9. Competitiveness and sectoral change in Dutch industry's low-carbon transition

This chapter simulates the potential economic and social impacts of input costs increases implied by the low-carbon transition on the competitiveness of the Dutch industry, based on a static model describing the industrial structure of the Netherlands and its interactions with the rest of the world through international trade and value chains. It shows that, while the aggregate economic impact of carbon pricing in the Netherlands is likely to be small, energy-intensive and trade-exposed sectors such as iron and steel can be significantly affected if they do not shift toward low-carbon technologies. Support to technology adoption and co-ordination at the European level can attenuate competitiveness effects.

As evident from the previous chapters, the transition to a more sustainable manufacturing sector entails additional costs, in terms of investment, feedstock, energy or taxes. These costs weigh on competitiveness and can affect the industrial structure, especially in a small open economy like the Netherlands. They may also cause carbon leakage, jeopardise the national efforts and undermine public support for climate policy.

At the same time, the green transition can contribute to building a new comparative advantage. Carbon pricing and other climate policies can send the right incentives to ensure Dutch industry remains competitive in the long run. It is important to send the right incentives to ensure the transformation of the industrial sector and allow the Netherlands to thrive in a future net-zero carbon economy, instead of creating stranded assets. In addition, R&D, demonstration and deployment subsidies are meant to reduce the costs of new installations and processes, in terms of capital and operational expenditures (notably energy and feedstock costs, for instance through material and energy efficiency gains).

Moreover, the relationship between climate policy and competitiveness crucially depends on the efforts of trade partners to simultaneously decarbonise their manufacturing sector. For the Netherlands, this is particularly important at the European level, but also at the global level.

Sectoral factors are of primary importance in shaping this relationship, as manufacturing activities are heterogeneous in terms of carbon-intensity, exposure to international competition or availability of low-carbon alternatives (Chapter 2).

Mitigating the adverse impact of carbon pricing on competitiveness can rely on exemptions to energy-intensive trade-exposed sectors, support to adopt low-carbon technologies or co-ordination with trade partners. The Netherlands historically chose the first option, but the second option is now being implemented (Chapter 5).

The objective of this chapter is to simulate the economic and social impacts of the low-carbon transition using a static model describing the industrial structure of the Netherlands and its interactions with the rest of the world through international trade and value chains. This model takes into account the different factors that mediate the relationship between climate policy and competitiveness at a granular sectoral level: carbon-intensity and energy use, degree of trade openness, level of competition with foreign substitutes, ability to switch to less carbon-intensive production modes …

This chapter shows that, consistent with ex post evaluations of the European Emissions Trading System (ETS), the aggregate economic impact of carbon pricing in the Netherlands is likely to be small. Although a significant concern from a microeconomic and human impact perspective, the number of jobs at stake remain limited. This calls for keeping the strong carbon price signal delivered through the carbon levy trajectory in place and to implement accompanying measures to ensure that affected workers can thrive in the labour market (e.g. re-skilling of displaced workers and other active labour market policies, Chapter 9).

Despite small aggregate effects, some sectors, in particular energy-intensive, trade-exposed sectors producing standardised goods subject to an intense competition on worldwide markets such as iron and steel, can be significantly affected under the assumption that they do not shift technologies. This chapter also shows that complementing the carbon price signal with support to low-carbon technology adoption and co-ordination at the European level can attenuate concerns over the short-run competitiveness of those sectors and substitute to sectoral exemptions.

9.1. Modelling the impact of low-carbon policies on the competitiveness of the Dutch economy

The effects of the low-carbon transition on the Dutch economy are simulated thanks to an augmented input-output (IO) model (Box 9.1 presents a more detailed description of the model). It is designed to reflect the current input-output structure of the economy in three regions (the Netherlands, the rest of the European Economic Area – EEA – and the rest of the world) at a granular sectoral level (39 sectors).

The IO modelling has the advantage of providing results at a detailed sectoral level, allowing to measure the impact of shocks on the structure of the economy and accounting for inter-sectoral linkages.

