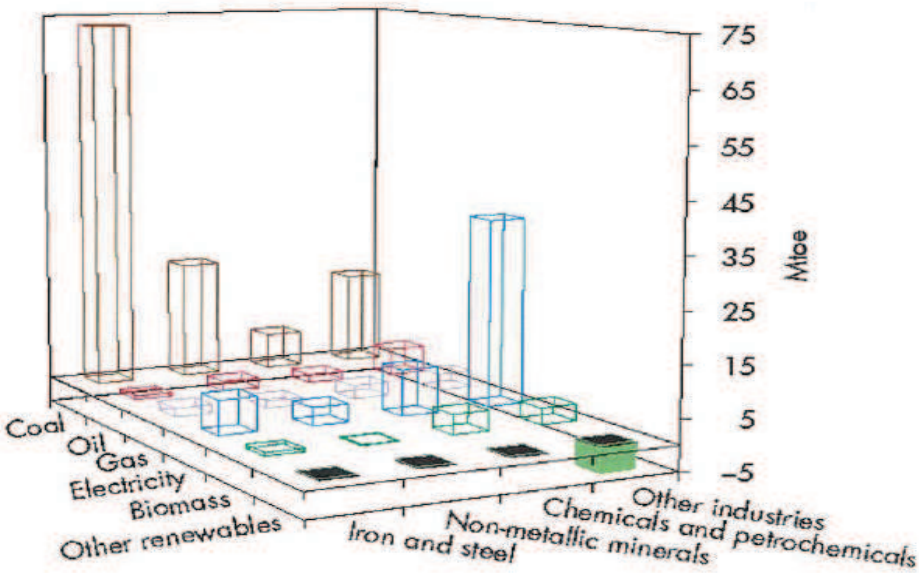
Chapter 6: Environmental Tax Reforms and Mitigation for Energy-intensive Industries: Some Lessons from European Experience

Mikael Skou Andersen

The purpose of this paper is to analyse in more detail the international experiences in applying carbon-energy taxation in two important energy-intensive sectors; iron and steel, as well as non-metallic mineral products (where cement is the most significant subsector).

In China iron and steel is the single most important industrial subsector to address in order to improve energy productivity. The net energy use per tonne of steel was 50-100 per cent higher in China than internationally in 2004 (IEA, 2007a:107). For cement the energy requirement per tonne of clinker is 20-25 per cent higher in China than in Europe (IEA, 2007a:152). According to World Energy Outlook (IEA, 2007b) China's iron and steel and cement sectors can deliver 2/3 the industrial energy savings required to comply with the IEA alternative policy scenario by the year 2030, which will reduce the projected increase in China's energy consumption by 50 per cent in 2030. While iron and steel could deliver annual energy savings of 83 Mtoe, non-metallic minerals could deliver about 30 Mtoe. While the IEA alternative scenario is in accordance with the 11th 5-year plan's aim to cut energy use per unit of GDP by 20 per cent by 2010, the averted CO_2-emissions from improved energy efficiency in these two industrials sectors in China would amount to approximately 0,3 Gt - or close to the entire reduction achieved under the EU-15 Kyoto target.

Figure 11.7: **Industrial Energy Savings in China by Fuel and Industrial Sub-Sector in 2030 in the Alternative Policy Scenario Relative to the Reference Scenario**



(From IEA, 2007b: 377)

In European countries, with the introduction ofenvironmental taxreforms (ETR) featuring carbon-energy taxation, the sectors of iron and steel as well as cement have posed a challenge despite revenue-neutral tax shifts, because these sectors, while highly energy-intensive, are not labour-intensive. The implication of this discrepancy is that at the sectoral level the introduction of carbon-energy taxes are not easily neutralised even when lowering taxes on labour. The tax shifting favours labour-intensive enterprises, so in Europe these two industrial sectors would have lost relatively more from environmental tax reform, if some special mitigation and compensation schemes had not been established.

The purpose of this paper is to review the experiences obtained in Europe with mitigation and compensation arrangements when designing the use of economic instruments for these sectors.

Before proceeding to present the schemes for environmental taxes in these key industrial sectors, a brief overview and characterisation of the available technologies are provided. The data are derived from the EU Research project COMETR which focused on the period 1995-2003. No attempt has been made to update the time-series further, as increases in international energy prices would only complicate the analysis.

Ferrous industries

Figure 6.1 provides an overview of the fuel mix in the ferrous industry in the seven

ETR-countries[64]. Most countries have a significant share of installations with basic oxygen furnaces (BOF) for which coal or coke is traditionally required. Denmark has only installations with electric arc furnaces (EAF) that rely on electricity and natural gas.

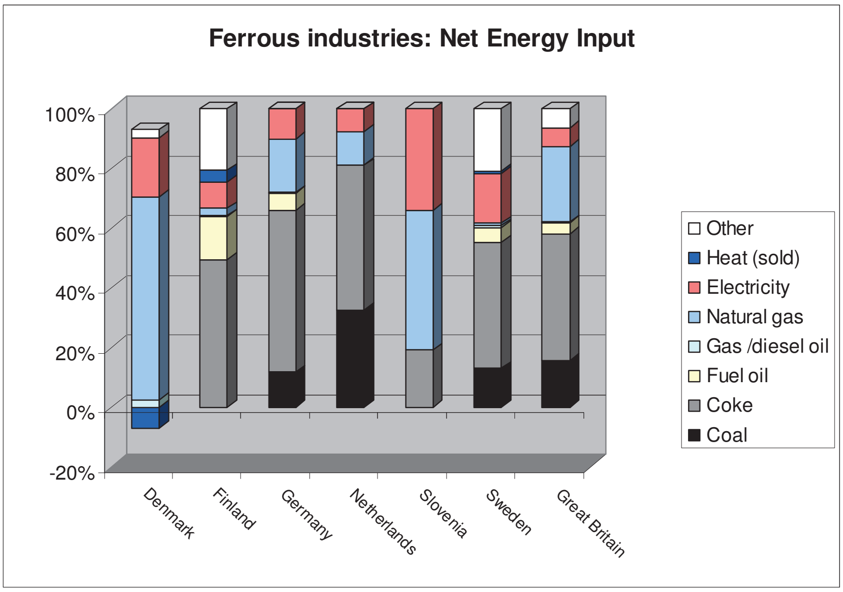


Figure 6.1 Fuel mix of ferrous industries in European ETR countries

(Source: COMETR, 2007).

