported from countries lacking climate policy regulations comparable to those in the EU would be subject to either import duties or the obligation to purchase allowances. Exported products that are at risk of carbon leakage would be accorded financial relief, so as to enable such products to maintain their price competitiveness on international markets. Owing to the substantial administrative costs entailed by border adjustments, they would be limited to relatively few, highly emission-intensive products subject to international competition. For border adjustments as well, their amount should be based on product-specific benchmarks.

Border adjustments would largely avoid incentives that promote production and investment leakage. If financial compensation for exports were keyed to benchmarks and not to actually incurred allowance costs, export-oriented manufacturers would also be prompted to use carbon-efficient production processes. Through the retention of the emissions price signal, border adjustments could induce efficient domestic-market responses from an allocative standpoint – that is, price-driven shifting of demand to less emission-intensive goods.

168. However, there are major challenges in practice to using the theoretical advantages of border adjustments as a corrective to climate policy regulatory gaps. These challenges comprise: (a) methodological difficulties such as the precise calculation of the border adjustment rate; (b) legal controversy, particularly as to assessing the compatibility of border adjustments and international trade law; (c) stiff opposition from international trading partners, giving rise to fears of trade policy counter-measures. For these reasons, it is rather unlikely at present that border adjustments could be implemented. Against this backdrop, greater attention should be given to the following option for reforming the EU ETS.

Output based allocation and consumption charge for emissions-intensive goods

169. The main difference between output based (or dynamic) allowance allocation and the current EU ETS allocation method lies in the fact that the volume of free allocation is based on current rather than past production volumes (BORKENT et al. 2014; QUIRION 2009; MONJON and QUIRION 2011). This would mean that the number of free allowances for a given company would not be set at the beginning of a trading period, but would instead vary in accordance with the company's level of economic activity. The number of allowances that are allocated should still be based on product-specific benchmarks.

The fact that an increase in production entitles a company to additional free allowances would also alter its pricing calculations. The value of the additional free allowances engendered by an additional production unit is not folded into the product price, since the company does not incur any (opportunity) costs through the use of these free allowances. This would reduce the risk of production leakage, while at the same time there would be little or no change in relative price structures in favour of more climate friendly products. Hence, allocative efficiency, i.e. price-induced shifting of demand to more climate friendly consumption patterns, would not be achieved (see item 155). The incentive to make production processes more energy efficient would be fully preserved, however, as it would reduce the need of purchasing additional allowances (or would increase the number of surplus allowances that are available for sale).

170. Apart from effectively reducing both production and investment leakage risks, another advantage of output based allowance allocation lies in its greater robustness against unanticipated changes in the overall economic situation. As the European financial and economic crisis has shown, sustained deviations from projected economic growth can permanently undermine the incentive effect of emissions trading, via the collapse of allowance prices owing to the resulting oversupply of such allowances. Under an output based allocation system, the volume of free allowance allocation would decline in case of production cutbacks brought on by an economic crisis. If the "saved" (i.e. not freely distributed) allowances were directly transferred to the MSR (or another reserve), the volume of allowances available in the emissions trading market could be managed more quickly and in a more targeted fashion. This approach could improve allowances price stability and thus investment certainty for carbon emission reduction projects. However, in doing this it would need to be ensured that economic growth exceeding projections would not result in the failure to meet overall emissions reduction targets. Such safeguards could be implemented (as is done in the current system) by applying a correction factor: If production volumes exceed projections and if allowances from the MSR (or another reserve) are in short supply, the specific free allowance allocation per unit of production would be cut back.

171. The allocation mechanism for the current (third) EU ETS trading period is, de facto, a mixture of lump sum (fixed) and output based (dynamic) free allocation. Although free allocation in the third trading period is for the most part not based on production activity during this period, these production volumes will determine the volume of free allowances that will be available during the next trading period – assuming that the current allocation method is retained. Hence, the strategies and pricing behaviour on the part of the affected industrial companies will likely be found between the anticipated behaviours for both allocation methods. Eventually, the current allocation method fails to provide allocative efficiency, nor does it effectively forestall production leakage. The allocation mechanism proposed by the European Commission for the fourth trading period would remain unchanged in its basic structure, i.e. it would be based on past production volumes. However, by virtue of a planned adjustment of allowance allocation – based on updated production data – midway through the trading period, along with more flexible rules for adjusting allocation to significant changes in current production volumes, the Commission's proposal represents a step toward dynamic allocation.