The standard IO approach however suffers from important limitations, in particular the absence of economic behaviour and cost optimisation. To overcome the latter, this chapter relies on an augmented IO model, which incorporates some important margins of adjustment relevant for the low-carbon transition of the Dutch economy. First, it models the substitution between energy and other factors of production, for instance allowing sectors that face a higher energy price to reduce their energy intensity, but at the expense of higher capital or labour costs. Second, demand is reacting to price changes, allowing to measure the impact of competitiveness changes on the economic activity in different regions. This analysis can be carried out for the energy-intensive sectors that are directly confronted with the transition, but also for the upstream or downstream sectors that are affected by changes in demand or in prices.

Although the model incorporates a general equilibrium dimension (domestic revenues affect domestic demand), it is not a fully-fledged Computable General Equilibrium (CGE) model. In particular, there is no price channel, which is usually key in CGE models to limit the impact of demand shocks and bring back the model to the equilibrium determined by the supply side. In such models, countries cannot run trade surplus or deficits for a long period as real exchange rates (through wages or nominal exchange rates) adjust to bring back the trade balance close to equilibrium.

Moreover, and very importantly, the augmented IO model corresponds to a comparative statics approach. It does not feature dynamics or any notion of time. For instance, investment is not modelled, which precludes simulating the dynamic effect of carbon pricing, deployment or R&D subsidies. This requires the modelling of endogenous productivity growth and spillovers, which are seldom found even in larger CGE models. The results of the model should therefore not be interpreted as the results of more stringent climate policy. Rather it shows what sectors will need specific attention when transitioning to a low- or net-zero carbon economy.

Compared to more complex CGE models, the augmented IO approach allows for a more granular sectoral approach while keeping a high degree of transparency, so that users and readers can easily understand the factors driving the results.

Box 9.1. An augmented input-output model to assess the impact of the green transition on the Dutch economy

Structure of the model

Figure 9.1 presents the functioning of the model, which is based on the OECD Inter-Country Input-Output (ICIO) Tables (OECD, 2018[1]) . It can be divided into three main building blocks:

The Input-Output price model. Following a shock affecting some of the prices, the model simulates the impact of the shock on the prices of all the products using input-output linkages and substitution between energetic inputs and other factors of production.

- For instance, if the shock corresponds to a tax on the Dutch natural gas sector, the price model will compute the impact on the price of products using Dutch natural gas as an input (e.g. refineries in the Netherlands or abroad). Beyond this first order effect, the model provides price effects taking into account all the input-output linkages (e.g. chemical products using refined petroleum products, food products using chemicals…) by using a Leontief inverse matrix.

- This block also models the substitution between energetic and non-energetic inputs. Faced with an increase in energy prices, firms may want to reduce their costs by lowering their energy intensity, at the expense of higher labour costs and capital expenditures. The sectoral elasticities of substitution are taken from Hebbink et al. (2018[2]), estimated for the Netherlands on the period 1978-2015, and applied in the model to the three regions.

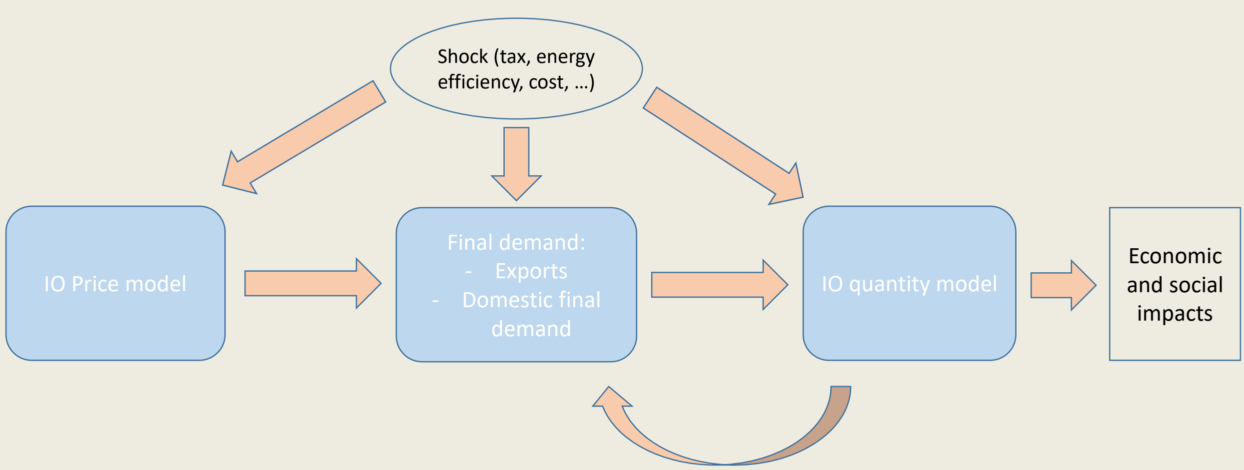
The final demand block. This block simulates the impact of price changes on the final demand addressed to producers in each region.