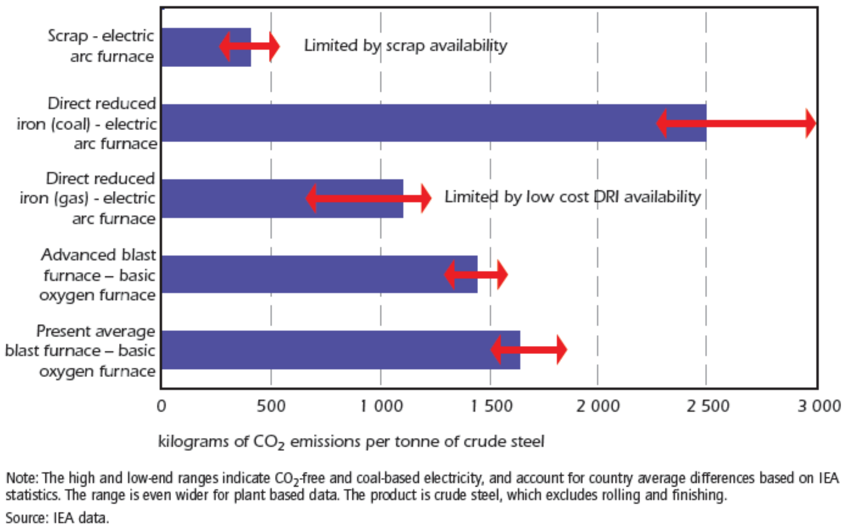


Figure 6.2: CO_2 emissions per tonne steel for different technologies (source: IEA; 2007a).

[64] Net energy input: The energy purchased by the sector from the Energy Supply Sector (or direct from other sectors), net of any autogenerated energy that it sells. It includes the energy inputs used for autogeneration (own energy production).

Figure6.2 shows CO_2 emissions per tonne of steel for different processes. Using scrap steel reduces energy use and CO_2 emissions very significantly (up to 80%), but is constrained by limited scrap availability. While in OECD countries there is plenty of scrap available, China has limited stocks to collect from. Especially for coastal regions trade would offer opportunities for gathering scrap steel. .

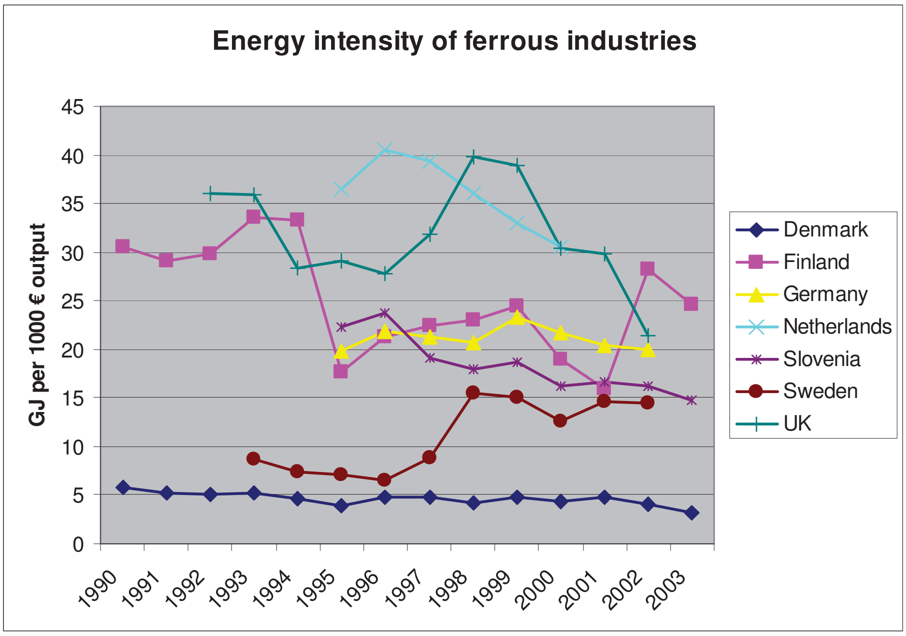


Figure 6. 3 (COMETR database, 2007).

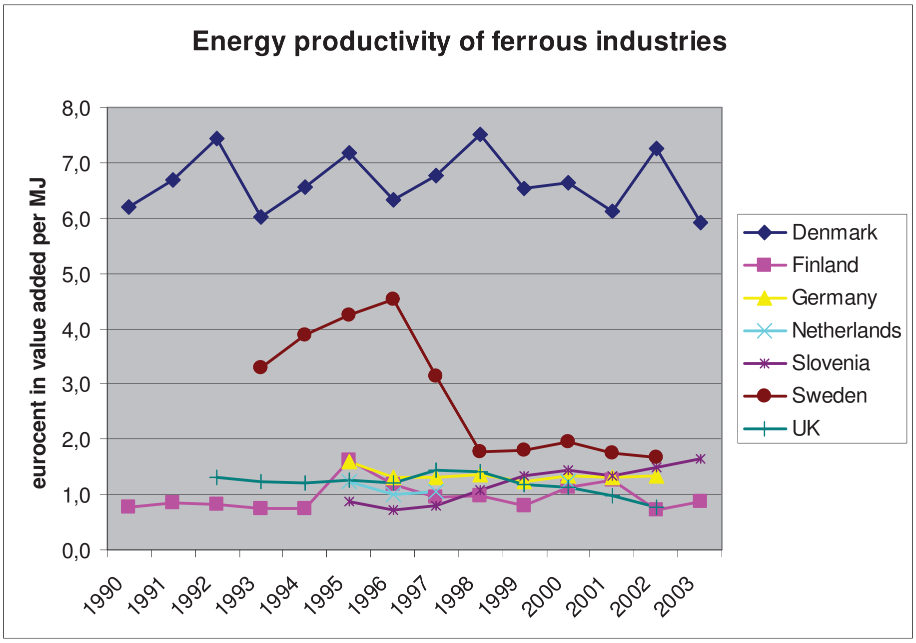


Figure 6.4 (COMETR database, 2007).

Figure 6.3 shows that energy intensities (GJ required per 1000 € output) are high in UK and the Netherlands and low in Denmark. The middle group consists of Finland, Slovenia and Germany. In Sweden ferrous industries become *more* energy intensive from the mid-1990's, which could be a result of the abolition of most energy taxes and lowering for CO_2-taxes with effect from 1994. The reason for the very low energy intensity in Denmark is presumably the combination of EAF with a high share of scrap steel.

Figure6. 4 shows conversely the energy productivity, which is about 1-2 eurocent in added value for each MJ (implying that for each kWh there will be 3,6-7,2 eurocent in value added). In Sweden the higher energy intensity leads to a sharp decline in energy productivity. Denmark has high energy productivity throughout the period, even higher than the ratio to energy intensity in other countries would suggest.

