10. Policies for decarbonising Dutch industry

This chapter proposes overall policy recommendations for achieving industry decarbonisation based on the analyses presented in Chapters 2 to 9. The recommendations concern the three main areas for policy action: carbon pricing, technology support, and complementary policies and framework conditions.

The current Dutch policy mix for industry decarbonisation combines an ambitious carbon pricing policy with extensive and targeted technology support in a bottom-up cluster-based strategy. Combining carbon prices with technological-specific support forms the basis of an effective and cost-efficient policy package. On one hand, well-designed carbon pricing makes a technology-neutral case for low-carbon investments and consumption choices. On the other hand, support schemes for low-carbon technology development and deployment, such as the Sustainable Energy Transition Incentive Scheme (SDE++) subsidy or the energy investment allowance (EIA) tax allowance, encourage the adoption of emerging low-carbon technologies that may achieve significant cost-efficient emission reductions in the long run. Carbon pricing and technology support are not substitutes but mutually reinforcing policy instruments, as strong future carbon prices help create demand for new low-carbon technologies developed with the help of technology-specific support. Complementary policies aimed at providing adequate infrastructure and framework conditions preserving business dynamism are necessary to ensure the success of such decarbonisation strategy.

Consolidating elements from the analyses in Chapters 2 to 9, this chapter develops overall policy recommendations for achieving industry decarbonisation. The recommendations concern the three main areas for policy action: carbon pricing, technology support, and complementary policies and framework conditions.

10.1. Carbon pricing – a cornerstone of the Dutch climate policy package

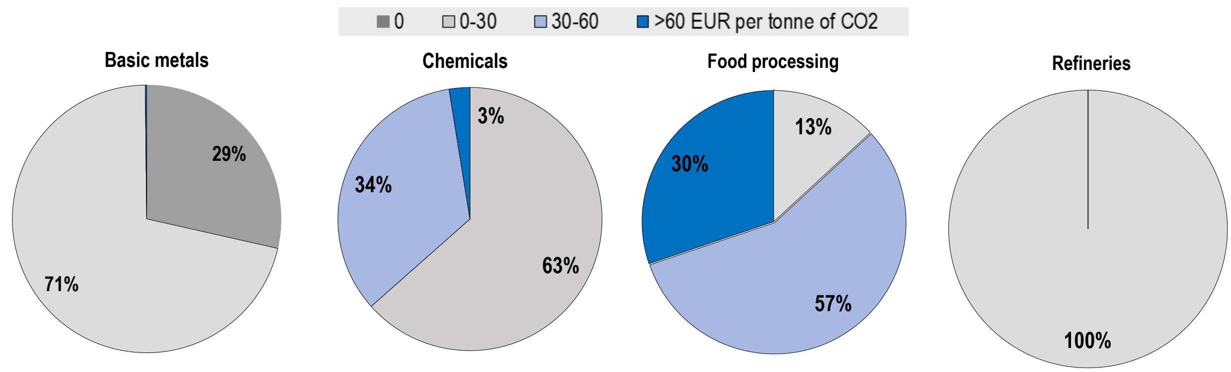
Carbon pricing is an effective and low-cost means of achieving carbon abatement. While most likely not in itself sufficient to deliver the degree of abatement required to reach the Dutch climate objectives, carbon pricing is an essential part of the solution. Carbon pricing makes polluters pay for the damage their emissions cause to society. Increasingly, carbon prices are set at levels to help societies reach their abatement targets. By raising the user cost of carbon-intensive assets, well-designed carbon pricing provides a technology-neutral case for low-carbon investment and consumption choices. Strong carbon pricing in the future increases the benefit of carbon-neutral technologies, making them worthwhile even in the absence of significant additional support. Carbon pricing can also support public finances by augmenting tax revenues.

The design of electricity taxation matters for decarbonisation too. Electricity taxes apply to an energy output (electricity) and are typically not distinguished by energy source, therefore, they typically do not send a carbon pricing signal and are discussed separately below. If they apply per output and independently of the energy source, they make electricity more expensive even when it is produced from clean energy sources and fail to favour decarbonisation of the electricity mix. They also may discourage deep cuts in carbon emissions through electrification of production processes when electricity generation itself is decarbonised.