- Final demand is broken down into exports and domestic final demand (final consumption, investment, changes in inventories) and sectoral price elasticities of demand are applied. The price elasticity of exports is generally higher than the one for domestic final demand since competition is fiercer in international markets, and foreign consumers usually do not have a strong preference over the origin of products once they are imported. The sectoral price elasticities for exports and domestic final demand are taken from Hebbink et al. (2018[2]), relying on an extensive review of the empirical literature.
- Imports of goods are indirectly affected by these elasticities as they correspond to exports from one of the two other geographical regions.

The Input-Output quantity model. This block simulates the impact of changes in final demand on the production of each sector in each region.

- Using the input-output tables, the model simulates the impact of changes in final demand on the demand for intermediate inputs. As for the price model, in order to take into account all the linkages, the Leontief inverse matrix is used. This allows obtaining the effect on value-added, production or employment at the sectoral level.
- The model also features a feedback loop between this block and the final demand block to take into account the 'income effect'. This feedback loop is estimated by first considering the changes in household's income resulting from changes in economic activity, which by its turn has an impact on household's consumption. This impact on consumption is measured by considering the use of household's income elasticities at the product level, based on the Global Trade Analysis Project (GTAP) model (Hertel and van der Mensbrugghe, 2016[3]). The resulting change in consumption is then used in the Leontief model to estimate its impact on the economy.

Figure 9.1. Overview of the input-output model



Starting from an initial situation (data for 2015), the model is designed to simulate the effect of various types of shocks (carbon pricing and subsidies, energy efficiency gains, etc.). Shocks can affect the three regions and enter the model through three gateways:

- They can affect prices (e.g. a price on carbon emissions).
- They can affect final demand (e.g. revenues from a carbon price can be consumed either by the government or by households and firms after a transfer through tax cuts or subsidies).
- They can affect intermediate consumption through the IO quantity model (e.g. energy efficiency gains in the manufacturing sector).

Scenarios simulated using the augmented IO model

Several scenarios are simulated using the model to provide a plausible narrative on the potential short-run sectoral effects of the low-carbon transition. In these scenarios, proceeds of carbon pricing are assumed to increase proportionally the final demand from a given region, without affecting the structure of the final demand by product or by origin of the products.

The first set of scenarios is designed to understand what sectors will need specific attention when transitioning to a low-carbon economy and some measures to limit this impact:

- Scenario A: Uniform tax increase of EUR 50 per tonne of CO_2 on all the CO_2 emissions in the Netherlands.
- Scenario B: Uniform tax increase of EUR 50 per tonne of CO_2 on all the CO_2 emissions in the European Economic Area.
- Scenario C: Uniform tax increase of EUR 50 per tonne of CO_2 on all the CO_2 emissions in the European Economic Area and a similar tax on the carbon content of imported carbon-intensive goods from the rest of the world. It is implemented on the products that are usually considered for a Border Carbon Adjustment (non-metallic mineral products – including cement, refined products, chemicals and metals – ferrous and non-ferrous). The emission intensity of imports used to calculate the tax is the one for the rest of the world.