Table 6. 1 Ferrous industries (27.1-3): Carbon-energy taxation, average tax burden (in euro per GJ).

	Denmark	Finland	Germany	Netherlands	Slovenia	Sweden	UK
1990	0.04	0.06				0.95	0.08
1991	0.04	0.06				1.64	0.11
1992	0.00	0.06			0.34	1.58	0.11
1993	0.00	0.13			0.31	0.13	0.10
1994	0.24	0.26			0.39	0.14	0.09
1995	0.15	0.43	0.32	0.08	0.53	0.12	0.10
1996	0.18	0.43	0.12	0.10	0.50	0.16	0.09
1997	0.62	0.66	0.12	0.10	0.85	0.26	0.07
1998	0.68	0.38	0.12	0.10	0.86	0.24	0.06
1999	0.82	0.29	0.21	0.09	0.78	0.25	0.06
2000	0.81	0.47	0.21	0.10	0.16	0.27	0.06
2001	0.67	0.48	0.24	0.12	0.20	0.25	0.14
2002		0.28	0.27	0.12	0.22	0.26	0.13
2003		0.31		0.12	0.26	0.25	

(Source: COMETR database, 2007).

Table 6.1 provides the average tax burden per GJ, net of exemptions, for the ferrous industries. It is lower than the nominal tax rates would suggest because of the various special arrangements in place for ferrous industries in all the countries.

The highest effective tax burden is found in Denmark; here the tax burden is about 0.75 €/GJ. In the other countries the burden is considerably lower; about 0.25 €/GJ in Germany, Sweden, Finland and Slovenia - and about 0.12 €/GJ in UK and Netherlands. However, our figures for Germany overestimate the tax burden, because it was not possible to disentangle the Spitzensteuerausgleich, that is the peak tax adjustment for energy-intensive industries with increased tax burden (see below).

Hence, when contrasting energy intensity and energy productivity with the tax tables, it becomes clear, that the lowest tax burden is found in UK and Netherlands, which have the highest energy intensity. The highest tax rate is found in Denmark, which also has the lowest energy intensity. Middle rates are found in Slovenia, Sweden and Finland, which also have mid-intensities.

While it is tempting to interpret this pattern to imply that energy intensities reflect the tax burdens, it would probably be too bold. Overall the tax burdens remain modest. The Danish tax burden of 0.75 €/GJ translates to 0.075 eurocent/MJ, which is about 1 per cent of value added per MJ (cf. figure 4). In comparison for the low tax country UK the tax burden of 0.13 €/GJ translates into 0.013 eurocent per GJ, which is also about 1 per cent of value added per MJ. And for Sweden, with 0.025 eurocent/MJ, it is also about 1 per cent. So that for this specific sector, for which so many exemptions were available (see below), the carbon-energy tax, under the present circumstances, may be more of a "harvest".

Cement

Figure 6.5 provides an overview of the fuel mix in the cement industries of the seven ETR-countries. Most countries rely heavily on coal and coke, but for UK and Netherlands the 'dash to gas' is clear. Waste and biofuels have been introduced in Slovenia and Denmark, and in Denmark the industry also supplies excess heat to district heating purposes.

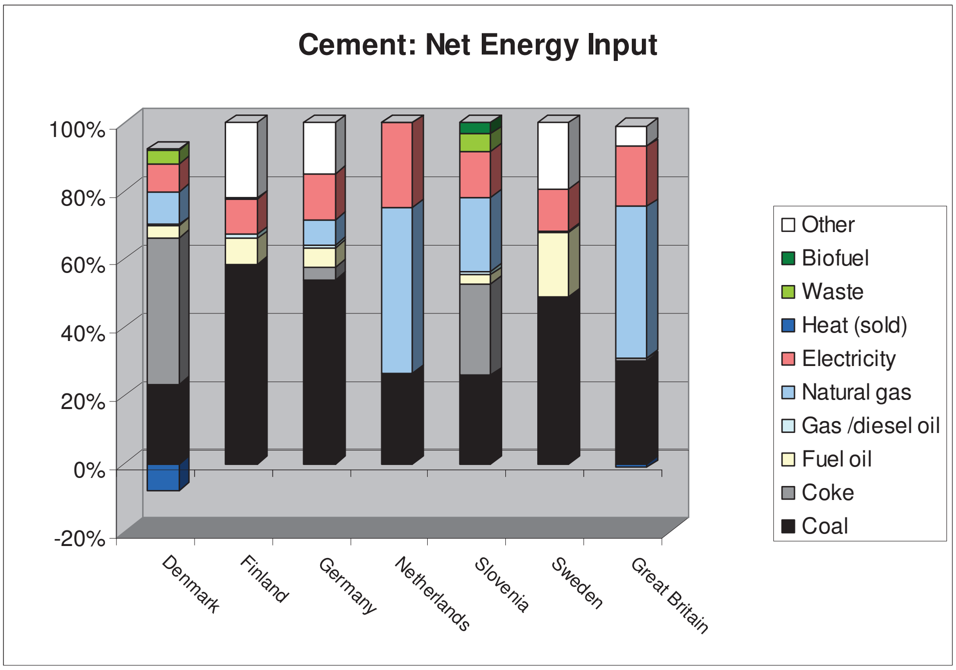
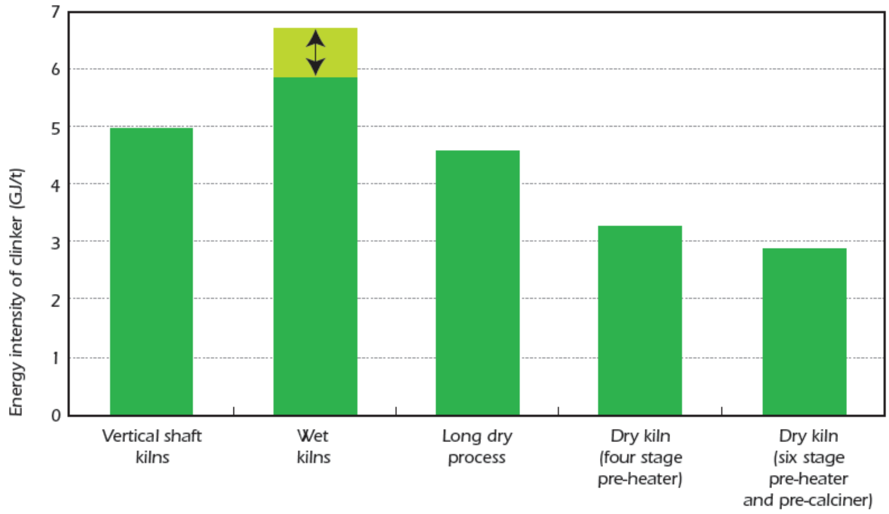


Figure6. 5 Fuel mix of cement industries in European ETR countries (Source: COMETR database, 2007).