In 2021, the Netherlands implemented a new carbon levy in industry that sets out an ambitious price trajectory until 2030, providing a clear signal to invest in long-term low-carbon assets and infrastructure. The carbon levy comes on top of several other existing instruments that effectively put a price on Dutch carbon emissions: the EU ETS, energy tax on natural gas[1] (fuel excise) and a sustainable energy surcharge (Opslag Duurzame Energie [ODE]) on natural gas[2]. However, concerns over competition that domestic energy users may face from firms in countries with less ambitious carbon pricing and energy taxation policies have led the authorities to grant extensive preferential treatment to energy-intensive users, such as tax exemptions, regressive tax rates, and freely allocated emission allowances. Such preferential tax treatment reduces the abatement incentive from carbon pricing. Although free allocation of pollution permits preserves the price signal at the margin, they can counteract incentives to shift towards low-carbon technologies (Box 5.1 in Section 5.1.3). Beyond preferential treatment through carbon pricing instruments, energy-intensive trade-exposed sectors receive significant financial support.

As a result, the overall carbon pricing signal on fossil fuel use in the Netherlands, measured in terms of the OECD Effective Carbon Rate (Box 5.5 in Section 5.8.1), is heterogeneous across the key industry sectors. Figure 10.1 provides a summary measure, indicating to what extent emissions from fossil fuel energy use are priced at different carbon pricing intervals, taking energy tax on natural gas, ODE rates on natural gas and the ETS permit price into account.[3] The carbon pricing analysis focuses on CO_2 emissions from fossil fuel-based energy use, thereby excluding emissions from using fossil fuels as feedstock.

Figure 10.1. Proportion of CO_2 emissions from fossil fuel energy use in industry at different marginal price intervals in 2021



Note: Figures are based on OECD Taxing Energy Use and Effective Carbon Rates methodology (2018[1]; 2019[2]). They include price signals from energy tax and ODE on natural gas (net of exemptions) and the EU ETS permit prices (independently of whether an allowance was allocated for free or not, following the opportunity cost argument). Please refer to Figure 5.10 in Section 5.8 for a more detailed explanation. CO_2 emissions in each sector are calculated based fossil fuel energy use data adapted from IEA (2020[3]), World Energy Statistics and Balances.

The analysis below offers three key policy insights on carbon pricing for the Dutch industry. First, the newly implemented carbon levy for industry sends a strong medium-term signal to encourage significant decarbonisation. Keeping the carbon levy trajectory in place – and potentially expanding it to the period of 2050 – will be critical. The level of the carbon levy in 2030 is determined as the price consistent with the 2030 abatement objective given an estimated *ex-ante* abatement cost curve. Second, the effective carbon-pricing signal, which derives from the carbon levy, EU ETS, energy tax on natural gas and the ODE on natural gas, applies unevenly across industrial users, fuels, production-processes and consumption levels, putting at risk the efficiency and effectiveness of carbon pricing in the Netherlands. This uneven price signal also entails horizontal equity concerns across sectors and energy users. Third, the current design of the Dutch electricity tax and ODE on electricity use does not directly encourage power producers to shift to cleaner sources of energy and, therefore, does not provide direct incentives for the decarbonisation of the power sector. Fourth, provisions aiming at preserving trade-exposed sectors from potential competitiveness losses are pervasive with potentially strong negative effects on the Dutch decarbonisation efforts: shielding carbon-intensive production from carbon pricing can harm the long-run competitiveness of the Dutch economy, leading to stranded assets and stranded jobs in a Paris Agreement-compatible, net-zero carbon world. It can make the decarbonisation of Dutch industry more expensive than needed. Substantive amounts of deployment and other subsidies are distributed to energy-intensive industries largely attenuating competitiveness concerns. This support should be reassessed in the light of the policy developments in Europe and abroad, with the view of phasing out inefficient carbon pricing exemptions and strengthening the policy ambition of carbon pricing across all users. The next sections discuss these insights and associated policy recommendations in more detail.