The second set of scenarios is designed to illustrate policy options in the Netherlands:

- Scenario D: Carbon levy of EUR 125 per tonne, without SDE ++ nor technical change. Scenario D simulates the effect of a carbon levy at its 2030 rate on the four manufacturing sectors that are responsible for the vast majority of the emissions (food processing sector, refineries, chemical sector, metallurgical sector – both 'iron and steel' and 'non-ferrous metals'). The scenario implicitly assumes that firms do not adjust their production processes but keep the same technology and the same emissions-intensity of output. This scenario is meant to illustrate a worst-case in which firms do not undertake any investment to reduce their emissions and are not supported by innovation and deployment subsidies. The additional costs for Dutch firms are obtained by assuming that the ETS price reaches EUR 80 per tonne of CO_2. Preferential treatment via free allocation of pollution permits is included. The share of free allowances for the ETS and dispensation rights for the carbon levy follow estimates by CE Delft (2021[4]).
- Scenario E: A flat effective average carbon tax rate. This scenario assumes that regressive rates and exemptions in the energy tax and surcharge are removed, to reach an effective average carbon price of EUR 30 per tonne of CO_2 (including fuel taxes, ODE on natural gas, the carbon levy and the EU ETS price). This flat rate is also applied to the same four manufacturing sectors that are responsible for the vast majority of emissions, except food processing, for which the effective average carbon rate is already above EUR 30 (**Table 5.24**).

Several studies have already investigated the impact of the low-carbon transition on the short-run competitiveness of the Dutch economy. Hebbink et al. (2018[2]) use the same augmented IO approach, although the models and scenarios differ. PwC (2020[5]) instead relies on case studies on the "big 12" firms to assess the impact of the carbon levy, the energy tax and the surcharge reforms on their earnings before interest, taxes, depreciation, and amortisation (EBITDA) and the attractiveness of investing in the Netherlands. Vollebergh et al. (2019[6]) analyse the economic impact of several CO_2 pricing options using the recursive dynamic general equilibrium Worldscan, developed by the Centraal Planbureau (CPB). Finally, CPB and PBL (2019[7]) compare the results obtained from the three above-mentioned studies.

A few results of these studies stand out:

- The competitiveness impact of emission pricing is limited at the aggregate economy level but may be significant for some sectors (Hebbink et al., 2018[2]; CPB and PBL, 2019[7]).
- The competitiveness impact is significantly smaller when emission pricing is implemented at the European level, and not only in the Netherlands (Hebbink et al., 2018[2]) under the assumption that no additional technology support is granted.
- The use of carbon pricing revenue dramatically affects the impact of the simulations (Hebbink et al., 2018[2]; Vollebergh et al., 2019[6]).
- The results are sensitive to several assumptions, notably the substitutability between domestic and foreign goods, the time horizon on which these elasticities are estimated, in particular whether these take into account location decisions in the long run (PwC, 2020[5]; CPB and PBL, 2019[7]).

This study is closest in spirit to Hebbink et al. (2018[2]) and Vollebergh et al. (2019[6]). It complements their findings by implementing new carbon pricing scenarios and using a different model. While Vollebergh et al. (2019[6]) use a CGE model, the augmented IO approach used in this chapter is simpler, although it integrates additional economic behaviours compared to Hebbink et al. (2018[2]).

This sensitivity of the results to the price elasticity of demand also applies to the model used in this chapter. For this reason, elasticities were selected to lie in the middle of available estimates and be treated in a conservative way (Hebbink et al., 2018[2]; Imbs and Méjean, 2010[8]). A doubling of price elasticities roughly leads to a doubling of sectoral effects.

9.2. Short-run competitiveness concerns require flanking policies in some sectors, but macroeconomic effects are small

9.2.1. Even under a worst-case scenario, the adverse impacts of carbon pricing are limited to a small number of sectors

This subsection provides the simulated impact of the carbon levy at its 2030 rate (EUR 125 per tonne of CO_2) on the four manufacturing sectors that are responsible for the vast majority of the emissions (food processing, refineries, chemical sector and metallurgy (Box 9.1, Scenario D).