Note: For wet kilns, the arrow represents the range of energy consumption for different wet kiln types.
Source: FLSmidth, 2006.

Figure 6.6 Energy efficiency of various cement clinker production technologies. Vertical shaft kilns account for 47 per cent of the production capacity in China, but are not used in Europe (IEA, 2007a).

Figure 6.7 shows that energy intensities (GJ required per 1000 € output) in cement have declined in most countries. Slovenia apparently has the lowest energy intensity, but the fuel statistics could be incomplete. Again Sweden is an exception, with increasing energy intensity, very likely for the same reason as above – the abolishment of the energy tax component for industry. Also the UK in the mid-90's experienced an increase in energy intensity, possibly as the fossil fuel levy on industry's electricity consumption was discontinued. As the UK climate change levy was announced in 1999 UK returned to improvement of its energy intensity. However, the energy intensity improvement is believed partly to reflect an autonomous trend towards improved energy efficiency. The shift from wet to dry technologies implies 20-50 per cent lower energy consumption and in Europe wet technologies are now prevailing with a share of 92 per cent (IEA, 2007a).

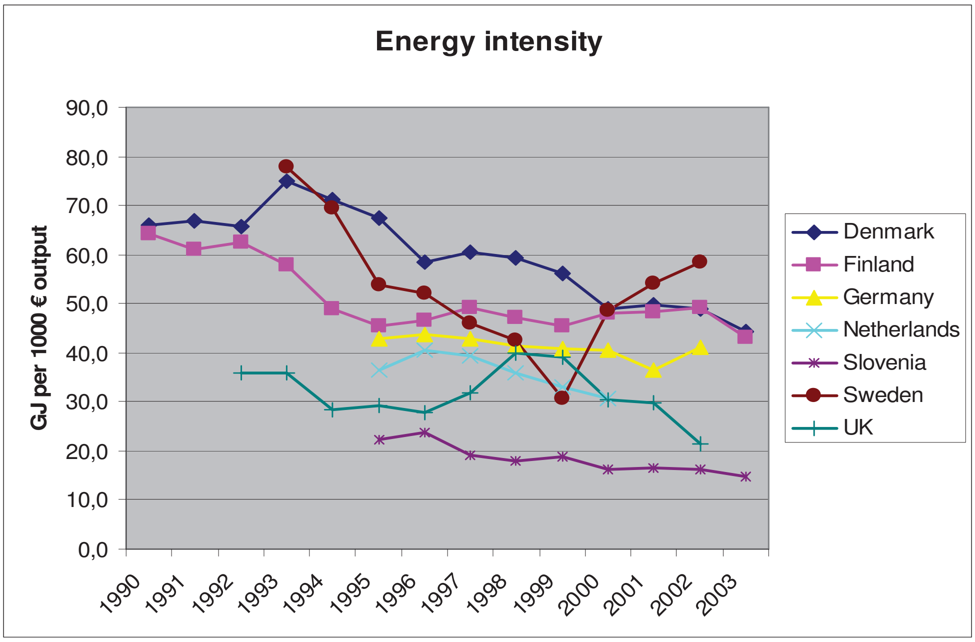


Figure 6.7 (Source: COMETR database, 2007).

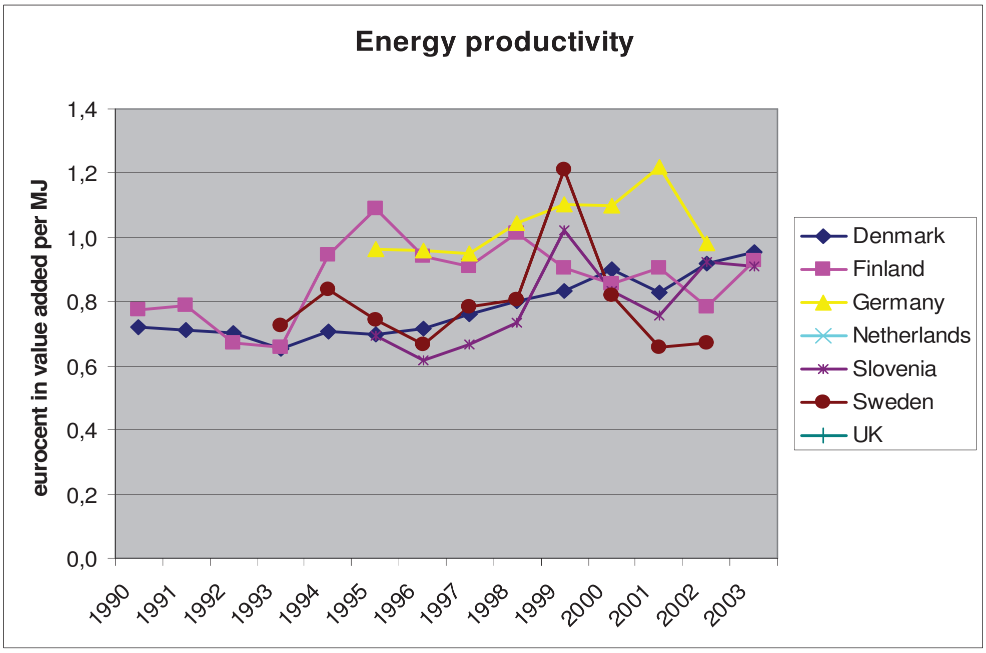


Figure 6.8 (Source: COMETR database, 2007).

Figure 6.8 shows conversely the energy productivity, which in most countries is lower for cement than for ferrous industries, with about 1 eurocent in added value for each MJ (implying that for each kWh there will be about 3,6 eurocent in value added). For Finland, Denmark and Slovenia a gradual improvement in energy productivity took place over the decade studied here, with about 4 per cent per year.