172. Compensating for the main weakness in output based allowance allocation – namely its poor allocative efficiency – would necessitate a complementary greenhouse gas emissions pricing mechanism on the consumption side of the market. This could be accomplished by complementing the EU ETS with an EU-wide consumption charge on particularly energy- and emission-intensive materials that benefit most from free allowance allocation (ACWORTH et al. 2014; NEUHOFF et al. 2015). The amount of such a charge would be based on EU ETS allowance prices and on the specific greenhouse gas emissions attributable to the manufacture of these materials using the best available technologies; for the latter, EU ETS product benchmarks could be used. Introducing such a charge would allow for re-establishment of consumer carbon price signals for emission-intensive materials – a signal that would otherwise disappear or be significantly weakened under the output based allocation scheme. Tying the consumption charge to the benchmarks and the EU ETS allowance prices would allow for precise compensation.

To avoid carbon leakage risks, this charge would be levied both on domestic and imported goods, but not on exported goods (ACWORTH et al. 2014; NEUHOFF et al. 2015). Hence, regardless of the country of origin of goods sold on the domestic market, the prices of all such goods would fold in a climate cost element, whereas on world markets (efficiently produced) EU goods would incur no disadvantage entailed by the EU ETS.

A consumption based climate charge could take a form similar to that of existing excise taxes, such as, e.g. on tobacco or alcohol (ACWORTH et al. 2014; NEUHOFF et al. 2015). Hence, the payment obligation can be passed on along the value chains. The charge would also be imposed on imported processed products containing relatively large amounts of materials involving emission-intensive production processes. The charge would be payable once these emission-intensive materials are released for consumption in the European market. This would ensure that consumers, in their purchase decisions, take into account the climate costs of various alternative products – including in cases where such costs are not folded into producer or import prices. Tying the charge to emission-intensive goods entering the consumption sphere could also take into account the value chain argument put forward in the carbon leakage debate (see item 117 ff.).

173. Combining output based free allowance allocation with a consumption charge on particularly energy- and emission-intensive materials could efficiently reduce carbon leakage risks, and would at the same time generate financial incentives for emission reductions on the production side (through more efficient manufacturing processes and fuel switching), and on the consumption side as well (by replacing emission-intensive goods and using them more efficiently). And finally, it should be emphasized that the implementation of such a combined instrument would be consistent with the multi-tiered carbon leakage risk classification advocated by the SRU. In industries with lower to medium carbon leakage risks and whose products are not subject to a consumption charge, the emissions price signal would be at least partly passed on due to cutting back on free allowance allocation, thus engendering some incentives for efficient material use.

However, a number of legal, administrative and methodical questions arise when it comes to the implementation of a consumption charge complementing the EU ETS. Hence, careful consideration is needed of whether and how imposing such a charge in a non-discriminatory fashion could successfully lay trade law and trade policy concerns to rest, more successfully than is the case with border adjustments. Furthermore, the advantages of a sound and incentive-oriented pricing of carbon emissions be means of a consumption charge need to be weighed against the administrative costs entailed by such an instrument. Much of the necessary data is in any case already being gathered, meaning that such costs would probably not be prohibitive. In the final analysis, the benefits of implementing such an instrument – in terms of climate policy steering effects and simultaneous protection against carbon leakage risks – must outweigh the associated costs. In the interest of minimizing the administrative burden, the charge should only be levied on a few particularly greenhouse gas emission-intensive materials that nonetheless account for a major portion of total industrial emissions.