Recommendation 1 – Maintain the carbon levy trajectory to provide a strong medium-term signal and encourage significant decarbonisation

Maintain the carbon levy trajectory – and potentially expand it to the period of 2050 – to provide a strong medium-term signal to encourage significant decarbonisation

10.1.1. The carbon levy trajectory sends a medium-term signal to encourage significant decarbonisation. The carbon levy's success will depend crucially on not compromising on this design feature in the future.

The newly introduced national carbon levy acts as a complement to the EU ETS and aims at setting a minimum price trajectory on Dutch emissions covered by the system. The carbon levy is supposed to provide insurance against the risk that EU ETS prices drop to levels that threaten investment in low-carbon assets. In theory, effective minimum prices lowers risk for investors beyond the volatile and uncertain price signal that derives from the EU ETS. Excessive carbon price volatility limits emission reductions and discourages clean investment to the extent that it causes risk-averse investors to forego clean investment that they would have undertaken with more stable prices. In particular, volatile carbon prices increase the cost of capital linked to an investment, which is particularly relevant for investments that require high capital expenditures upfront. Stable carbon prices in turn limit the increase in the cost of capital and can convince risk-averse investors that clean investment provides reliable returns in the future and is worthwhile (Flues and Van Dender, 2020[4]).

Setting a pre-defined price trajectory is an important feature of the national carbon levy (Table 10.1). Committing today to future price increases can create strong incentives, particularly for investments in long-lived assets and infrastructure – which are typical in the industry sector. It will also reduce economic and competitiveness disruptions that may be driven by high prices in those sectors where costs to implement decarbonisation technologies are high in the short-run but relatively lower in the long run (e.g. some sectors may be able to switch to a new zero-carbon technology in the longer run, but cutting emissions may be difficult as long as the existing technology remains in use). Phasing-in the levy base over time (Table 10.2) further attenuates short-run competitiveness concerns. Carbon price trajectories can also increase acceptance of the policy through transparency and by leaving room for adjustments (e.g. technological shifts or efficiency measures) to avoid paying the higher future price.

Table 10.1. Statutory price trajectory of carbon levy in 2021

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Levy rate (in EUR per tonne of CO_2)	30	40.56	51.12	61.68	72.24	82.8	93.36	103.92	114.48	125.04

Note: Calculation based on legislative proposal "Wetsvoorstel Wet CO_2-heffing industrie", Art. 71p.

One important success factor of the carbon levy in driving emission reductions is the government's ability to commit to rising prices in the future. As changes to the governing coalition may lead to a revision of the price trajectory, or a removal of the levy in the extreme case, it does not provide a perfect commitment device. The recent general elections provide uncertainty in this respect. Wide-ranging agreement across the political spectrum on future prices can help increase the credibility of price expectations. Having developed the carbon levy and price trajectory through ongoing conversations with stakeholders in the context of the Climate Agreement may increase and have widened the acceptability of the instrument by the relevant parties.

These positive features of the carbon levy, however, may not play out their full potential. In particular, the generous (over)allocation of dispensation rights to carbon-intensive sectors[4] largely erodes the carbon pricing signal, particularly in the early years of the levy (Table 10.2). The small market size may hamper the efficient allocation of dispensation rights as only little trade may occur, and most likely only within the industry clusters. Also, indexing the allocation of dispensation rights on the current production volume does not encourage energy-intensive users to reduce emissions by producing less. In addition, the complex design of the carbon levy increases the administrative and compliance burden for liable firms.

Table 10.2. Estimated proportion of emissions paying the levy in key sub-sectors

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Chemical industry	5%	10%	14%	19%	24%	27%	32%	37%	42%	46%
Food	0%	2%	6%	11%	16%	21%	26%	31%	36%	40%
Metallurgical industry	1%	6%	10%	15%	20%	24%	29%	34%	39%	43%
Refineries	10%	14%	18%	23%	27%	31%	35%	40%	44%	48%

Note: The estimation assumes benchmark values follow the draft revisions to the EU ETS benchmarks published in December 2020. No behavioural adjustments in the emissions base, i.e. no technological shifts, no energy efficiency improvements or rebound effects compared to 2021 are assumed.
Source: CE Delft (2021[5])

10.1.2. Importance of carbon levy for promoting emerging technologies

The carbon levy trajectory is critical to the further development and deployment of the new emerging technologies discussed in Chapter 7. The main reason why industry is not yet investing extensively in these technologies is their cost compared to the carbon-intensive alternatives currently in use. The carbon levy helps to bridge price differentials between substitute processes that differ in the carbon-intensity and thereby encourage investments in these key emerging technologies.