Table 6.2 Cement industries (26.5): Carbon-energy taxation, average tax burden (in euro per GJ)

	Denmark	Finland	Germany	Neth.lands[65]	Slovenia	Sweden	UK
1990	0.00	0.11				0.57	0.09
1991	0.00	0.11				0.93	0.14
1992	0.00	0.10			0.12	0.91	0.19
1993	0.00	0.17			0.15	0.17	0.19
1994	0.10	0.38			0.17	0.17	0.16
1995	0.14	0.70	0.26	0.33	0.26	0.17	0.17
1996	0.20	0.66	0.08	0.35	0.25	0.20	0.20
1997	0.14	1.09	0.07	0.34	0.61	0.38	0.05
1998	0.08	0.38	0.08	0.36	0.59	0.36	0.02
1999	0.06	0.31	0.16	0.43	0.52	0.54	0.01
2000	0.00	0.31	0.17	0.51	0.30	0.36	0.01
2001	0.23	0.31	0.20	0.73	0.32	0.30	0.17
2002		0.31	0.22	0.76	0.34	0.32	0.19
2003		0.32		0.78	0.35	0.31	

(Source: COMETR database, 2007).

Table 6.2 provides the average tax burden per GJ, net of exemptions, for the cement industries

The average tax burdens for cement are lower than the nominal tax rates would suggest because of the various special arrangements in place for energy-intensive industries in all the countries. They converge more than for ferrous industries and range from about 20 to 35 eurocents/GJ (Netherlands displays a higher figure, but it applies to non-metallic minerals as a whole). Around 1998-1999 Finland, Sweden and Denmark saw notable reductions in the average tax burdens. Altered arrangements for tax exemptions are believed to be the explanation in Finland and Sweden. In Denmark the cement industry was able to take advantage of the tax wedge between the high CO_2-tax for heat (80€/tCO_2) and the low tax rate for process energy (down to 0.5 €/tCO_2). Germany and UK on the other hand experienced a doubling or more of the tax burden following the ecological tax reform and the climate change levy respectively.

Overall the tax burdens remain modest. The average tax burden of 0.25 €/GJ translates to 0.025 eurocent/MJ, which is about 2 per cent of value added per MJ (cf. figure 8). While it is tempting to interpret the general pattern of energy productivity improvements to reflect the gradual increase of the average tax burden, it may also be related to autonomous technological trends and technology upgrades.

Methods to mitigate carbon-energy tax rates in ferrous and cement industries

The EU's Energy Taxation Directive (2003/96/EC) Art 2, no. 4 prescribes, that certain uses of energy products and electricity may be exempt from the EU minimum rates. The most important exemptions relating to the two above sectors include;

[65] Sector 26 as a whole.

electricity used for metallurgical processes,

energy for mineralogical processes

dual use of energy products (the combined use for heating and process purposes, such as in metallurgical processes),

Despite these exemptions from EU-harmonised taxes, the 7 ETR-countries have unilaterally imposed carbon-energy taxation including for ferrous and cement industries. Accompanying exemptions and mitigation arrangements for energy-intensive industries, including the above sectors, have then been introduced. Below we describe how the different countries have chosen to do so. This description leads to a discussion of which mitigation arrangements best support the complementary goals of energy productivity and competitiveness.

Reduced tax rates:

Sweden: When the carbon-energy tax burden exceeds 0.8 per cent of product sales value, the tax rates can be reduced to the EU minimum tax rates. This applies only to coal and gas. 50-60 companies benefit from the rule.

Finland: Where the carbon-energy tax burden exceeds 3.7 per cent of value added, the tax rates are reduced to the EU minimum tax rates. 10-12 companies, mainly pulp and paper, benefit from the rule.

Denmark: While the standard CO_2-tax rate is 12 €/tCO_2, energy-intensive industries are levied 3 €/tCO_2. Further reductions, down to 0.40 €/tCO_2, can be obtained if the industries accept government energy auditors and agree to a scheme of binding energy efficiency measures.

Netherlands: For electricity and gas big users can obtain reduced rates corresponding to the EU minimum energy tax rates. A consumption above 1 mio. m^3 of gas or 10 million kWh of electricity is required. About 60 per cent of industrial energy consumption is believed to benefit from the reduced rates.

Slovenia: Certain energy-intensive industries with an annual emission of more than 10 tCO_2 are allowed a deduction corresponding to their historical emission. About 150 companies are believed to make use of this rule.

Germany: In general manufacturing industries only pay 60 per cent of the nominal tax rates. And companies that as a result of the tax increase since the introduction of the ecological tax reform in 1999 experience more than 20 per cent increase in their energy tax burden, can obtain a "Spitzenausgleich" (peak adjustment). Above the peak of 20 per cent tax increase, only 5 per cent of the tax rate applies. However, the reduction is contingent upon the fulfilment of environmental agreements with targets for energy efficiency. Energy-intensive industries furthermore benefit from coal being taxed only with the EU minimum tax rate.

UK: Energy-intensive industries can pay 20 per cent of the tax rate of the climate change levy. The reduced rate can be obtained where companies make agreements for improved energy efficiency. These agreements are negotiated between the government and sector industry associations.

EU state aid rules restrict how member states can favour energy-intensive industries. This is because an exemption from a general tax is regarded functionally as a kind of state aid. The major principle behind is laid down in the EU Treaty which requires no distortions of the internal market of the EU. Following a decision of the European Court of Justice this view of state aid applies not only to EU taxes but also to member state taxes. The EU Treaty has very strict provisions for state aid; such aid requires approval of the European Commission. In this way the EU can control to a great extent the provisions which member states try to make for energy-intensive industries. The European Commission has issued a set of guidelines for state aid for environmental activities which are important for the tax rules applying to energy-intensive industries[66]. Exemptions are deemed acceptable if they are general and non-discriminatory, but they will not be deemed acceptable if they are selective and applying only to specific firms so as to offer them special favours.

Environmental agreements

The EU guidelines on state aid determine, that energy tax rates can be reduced, where environmental commitments or agreements on energy efficiency are concluded between energy-intensive industries and the authorities.

Such arrangements have been introduced early on in Denmark (from 1996) and in Germany (initially from 1995 and linked with the energy tax from 1999) and later UK (from 2001). Sweden, Finland and Slovenia have not made use of such mechanisms. Netherlands had a very extensive system of self-commitments (so-called “covenants”) in place prior to the introduction of its carbon-energy tax scheme in 1997, but the tax rates and the agreements are not directly linked.

In Denmark certain pre-specific energy-intensive industries can be entitled to reduced CO_2 tax rates if they sign an agreement with the Danish Energy Agency. Businesses entering such environmental energy savings agreements have to set up an energy management system, including an energy audit, staff training, procurement policies favouring energy efficiency, and annual progress reports. In addition, the enterprise must commit to an energy-saving target and has to enter into an agreement with the government to be eligible for a partial reimbursement of the tax. The reduction can be revoked if the obligations are not fulfilled, ie in the case of non-compliance. Bjørner and Togeby (1999) found that companies participating in the program accomplished on average 60 per cent greater energy savings than companies subject to the tax only, confirming that this feature of Denmark’s program contributes to the marked impacts on energy productivity. Another powerful aspect of Denmark’s carbon-energy taxation program was the earmarking of 20 per cent of the revenue during the first five years to co-finance energy-efficiency measures and upgrade production

[66] European Commission (EC), *Community guidelines on State aid for environmental protection*, [2001], OJ C 37, 3.2.2001. New guidelines were adopted in April 2008: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:082:0001:0033:EN:PDF

technologies.