Similar to most models the augmented IO model is unable to simulate the impact of the price signal on the uptake of new low-carbon technologies, on energy efficiency improvement, and the impact of technology support measures. The emissions base in the model remains the same. Therefore the results of this simulation do not necessarily reflect the effects of a more stringent climate policy in the Netherlands. Rather they point to the sectors that are particularly affected by the low-carbon transition and may need specific attention. The simulation is meant as a thought experiment to better understand the mechanisms at play and represent an unlikely worst-case scenario in which emissions remain at their initial level and affected industries are not supported through subsidies. The next subsections shed light on how support schemes such as Sustainable Energy Transition Incentive Scheme (SDE++) and co-ordination at the European level can drastically reduce the effects.

This scenario corresponds to an increase in the average effective carbon price, reaching a level of EUR 25-40 per tonne of CO_2 depending on the sector (Table 5.24). These numbers are much lower than implementing a marginal price of EUR 125 per tonne of CO_2 (Table 5.17) because a significant share of the emissions in these sectors benefit from free allowances in the EU ETS and free dispensation rights for the carbon levy (Tabme 5.19).

Even without technology support and emission reduction, increasing the price to EUR 125 per tonne now would be mild on the Dutch economy (Figure 9.2, -0.1% on total value added). As the carbon levy mainly weighs on manufacturing sectors, the impact on the value added of these sectors would be higher (-0.9%), although not major. In contrast, the impact on services sectors would be nil. On the one hand, domestic services are affected by higher prices of domestic manufacturing goods used as inputs, although this effect is mitigated by the possibility of substitution by imports. On the other hand, as they represent a high share of final demand, they benefit from the redistribution of the carbon levy revenues[1].

The impact is however very heterogeneous across manufacturing subsectors. Iron and steel is by far the most affected sector, with a decrease of -7.2% in value add. The effect is also significant in the coke and refined products sector and the chemical sector (respectively -2.2% and -3.9%), whereas the impact on the non-ferrous metal sector is lower (-1.1%).

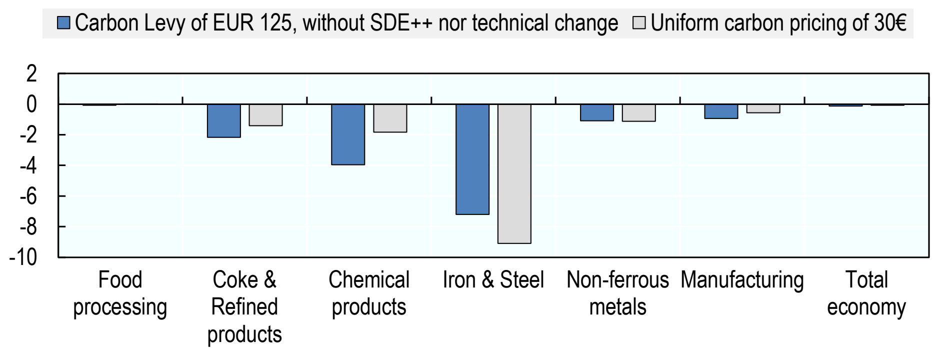
The size of the effect mainly depends on four sectoral factors:

- The emission intensity, which impacts the amount of the carbon price and the extent to which it will weigh on the production costs.[2]
- The price elasticity of demand, which governs the response of the domestic and foreign demand to price hikes.
- The degree of openness to trade, which tends to increase the sensitivity of demand to price changes. The price elasticity of exports being usually higher than the one of domestic demand, the more export-oriented the sector, the higher the response of total demand to price changes.
- The substitution between energy and other factors of production, which allows firms to smoothen the impact of the carbon levy by substituting away from energy.

In addition to these four factors, sectors are differently affected through their input-output linkages, i.e. they suffer from price increases of their emission-intensive inputs and from reduced demand if they supply downstream emission-intensive sectors.