174. In light of (a) the deficiencies of the current design of the EU ETS; (b) the regional differences in carbon prices, which are likely to remain for the foreseeable future; and (c) opposition to border adjustments, careful consideration should be given – with a view to the upcoming reform of the EU ETS for its fourth trading period – to introducing a consumption charge that would complement a more output based allowance allocation. To this end, the lessons being learned from similar approaches in other countries should be closely monitored and evaluated. That said, rash exclusion of border adjustments as an alternative instrument should be avoided.

2.5.3 Preferential treatment in Germany

175. In Germany, the situation as regards regulatory exemptions and other forms of preferential treatment is considerably more complex than it is for the EU ETS. The German industrial sector benefits from a substantial number of energy policy advantages such as reduced liability to pay, among others, the EEG surcharge; electricity and energy taxes; the cogeneration surcharge; the offshore liability surcharge; grid fees. These advantages are often justified by referring to carbon leakage risks and concerns about international competitiveness. Notwithstanding, oftentimes the eligibility requirements are not sufficiently based on plausible criteria for the assessment of potential jeopardy to competitiveness and of carbon leakage risks. Moreover, the current design of preferential treatment often engenders misguided incentives and distortive effects.

Hence, the SRU recommends that a critical review be undertaken of the numerous energy policy privileges accorded the industrial sector. In doing so, the focus should be put on the cumulative effects of the various climate and energy policy burdens and relief measures. Any relief that cannot be reasonably justified on the grounds of competitive disadvantages and carbon leakage risks should be abolished or curtailed. And in cases where such relief is justified, it should be limited to the necessary scope. It should also be ensured that the design of relief measures creates incentives to unlock available economic potential for energy efficiency improvements.

176. Using the criteria defined in section 2.5.1 as a basis, exemplary weak points as well as reform options concerning the current design of energy policy relief measures in Germany will now be outlined.

It holds even more true for nationally granted regulatory relief in Germany than for the EU level that the eligibility requirements for relief measures do not appear to be properly targeted toward threats to competitiveness or carbon leakage risks (GAWEL und KLASSERT 2013; GAWEL und PURKUS 2015). For being granted reductions in grid fees, the co-generation surcharge, and the offshore liability surcharge, the sole eligibility criteria are electricity cost intensity and quantity of electricity purchased. For the electricity tax as well, additional relief, over and above the general privileges granted to manufacturers, is based on cost criteria. Neither trade intensity nor price elasticity are taken into account as quantitative criteria; nor are qualitative assessments of effects on competitiveness carried out. Hence, in many cases, there are no serious threats to competitiveness resulting from caps being placed on relief to be expected. The sole exception in this regard is the special equalisation scheme in the German Renewable Energy Act of 2014 (EEG) that was amended once again in 2014 at the insistence of the European Commission. But here too, the number of beneficiaries is large, and became even larger upon adoption of the EEG amendments. Between 2012 and 2015 alone, the number of manufacturers receiving preferential treatment roughly tripled, to 2,052, and the amount of electricity subject to EEG surcharge reductions increased by nearly one fifth, to 95 TWh (BMWi and BAFA 2015; FIEDLER and WRONSKI 2015).

Insofar as either threats to competitiveness or carbon leakage risks are used as a justification for relief, the beneficiaries of relief and its scope should be rigorously and transparently geared to the aforementioned goals. To this end, the eligibility requirements for relief should be expanded to include a criterion for the trade effects of rising energy costs. In so doing, readily available data could be used – for instance, data that forms the basis for the EU ETS related electricity price compensation (NEUHOFF et al. 2013; Agora Energiewende 2014). It should be noted, however, that domestic energy taxes and levies also have an impact on competition among companies within the European Union. Hence, differences in energy policy regulations among EU member states are relevant from an economic standpoint, notwithstanding the fact that offshoring within the EU has no direct impact on global greenhouse gas emissions.

For reasons of transparency and consistency, and in the interest of administrative manageability, the eligibility requirements for the various nationally determined forms of preferential treatment should be harmonized as far as functionally justified. This holds true, in particular, in cases where such privileges are based on the same arguments. Moreover, an increased criteria-based gradation of the scope of preferential treatment could provide relief for non-privileged electricity customers, as this would reduce the overall financial volume of preferential treatment.