The environmental agreement in German industry must be considered in the context of the general energy tax rate reduction (60 per cent of nominal rates). A self-commitment of German industry was announced four years (in 1995) before the ecological tax reform started in 1999. Crucial points of the ETR were the increase in energy tax rates, the introduction of an electricity tax, and a scheme of exemptions for industry. One of the reasons behind the special tax provision was the industry self-commitment which promised that German industry would reduce CO_2 emissions by up to 20 per cent (relative to business-as-usual) by 2005.

In the UK 44 climate change agreements (CCAs) were concluded with different sectors – including ferrous industries and cement - with different sites (target units or TUs) individually signed up within the sectors. The agreements set out targets related to energy use or carbon emissions over this decade, comprising a final target in 2010 and 'milestone' interim targets for 2002, 2004, 2006, and 2008. The CCL on the TUs in all the sectors with CCAs was set for the first target period (to April 2003) at 20 per cent of the rate charged on other industrial and commercial energy use. If a sector, or the individual TUs within it, met their 'milestone' targets, the sector (or the complying TUs) would be 're-certified' (ie entitled to the reduced CCL rate for the next target period, the following two years). If the target was not met, the non-complying TUs would have to pay the full rate of the CCL on their energy use in the next target period. This provides a powerful incentive for the sectors and TUs to meet their targets.

The reduction targets were negotiated between each individual industrial sector and the government (Department for the Environment, Food and Rural Affairs) and by and large were achieved. In fact, the results of the first target period showed a very considerable over-achievement by most sectors compared to their 2002 milestone targets. Overall, the results showed that 221 PJ less energy had been consumed in the CCA sectors compared to the base years, which amounts to an absolute saving of 4.3 million tonnes of carbon (in the UK Climate Change Programme, it was envisaged that the CCAs would only save 2.5 million tonnes of carbon by 2010).

An interpretation of this result is that agreements on energy savings may be effective, but it can further be assumed that one of the important reasons for the effectiveness in reducing CO_2 emissions relates to the penalty payment for non-compliance in the form of withdrawal of the special tax provisions. It was the lack of full compliance with the German self-commitment and the absence of clear rules for penalties that caused difficulties in the European Commission with the initial extension of the scheme for the *Spitzenausgleich*.

Impact on competitiveness

In the following we explore the premises of the exemptions by returning to the sectoral company perspective; what are the costs of ETR to industries and to what extent can these costs be mitigated by revenue recycling through lowering the employers' social security contributions (SSC)? We take advantage of the COMETR database to explore the distributional implications of ETR for the various industry sectors.

From the company perspective the increased level of carbon-energy taxation is offset by two factors: 1) the revenue recycling by reducing SSC, and 2) improved energy efficiency which leads to lower energy costs per unit of output (cf. elasticities derived in Enevoldsen et al., 2007)[67].

Table 6.3 The net costs of ETR in per cent of gross operating surplus, taking into account revenue recycling to employers as well as the share of improved energy efficiency related to the increase in carbon-energy taxes. Positive figures indicate a gain, negative a cost.

	Meat	Paper	Chem.	Pharm.	Glass	Cement	Ferrous	Non-ferrous
DK_{96-02}	-0.8	0.0	-0.1	-0.1	-0.3	1.4	-2.3	-0.9
DE_{99-02}	6.9	1.2	-1.2	1.1	0.2	-0.4	-1.6	-2.1

(Source: Andersen and Speck, 2009).

Table 6.3 provides an overview of the share of ETR net expenditures at the sectoral level as a share of the gross operating surplus[68] (GOS) for Denmark and Germany; countries for which the revenue recycling data could be disaggregated to the sectoral level.

It is evident that for most sectors ETR appears to represent a cost, even when the accelerated energy efficiency improvements which can be related to the tax increases are taken into account. However, the energy productivity improvements which can be related to the tax increases are relatively minor compared with the gross energy productivity improvements that have taken place during the last decade.

Figures6.9 and 6.10 decompose for energy-intensive sectors the net effects of ETR into the gross carbon-energy tax payments, the revenue recycling and the gains from improved energy efficiency, respectively.

From the sectoral perspective the burden for energy-intensive industries is in most cases negative. Company managers in energy-intensive industries may not have appreciated the tax. Yet, the tax-induced improvements in energy efficiency – and if they focused only on the gross burden of ETR, unadjusted for the gains – have reached up to 5 per cent of the gross operating surplus for some energy-intensive industries. However, it is more appropriate to take account of the improved energy productivity. For cement and glass sectors the costs are reduced to less than 1 per cent of the gross operating surplus after revenue recycling of employers' SSC and energy efficiency improvements, while for ferrous and non-ferrous metals it appears to have reached in some cases 2 per cent of gross operating surplus. Denmark's cement sector, on the other hand, experienced a gain of more than 1 per cent of gross operating

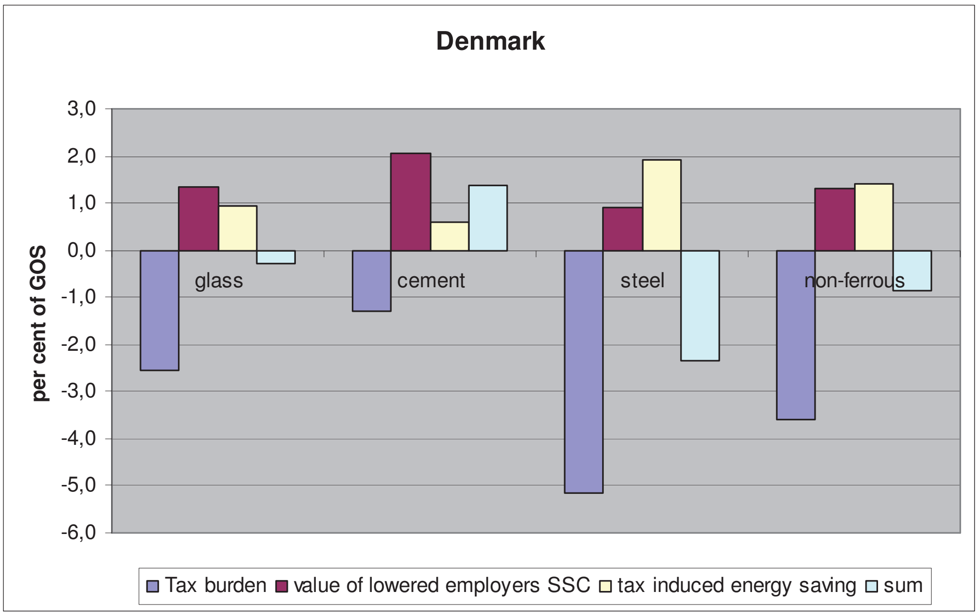
[67] Enevoldsen M.K., Ryelund A.V. and Andersen M.S., 'Decoupling of industrial energy consumption and CO2-emissions in energy-intensive industries' *Scandinavia, Energy Economics* (2007), Vol. 29 (4): 665-692.