If low-carbon technologies become profitable, the carbon price will not only stimulate their uptake, but also provide an incentive for the industry to invest in R&D. These investments in R&D in turn lead to better and more cost-effective green technologies needed to achieve the climate ambitions. Since investments in R&D only yield a return in the future, it is important that the carbon levy is guaranteed to take effect in the future, as uncertainty about future profitability of using green technologies will decrease investments in R&D today.

The business case for both CCUS/ carbon capture and storage (CCS) and the electrification of heating are highly dependent on the carbon levy trajectory. For hydrogen, the carbon levy is not sufficient to tip the break even point in the industrial sector, but without the carbon levy trajectory in place, the production of green hydrogen would be even less profitable. Also for the circular economy, the carbon levy helps to create a level playing field for recycling and bio-based materials with fossil fuels based products.

Recommendation 2 – Gradually eliminate energy tax and ODE exemptions, as well as regressive rates, to strengthen the efficiency, effectiveness and fairness of the carbon pricing signal

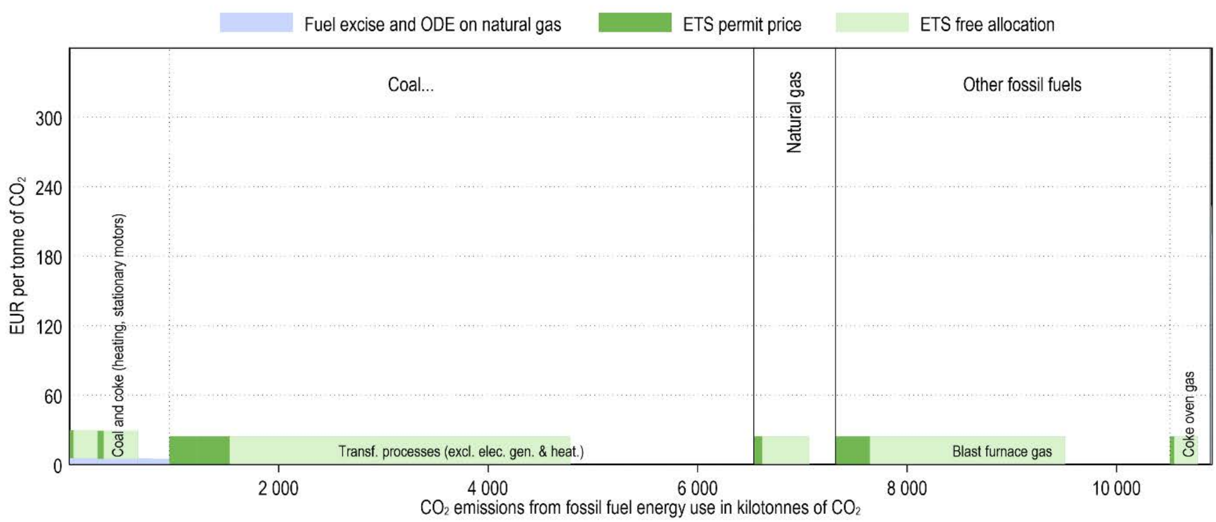
Gradually eliminate tax exemptions and ensure that remaining preferential treatment is aligned with trade-exposure of a specific industrial sector, not only its energy intensity

Different policy instruments are in place that put an effective price on Dutch carbon emissions: the carbon levy, the EU ETS, energy tax on natural gas and the ODE on natural gas. While carbon pricing is an explicit *policy intent* of the first two instruments, it is a *policy effect* of the latter two instruments. The central policy objective of the Dutch energy tax and the ODE is to fund the general budget and the SDE++ subsidies.