Iron and steel is the most affected sector in these simulations as it cumulates a current high emission intensity, a high elasticity of demand and significant openness to trade (i.e. the sector produces standardised goods which are intensively traded).

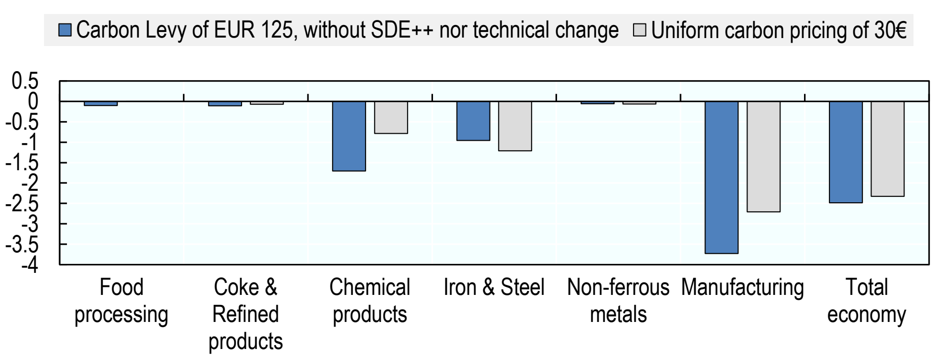
Figure 9.2. Estimated impact of two carbon pricing scenarios on the value-added of selected sectors in the Netherlands (in percentage)



Note: The first scenario assumes a current carbon price of EUR 125 per tonne, no technology support through SDE++ and no technological change (i.e. the emissions base remains the same as in the BAU. See Scenario D, Box 9.1. Value-added in the coke & refined products sector is reduced by -2.2%.
Source: Calculations based on the augmented IO model described in Box 9.1.

The impact in terms of employment would also be limited (-0.03%, representing 2 500 workers in the total economy, Figure 9.3). Employment losses are concentrated in manufacturing (-3 700 workers), while the employment slightly increases in the rest of the economy. Within the manufacturing sectors, most of the employment losses are found in the chemical sector (-1 700 workers) and the iron and steel sector (-1 000 workers). While the relative impact is the highest in the iron and steel sector, this sector only represents a small share of employment (1.8% of jobs in the manufacturing sector).

Figure 9.3. Estimated impact of two carbon pricing scenarios on the total employment of selected sectors in the Netherlands (in thousand workers)



Note: The first scenario assumes a current carbon price of EUR 125 per tonne, no technology support through SDE++ and no technological change (i.e. the emissions base remains the same as in the BAU). See Scenario D, Box 9.1. Employment in the chemical sector is reduced by 1 700 persons.
Source: Calculations based on the augmented IO model described in Box 9.1.

Figure 9.2 and Figure 9.3 also display the impact of another scenario in which an average effective carbon price of EUR 30 per tonne of CO_2 is applied to the same four subsectors of the industry (Box 9.1, Scenario E,) The impact of this scenario for the total economy and the manufacturing sector (respectively -0.1% and -0.6%) is comparable to the carbon levy scenario. However, the impact on some sectors, in particular "iron and steel" and "non-ferrous metals", is significantly higher. This effect is driven by the removal of significant preferential treatment (i.e. these sectors disproportionately benefit from tax exemptions and free permit allocation in the current situation). The *average* carbon price amounts to

EUR 3.3 per tonne of CO_2 in BAU for the basic metals sector[3], compared to for example EUR 76.3 tonne CO_2 in the food processing sector. For more details of the tax and ETS treatment of these sectors (Chapter 5).

This scenario is meant to represent the impact of reducing the exemptions benefitting energy-intensive sectors, and is complementary to the previous one. While the carbon levy scenario principally affects the *marginal* price of carbon, this second scenario mainly focuses on the *average* price by removing exemptions. Playing both on the marginal and average prices would increase the effectiveness of the carbon price signal while improving its fairness, although the impact on competitiveness could be higher in the absence of accompanying measures.