[68] Gross operating surplus denotes the surplus of activities before consumption of fixed capital.

surplus.

The claim of the Porter hypothesis[69] is that increased carbon-energy taxation will in the longer term pressure industries to innovate both their processes and products so as to become more competitive and win market shares. Porter does not claim that energy taxation *per se* will induce sufficient energy savings to even out the increased tax burden, the implication of Porter's hypothesis is rather that companies will win on increases in market shares and *demand*.

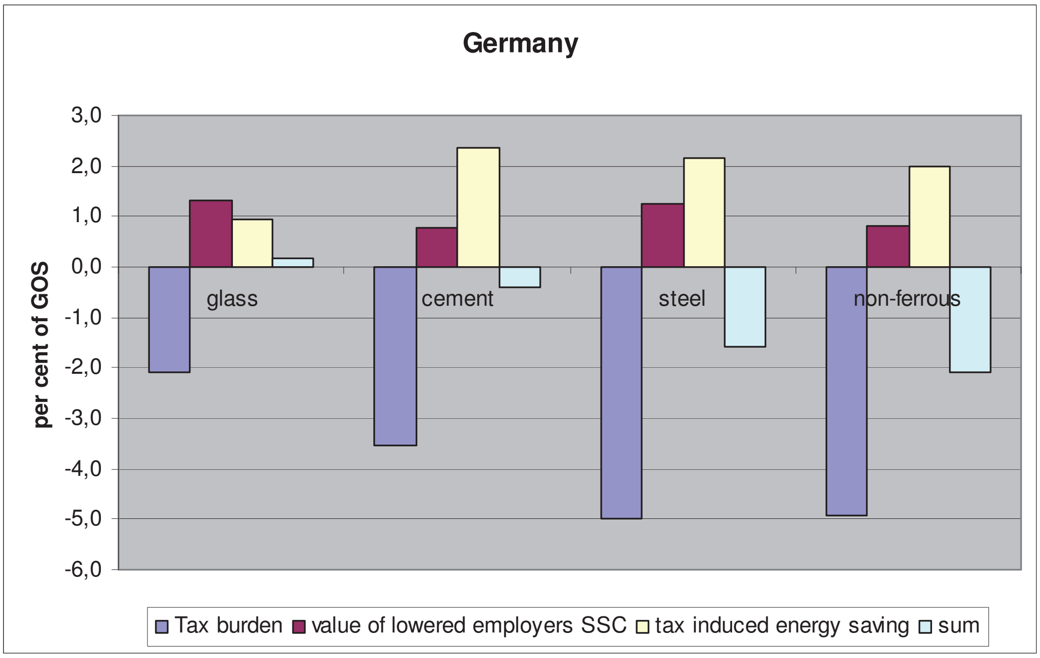
Figure 6.9 Denmark: Gross and net tax burden for energy intensive industries.



(Source: Andersen and Speck, 2009).

[69] Competitiveness, according to Harvard economist Michael Porter, depends on the capacity of a nation's industry to innovate and upgrade, and it is pressures and challenges, in particular from strong domestic rivals, that lead companies to gain advantage against the world's best competitors. Porter argued in *The Competitive Advantage of Nations* (1990) that contrary to conventional wisdom, environmental standard-setting may actually be able to encourage innovation and hence improve competitiveness (the argument is further elaborated by Porter and van der Linde (1995), see also Andersen and Ekins (2009) chapter 1).

Figure 6.10 Germany: Gross and net tax burden for energy intensive industries.



(Source: Andersen and Speck, 2009).

In the COMETR project both the E3ME modelling of the macroeconomic impacts and the panel regression analysis of the impact of energy taxes in 56 industrial sectors pointed to the existence of Porter demand effects (Andersen and Ekins, 2009). In the following we try to put the sectoral costs of ETR, cf. above, in perspective in relation to these 'Porter effects' as well as the gross energy savings attained by industries in the wake of ETR.

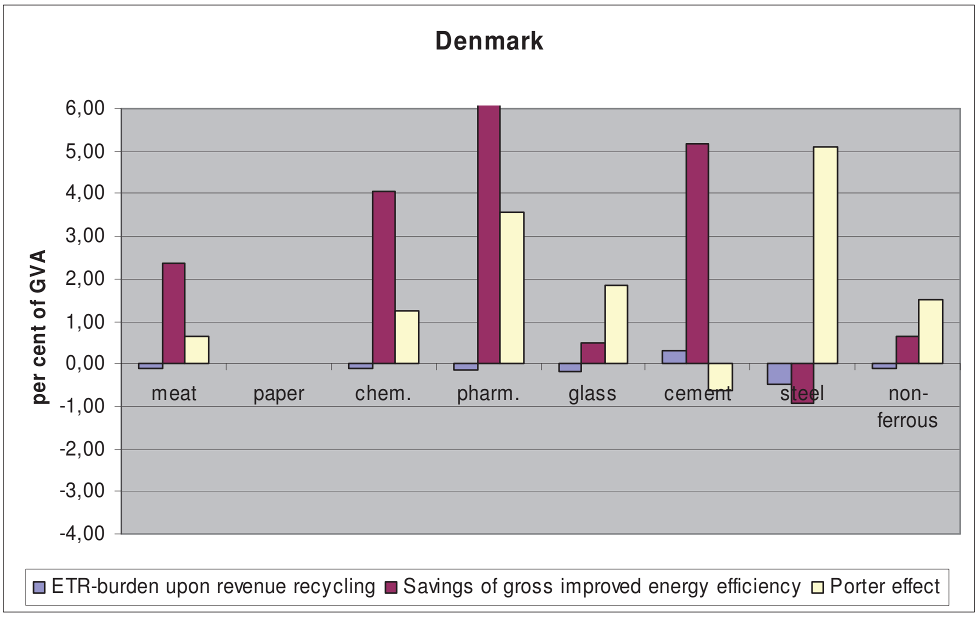
The gross energy savings are the costs foregone per GJ of output at the current energy prices. Bearing in mind that above only the *accelerated* energy savings that could be attributed directly to the annual tax rate increases were included, we show here the value of gross energy savings accomplished by the various sectors. The additional energy efficiency savings attained in most sectors are far higher than can be attributed statistically to the tax rate increases. As energy prices fluctuated within the traditional band over the period analysed here, changes in underlying fuel prices cannot explain the savings.