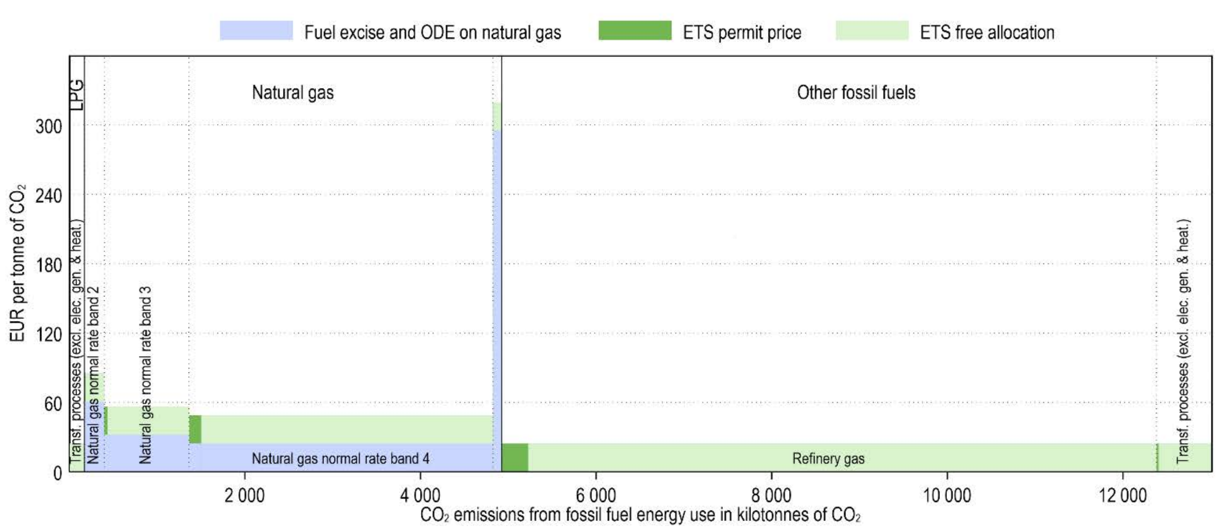
A parallel across all four effective carbon pricing instruments is that they grant extensive preferential treatment to energy-intensive industry users, in particular the chemicals, refineries and basic metals sector. Dispensation rights and pollution permits are allocated freely under the carbon levy and the EU ETS and generous exemptions are granted under the energy tax and ODE on top of their regressive rate structure. These instruments and preferential treatment yield a very heterogeneous carbon rate net of free allocation across energy users within industry. Figure 10.2 provides a detailed overview on how taxes and emission trading prices apply to all fossil fuel energy use in the specific sectors. Free allocation of permits reduces average carbon prices significantly in the basic metals, chemicals and refineries sector. Food processing is subject to relatively high energy taxes because of their nearly exclusive use of natural gas as an energy source and some energy use falling in the relatively highly taxed first consumption bin. Sectoral average effective carbon rates in 2021 are estimated at EUR 76 per tonne for the food processing sector, against an average rate of EUR 13 per tonne in chemicals, EUR 3 per tonne in basic metals and EUR 7 per tonne in refineries. More details on the figure can be found in Sections 5.1 and 5.8.

Figure 10.2. Effective carbon rates on CO_2 emissions from fossil fuel energy use in Dutch main industry subsectors, 2021