177. There are discontinuities in the scales which determine a company’s financial burden with energy consumption related levies imposed on the national level. When company-specific thresholds for (relative) energy costs are exceeded, the absolute burden is reduced – a phenomenon that might engender misguided incentives that could prompt companies to increase their energy consumption. Article 94 of the German Renewable Energy Act (EEG) authorizes the government to set standardized electricity consumption benchmarks. In the SRU’s view, the government should define these values in a timely manner, and as all encompassing as possible (as far as feasible with reasonable effort) so as to eliminate such misguided incentives. In certain cases, it might again be possible to use the preparatory work that was done in drafting electricity price compensation rules.

178. All of the various national forms of relief have one thing in common – namely that they do not send a strong marginal energy price signal to industrial companies. Hence, electricity consumption benchmarks (insofar as available) could be used to cap energy consumption eligible for relief at an amount consistent with production methods that use electricity efficiently. This would give companies an economic incentive to improve their energy efficiency. Instead, the actual average costs entailed by the various surcharges show a degressive curve with respect to the total amount of electricity used, since relief is granted for aggregate energy use exceeding a fixed amount that companies are required to pay out of their own pocket. This in turn not only eliminates economic incentives to improve energy efficiency, but also places smaller companies in a given industry at a disadvantage relative to larger competitors. In the interest of avoiding distortion of competition within individual industries and promoting energy efficiency incentives – including in companies that generate their own electricity – energy levies should also reasonably include consumption of self-generated electricity (that is, more than currently is the case).

179. Even if it is unfeasible to design relief measures in a manner that is free of any discontinuities and distortions, taking into account the principles laid down in section 2.5.1 could substantially curtail the misguided incentives and distortions that obtain at present. Eventually, it is necessary to weigh the incentive compatibility of the relevant regulations against their administrative practicability, taking into account the applicable legal restrictions. However, there is definitely considerable room for improvement in the current – distorting and hardly targeted – arrangements.

2.6 Summary and recommendations

180. Germany has traditionally been a strong industrial nation. Its manufacturing sector is of major importance, as compared to other EU countries, accounting for an above-average 22 per cent of the country's gross value added. Hence, the industrial sector is pivotal in terms of economic prosperity and employment. That said, with currently around 30 per cent, this sector – jointly with the transport sector – accounts for the lion's share of Germany's final energy consumption. The industrial sector thus plays a key role both for the *Energiewende* and for achieving the EU climate goals, in that it needs to reduce its energy consumption and greenhouse gas emissions as well as to develop innovative and marketable energy efficient and environmentally benign products and processes.

A heterogeneous industrial sector calls for a differentiated view of threats to competitiveness

181. As to how the burdens of climate and energy policies are allocated among the different sectors, it is often pointed out that the industrial sector is particularly affected by these costs. Germany's industrial base could be weakened by ambitious climate policy measures that may also increase energy costs. It is also thought that ambitious energy policy measures might be ineffectual owing to carbon leakage risks as the result of the weakening of international competitiveness of the German industrial sector and the offshoring induced thereby. However, broad-brush arguments do not do justice to the complexity of this issue, and can result in the importance of carbon leakage risks being exaggerated. What is needed instead is a differentiated view that factors in the heterogeneity of the various industries.

Industrial competitiveness, in point of fact, is determined by numerous factors, among the most important are: (a) a stable regulatory framework; (b) an efficient infrastructure; (c) innovation potential; (d) a good educational system and motivating work environments; and (e) security of supply in terms of both energy and raw materials. Relative to other nations around the world, Germany offers a high location quality for industrial companies. However, in the public debate, the level of energy costs, particularly for electricity, is often deemed a drawback for industrial companies – one that substantially undermines their competitiveness and that could even lead to severe de-industrialization of Germany. Yet, energy is a major production factor for only a few energy-intensive industries such as the following: metal production; non-ferrous metals; paper; basic chemicals; and processing of nonmetallic minerals. For the majority of German industries such as the machine and vehicle construction industries, energy costs are of secondary importance, representing a maximum of only 2 per cent of production costs; and thus such industries are relatively little affected by energy price increases.