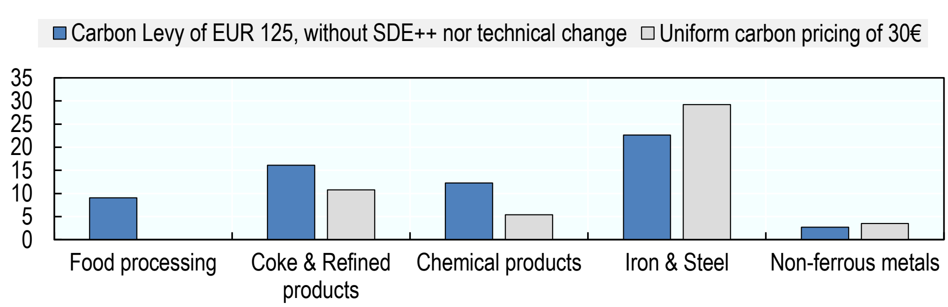
9.2.2. Combining carbon pricing with technology support can limit potential adverse impacts in affected sectors.

In the previous subsection, the proceeds of the carbon pricing are supposed to be spent according to the share of each product in the Dutch final demand. This is however not in the spirit of the Climate Agreement,[4] according to which carbon levy proceeds should be used to finance the greening of the industry (Chapter 5).

Channelling these revenues back to the sectors paying the carbon tax is likely to significantly reduce the impact on their competitiveness. If the proceeds were returned to the sectors contributing to the levy to exactly match the payments, the competitiveness impact would be nil according to the augmented IO model, as their additional costs are completely offset by subsidies.

In practice, these sectors are likely to invest these revenues to reduce emissions, particularly if benefits from abatement payments are explicitly conditioned on green investments as in the SDE++ scheme. In that case, although costs are temporarily higher in the short run and may affect competitiveness, these investments are meant to offset the higher carbon price and could allow competitiveness gains in the medium run.

Figure 9.4. Estimated sectoral energy efficiency gains required to offset the effect of carbon pricing on competitiveness (in percentage)



Note: In the first scenario (carbon levy as of 2030, without SDE++ nor technical change – Box 9.1, Scenario D), energy efficiency gains of 12% are required in the chemical sector to offset the competitiveness impact of carbon pricing.
Source: Calculations based on the augmented IO model described in Box 9.1.

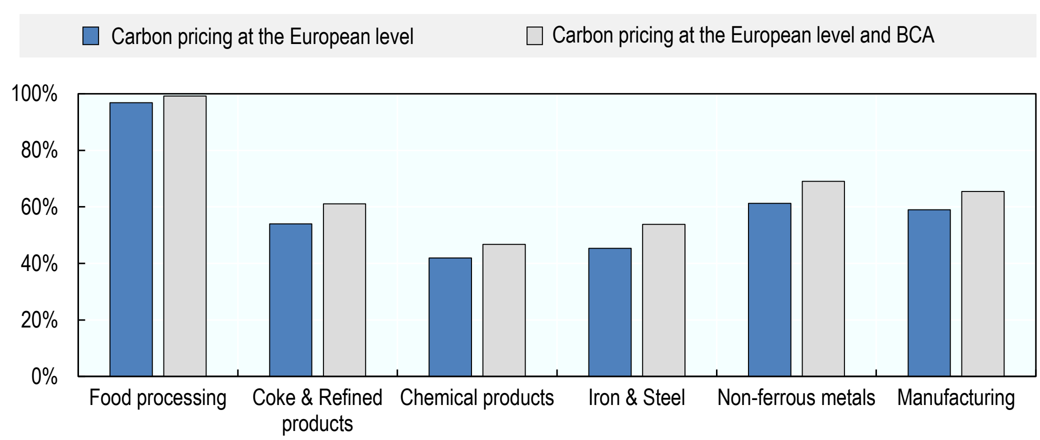
Figure 9.4 displays the sectoral efficiency gains that would be needed to completely offset the effect of carbon pricing on competitiveness. These efficiency gains are illustrative of the efforts required by the manufacturing industries to recover their competitiveness, but do not constitute an energy efficiency gain target since industries have other alternatives to reduce their emissions, such as switching to carbon-free energy sources (biomass, blue or green hydrogen, renewable electricity) and carbon capture and storage (CCS). For the carbon levy scenario, these efficiency gains range from 3% in the non-ferrous metal sector to 23% for iron and steel. Despite a roughly similar increase in the average carbon price, the required energy efficiency gains are higher for sectors using emission-intensive energy (e.g. coal in the iron and steel sector compared to electricity in the non-ferrous metal sector). For comparison purposes, emissions are supposed to be reduced by around 38%[5] in the industry between 2017 and 2030 under the Climate Agreement.