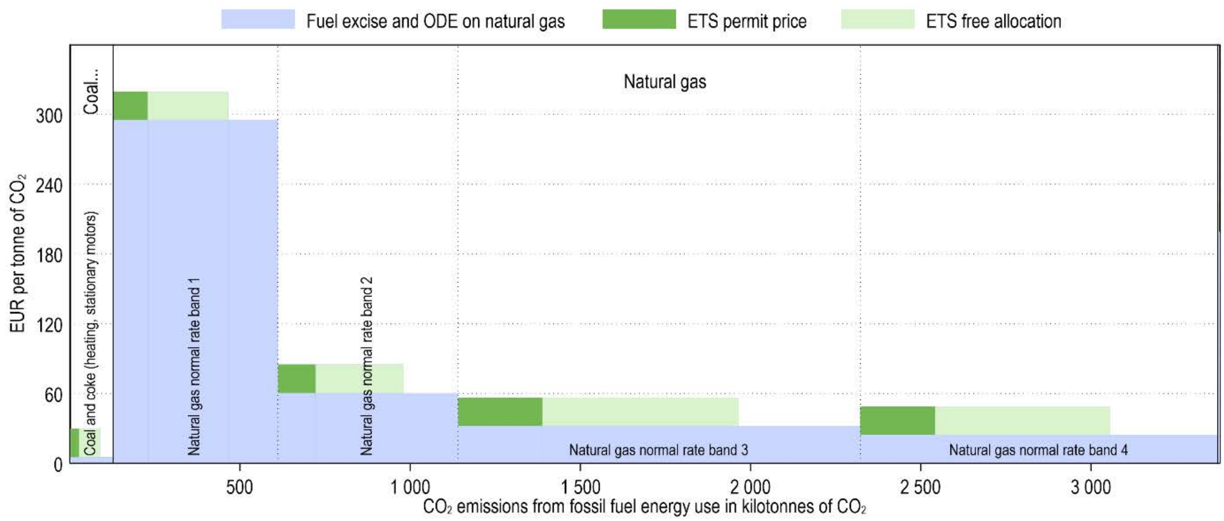
A. Basic Metals



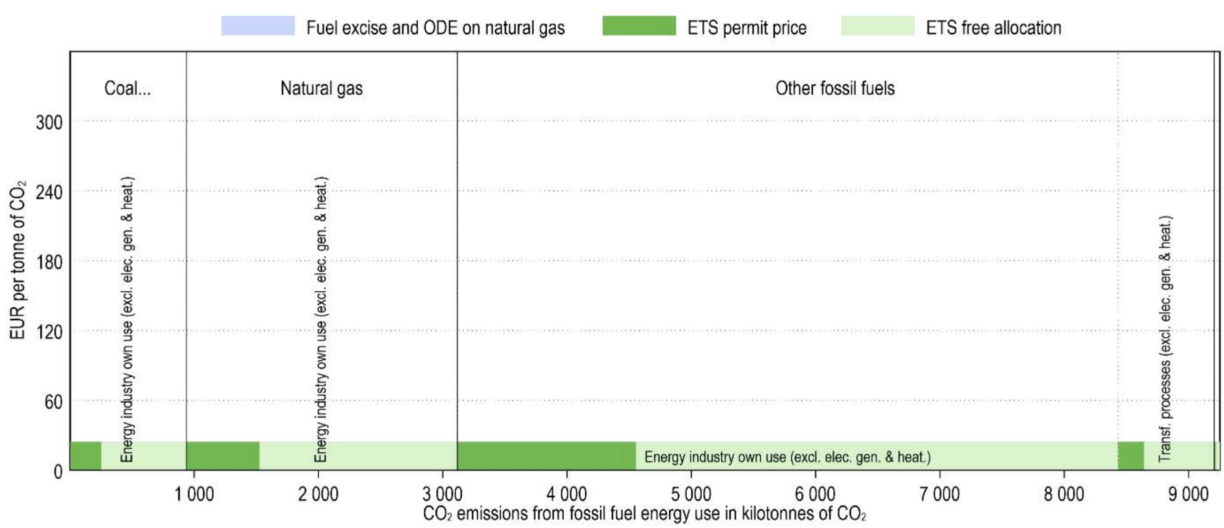
B. Chemicals



C. Food processing



D. Refineries



Note: Please refer to Sections 5.1 and 5.8 for a more detailed discussion. The effective carbon rate (ECR) includes energy tax on natural gas ("fuel excise") and ODE rates on natural gas applicable on 1 January 2021. The ETS permit price is the average price in 2020. The national component of the carbon levy is set to zero for 2021 because of the large amount of excess dispensation rights in 2021 that are not bankable, thereby losing their value for future trading periods. The methodology to estimate the overlap of taxes and ETS prices is explained in detail in OECD (2016[6]). ETS data from the Dutch emissions registry is matched to fossil fuel energy use data from IEA (2020[3]), World Energy Statistics and Balances. It is assumed that the EU ETS coverage distributes evenly across all fuels and users in each sub-sector.

The Dutch climate policy package provides significant support to the deployment of low-carbon technologies in energy-intensive trade-exposed sectors, which cushions competitiveness concerns and can be considered as duplicating the generous carbon pricing exemptions and regressive rates. To avoid duplicating policy efforts and driving down abatement incentives, the gradual phase-out of inefficient exemptions could be envisaged without compromising on industries' long run competitiveness. Additional advances at the EU level may further limit competitiveness concerns (see below).