Exploiting the opportunities opened up by ambitious energy efficiency policies

182. For industrial companies affected by rising energy prices, improving their energy efficiency can (partially) offset such increases. Numerous studies have demonstrated the existence of extensive beneficially-to-tap energy efficiency potential that is not leveraged due to various barriers. While there are already numerous policies in place concerning measures that promote industrial energy efficiency, such measures do not always achieve the desired and required effect. In view of the need to reform current policy instruments, integrated, long-term energy efficiency policies should be implemented that are bolstered by mandatory energy efficiency objectives. What is needed is a coherently configured mix of instruments comprising regulatory standards, financial incentives, funding policies, and consulting and information programmes. At the same time, current instruments that have proven their worth should be maintained, optimized and rendered more stringent. Among the measures that should be implemented are incentives to initiate greater and more effective use of energy and environmental management systems, and for the establishment of energy efficiency networks in conjunction with data gathering and benchmarking. What is likewise needed, however, are commitment and self-organization of the business sector; for after all, this sector is the locus par excellence of expertise, networks (by virtue of trade groups) and above all mutual trust – which plays a crucial role for SMEs. Of particular relevance when it comes to companies investing in energy efficiency are long-term planning certainty and stable policy frameworks.

Designing anti-carbon leakage measures in a targeted fashion

183. Rising energy prices are likely to entail the risk of carbon leakage and to jeopardize the competitiveness of companies that make highly energy-intensive products subject to international competition. In the manufacturing of such products, the still existing energy efficiency potential is not enough to offset a substantial energy price increase. That said, the number of products actually affected is inconsistent with the very large number of industries that receive regulatory relief. Hence a critical review should be undertaken of the numerous energy policies that give preferential treatment to the industrial sector in Germany and the EU. Any relief that cannot be justified on the grounds of significant competitive disadvantages – and in particular carbon leakage risks – should be curtailed. And in cases where such relief is justified, it should be limited to the necessary scope. Furthermore, national and EU energy policy relief instruments should be harmonized more closely.

184. The list of industries whose companies are granted free allowances under the EU ETS reveals how broad the definition is of industries whose competitiveness is jeopardized. These account for around 95 per cent of all industrial emissions. The eligibility requirements for inclusion on the carbon leakage list should be more precisely keyed to actual carbon leakage risks, as this would reduce the number of beneficiaries. A multi-tiered classification system for this risk could also result in more precise differentiation of the scope of relief, in accordance with the industry-specific leakage risk. Moreover, the assumptions concerning allowance prices and climate policies in competing regions should be aligned with real-world conditions. By focusing free allowance allocation (and compensation for indirect EU ETS costs via electricity prices) on industries where genuine leakage could actually occur, government revenue from emissions trading would rise substantially. This would be the case to an even greater degree if adjusting the allowance budget reduced the overall supply of available allowances, thus driving up their prices. The funds made available could be used for investments in transformation of the energy system and support for energy efficiency improvement measures. This would pay off not only ecologically, but would also incentivize sustainable economic developments – which are particularly needed in times of the European economic and debt crisis. The benefits that come into play here include an increase in domestic value creation, reduced vulnerability to exogenous energy price risks, and opening up new markets for innovative energy technologies.

Ensuring incentives for environmentally compatible economic activity, including for industries granted relief