9.2.3. European co-ordination in carbon pricing can also significantly reduce the adverse impact on competitiveness

Implementing carbon pricing at the European level would significantly reduce the negative competitiveness effect on the affected sectors. Figure 9.5 compares the impact of carbon pricing, if implemented at the Dutch or European level. It shows that the average competitiveness effect in manufacturing is more than halved (-59%) when carbon pricing is implemented at the European level. This effect is heterogeneous across sectors, depending on two factors. First, it is affected by the respective importance of intra-European and extra-European trade for Dutch firms. Second, it depends on the emission intensity of Dutch firms compared to their European counterparts. If Dutch firms emit less than their European competitors, carbon pricing at the EU level gives them a comparative advantage. The reduction of the competitiveness effect is the smallest in the chemical sector (-42%), while it is almost fully offset in the food-processing sector (-97%).

Figure 9.5. Carbon pricing at the European level and BCA mechanisms significantly reduce the estimated impact on competitiveness

Reduction of competitiveness effects (measured in terms of value-added loss), compared to unilateral carbon pricing



Note: When a carbon price increase is implemented at the European level (Box 9.1, Scenario B), the negative competitiveness effect on the Dutch manufacturing sector is reduced by 59% compared to a unilateral carbon price (Box 9.1, Scenario A,). If the European carbon price increase is supplemented by a BCA (Box 9.1, Scenario C), the negative competitiveness effect on the Dutch manufacturing sector is reduced by 65% compared to a unilateral carbon price (Box 9.1, Scenario A)
Source: Calculations based on the augmented IO model (Box 9.1).

On top of carbon pricing at the European level, the hypothesis of levelling the playing field between European producers, subject to carbon pricing and extra-European producers through a border carbon adjustment (BCA) is often considered by policy makers and academia, even if this option raises unresolved practical and legal questions (OECD, 2020[9]). Figure 9.5 confirms that implementing a BCA at the European level on five products (food processing, refined products, chemicals and metals – ferrous and non-ferrous) would further limit the competitiveness effect on Dutch producers, in particular for the iron and steel and non-ferrous metals sectors. However, the additional impact would remain modest as the BCA implemented in these simulations only benefits the competitiveness of European producers in the European market, but not in foreign markets. If coupled with an export-based rebate (offsetting carbon pricing for exported products), the impact would be significantly greater (Fischer and Fox, 2012[10]; Branger and Quirion, 2014[11]), but the rebate could reduce the incentives to decarbonise the domestic production.

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Notes

[1] See below a discussion on an alternative use of tax revenues.

[2] The emission intensity in the current model does not change, i.e. it is assumed that no technological improvements are made thanks to the carbon levy and SDE++.

[3] It consists in the 'iron and steel' and 'non-ferrous metals' subsectors. Average effective carbon rates are however not available at that level of disaggregation.

[4] "Any revenue generated by the carbon levy will be channelled back into making industry greener. This will be achieved through a generic subsidy scheme, which will be linked to an already existing subsidy scheme".

[5] Emissions in the industry are 58 Mt eq CO_2 in 2017. The Climate Agreement plans an additional reduction of emissions of 14.3 Mt eq CO_2, on top of the 7.7 Mt eq CO_2 reduction already included in the National Energy Outlook 2017.

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