In most cases where ETR caused increased costs, these are more than offset by the gross energy savings. To some extent the gross energy savings reflect 'business-as-usual' and only those energy savings attributed to the tax rate increases should be included when accounting for the impacts of ETR, as approached above. Nevertheless the gross energy savings achieved do put the costs of ETR in an illuminating perspective.

Figures 6.11 and 6.12 provide an overview of the costs of the ETR burden relative to the gross energy efficiency savings. It is noticeable that unlike most other sectors there has been an absence of improvements in energy productivity in the steel/ferrous industries for both Denmark and Germany. It is the same for German cement, while Danish cement shows a strong improvement.

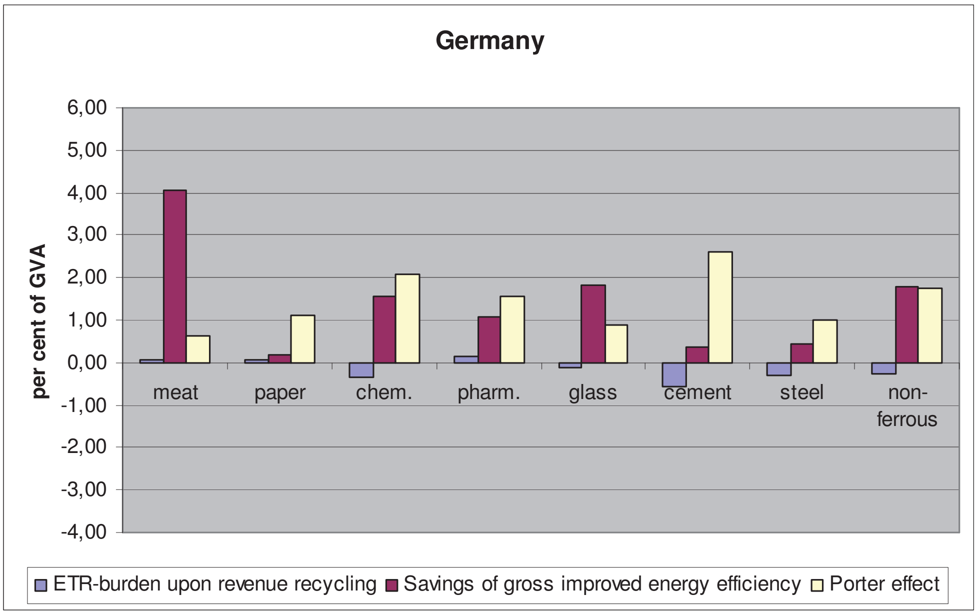
An estimate for the Porter demand effect to gross value added is provided on the basis of the relationships derived in the panel regression analysis. They indicate that the economic growth in the sectors to some extent was boosted by the tax switch. However, as a minor degree of multi-collinearity in that analysis could not be ruled out, the Porter demand effects must remain a best guess and requires further efforts with improved econometric techniques.

Figure 6.11 Denmark: ETR-burden, energy savings and Porter effects in energy-intensive industries (1996-2002)



Source: Andersen and Speck, 2009.

Figure 6.12: Germany: ETR-burden, energy savings and Porter effects in energy-intensive industries(1999-2002).



Source: Andersen and Speck, 2009.

Conclusions

The ferrous industries and the cement sector have benefitted from some of the most extensive reductions and exemptions from carbon-energy taxation. As a result the tax burden per unit of GJ and carbon has been low compared with other sectors. Although the tax rates have driven some improvements in energy productivity, it is likely that exactly for these two important sectors the accompanying policy measures, such as agreements (backed by tax payments as penalty) and recycling of revenue for technology support, may explain a great deal too. The 60% higher savings identified by Bjørner and Togeby (1999) point in this direction.

Although energy intensities in the ferrous industries declined notably, no apparent improvements have taken place in their energy productivity as such. This paradox may hinge on ferrous industries being exposed to fierce competition, preventing them from capitalising on the improved energy intensity performance. Energy productivity is a relative phenomenon, and if value added is under pressure, the decline in energy intensity simply goes hand in hand with a decline in value added. Nevertheless the physical reduction in energy consumption and carbon emissions may represent some overall welfare economic value.

For cement, which is less traded because of the unfavourable weight-to-value-ratio, the sector seems to have performed better in energy productivity, having managed to capitalise on the declines in energy intensity. In most of the countries with ETR very marked declines in energy intensities can be noticed. This trend has contributed to improving energy productivity with about 4% p.a.

The experience reviewed here is promising in terms of the prospects for lowering the energy intensity of energy-intensive industries in a relatively short time-span. Whether these improvements in turn will lead to improved competitiveness will depend on a number of factors, including the extent to which producers on the main competing markets embark on similar policies.

According to IEA (2007a) China is with its significant investments in new technology very close to and perhaps performing better in energy efficiency than USA (especially in cement), but does not reach the level of energy productivity which can be found in some parts of Europe. As indicated above existing technologies in cement and ferrous industries could deliver 2/3 of the industrial energy savings necessary to avoid a high-growth scenario for energy consumption in China. With China responsible for 42% of global pig iron production and 46% of global cement production (most of which is consumed domestically) improvements in energy efficiency in exactly these two sectors would likely also have important spin-offs for global energy price developments as well as for future global CO_2-trajectories.

The experience from Europe seems to suggest that in these highly energy-intensive industries introducing a tax switch could provide an important signal to company managers to improve energy efficiency substantially – and that momentum can be created with accompanying policy measures that address the actual technological challenges in the enterprises with advisory support, some subsidies and reduced tax rates (subject to effective penalties).

Annex table: Sector definitions in this paper, following the NACE classifications, cf. European Commission Regulation 29/2002.

Ferrous industries	Manufacture of basic iron and steel and of ferro alloys (27.1) Manufacture of tubes (27.2) Other first processing of iron and steel (27.3)
Cement	Manufacture of cement, lime and plaster (26.5)

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