185. For the fourth EU ETS trading period, the method of free allowance allocation should be broadly reformed. Such reform should aim for effectively preventing carbon leakage, incentivizing manufacturers to improve energy efficiency, and incentivizing consumers to purchase more environmentally compatible products. Transitioning to more output-based allocation in conjunction with a consumption charge on particularly energy-intensive materials would work towards these goals and should thus be considered thoroughly. The consumption charge on energy-intensive materials should be implemented EU-wide, and be levied on both domestically produced and imported materials. Payment of the charge would be due once the materials and products in question were sold to European final consumers. The amount of the charge would be based on EU ETS allowance prices, so as to re-establish the carbon price signal that is suppressed by output-based allocation. If such administratively and legally ambitious approaches turn out to be unfeasible by the time the fourth EU ETS trading period gets underway, ways to implement them at a later time should be assessed. This applies in particular if, in spite of the Paris Agreement, no substantial progress is made toward harmonizing climate policy regulations for industrial production. Tiering free allowance allocation in accordance with industry-specific leakage risks is a measure that can and should be implemented right at the start of the next trading period. Free allocation to the full extent of industry-specific carbon benchmarks should be granted only to industries with very high carbon leakage risks.

186. The need to reduce the surplus of allowances that has accumulated thus far is to be addressed independently of modification of the assessment criteria for carbon leakage risks and of reforming allocation rules. In order for the emissions trading incentive mechanisms to be re-established and preserved, it is inevitable to raise the bar of ambition via an increase in the reduction factor and possibly permanently retiring allowances from the MSR.

187. In Germany, the situation as regards regulatory exemptions and other forms of preferential treatment of the industrial sector is considerably more complex than it is for the EU ETS. The German industrial sector benefits from numerous energy policy advantages, which are often justified by referring to carbon leakage risks, and concerns about international competitiveness. Notwithstanding, oftentimes the eligibility requirements are not sufficiently based on plausible criteria for carbon leakage risks. The suitability and reasonableness of all forms of relief should be reviewed, and the eligibility requirements should be oriented toward achieving the pursued goals; whereby efforts should be made to achieve greater harmonization of such requirements. In the interest of minimizing misguided incentives and distortion of competition, the eligibility criteria for energy policy related relief should, insofar as possible, be granted on the level of specific processes, products and industries rather than on the level of individual companies.

The feature that all national energy policy related relief measures have in common is the lack of a robust marginal energy price signal to industrial companies. Consequently, this severely weakens economic incentives for technical improvements aimed at reducing energy use and greenhouse gas emissions. Therefore, privileged energy consumption should be limited (insofar as administratively feasible) by applying product-specific benchmarks. When implementing such an approach, available data (that forms the basis for compensating indirect EU ETS costs via electricity price) may be used. In order to avoid that incentives are confined to the reduction of electricity consumption from the public grid, energy levies should also reasonably (that is, more than currently is the case) include consumption of self-generated electricity. Furthermore, granting preferential treatment should be tied more robustly to companies' quid pro quo measures aimed at increasing industrial energy efficiency.

Climate policy should be regarded as an opportunity, not an obstacle

188. Finally, reference should again be made to the profile and visibility of the German *Energiewende* on the international stage, as well as to Germany's role in setting an example for other countries. The challenge in this regard is to demonstrate that the country's energy system can be transformed without weakening its industrial sector. In doing so, Germany can exhibit economic and ecological prudence by strengthening its competitiveness through high-quality innovative products, not by participating in a race to the energy price bottom. Ambitious energy and climate policies should not be regarded as impediments to economic development; instead, there should be greater focus on the opportunities opened up by such policies. The SRU therefore welcomes the fact that this is, in principle, the government's view of the situation as well. Improving the economy's energy efficiency, stimulated through appropriate policy measures, reduces energy cost pressures and dependence on imported fuel. Replacing imported energy with domestic value creation engenders multiplier effects, and (policy-) induced innovation opens up business opportunities in steadily growing "green" markets. The latter relates to the ecological benefits of ambitious domestic climate policies that go beyond the scope of a German and European Union setting. International diffusion of induced technological progress can contribute to climate and environmental protection on the global level as well. However, in order to promote product and process innovations, particularly in the field of environmental and energy efficiency technologies, incentives are needed that also include a suitable price signal. An ecologically and economically sustainable industrial sector cannot be ensured by shielding it extensively from energy price signals. Furthermore, broad political support and general public acceptance will be undermined if the cost of the energy system and its transformation is largely shifted on the shoulders of private households as well as commercial and industrial users who do not (or to a lesser extent) benefit from energy policy related relief.

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