10.1.3. Gradually eliminating energy tax and ODE exemptions could strengthen the efficiency and effectiveness of the carbon pricing signal in the Netherlands and will generate additional revenues

In the Netherlands, most energy-intensive industry is exempt from paying energy tax and ODE on natural gas. If energy-intensive users are not fully exempt, they are subject to the lowest possible rates given the regressive rate structure of both instruments. More precisely, we estimate that 78% of industrial emissions from fossil fuel energy are exempt from paying energy tax or ODE on natural gas, while 12.5% fall into the bands with the lowest possible rate (bands 3 and 4). Energy tax exemptions for industrial users are a widespread practice within Europe and the rest of the world. Their main objective relates to supporting specific production and addressing competitiveness concerns for certain trade-exposed and energy-intensive industries. However, the regressive rate structure in the Netherlands provides relief to energy users on the sole criteria of energy-intensity and size, with no differentiation based on the actual exposure of a sector to international competition. Similarly, fossil fuels of high carbon content (e.g. coal) are exposed to a much lower carbon pricing signal per tonne of CO_2 than lower carbon content fuels (e.g. natural gas).

From a decarbonisation perspective, this preferential treatment of energy-intensive users adds inefficiency to the overall carbon-pricing signal and entails horizontal equity concerns. As price-induced decarbonisation incentives are not evenly distributed, abatement efforts may not arise where they are cheapest. These policy choices risk increasing the total costs of decarbonising the Dutch industry sector. In addition, while minimal price signals reach the energy-intensive users, the less concentrated industries (e.g. companies in the food processing sector) and small energy users in other sectors pay a relatively high energy tax and surcharge per tonne of carbon.

Equity and political economy challenges are further exacerbated as energy-intensive industry is effectively exempt from financing low-carbon technology support via the ODE-SDE++ linkage, the ODE surcharge is supposed to finance the SDE++ subsidies for specific technologies. The generous exemptions and low ODE rates in the third and fourth consumption bands limit the contribution of energy-intensive industrial users to the ODE-SDE++ redistribution mechanism (Table 10.3). If the framework for providing exemptions is not reformed in the future, small industrial energy consumers risk contributing highly to the expanded SDE++ budget, while potentially having little opportunity for claiming SDE++ subsidies, which are directed mainly at technologies for energy-intensive industry.

Exempting emissions from energy tax and the ODE on natural gas also reduce the effectiveness of carbon pricing via two channels. First, there is no incentive to cut emissions in the sectors that are exempt from the energy tax and surcharge, meaning that at a given carbon price some relatively cheap abatement opportunities are likely foregone. Second, there is an incentive to shift emissions from the emission base that is covered by a price to the emission base that is not covered. For example, as the coal tax is lower (both in CO_2 and gigajoule [GJ] terms) than the lowest rate band of the energy tax on natural gas, there is an incentive for emitters to reduce gas consumption and increase the use of coal.

A standard tax policy advice that applies in this context calls for broadening tax bases, that is removing exemptions, refunds and preferential rates. A future review of the energy tax and ODE on natural gas could aim to rationalise the design of the tax, establish a uniform rate across users and fuels (including coal and liquid fuels) based on their carbon content and remove exemptions. A carbon price that covers all fuels at equal rates expressed per tonne of CO_2 will alter prices more effectively for high-carbon fuels than for low-carbon fuels. This means, for example, the price of coal will increase more than that of natural gas, encouraging energy users to substitute coal with natural gas. Potential positive and negative side-effects on other environmental outcomes and fuel use related externalities could be discussed in that context.

Phasing-out inefficient and unequal tax and surcharge exemptions is facilitated through the generous low-carbon technology-specific support for energy-intensive users and even more so if European trade partners act accordingly. In the context of the ongoing discussions on the EU Green Deal, a revision of the Energy Tax Directive provides room for such an approach.

Table 10.3. Energy tax and ODE payments on natural gas use (2017) and energy base (2016)

	Energy tax payments on natural gas use (in mio EUR)	ODE payments on natural gas use (in mio EUR)	Energy base (natural gas) (in mio m³)
Industry total	221.6	36.48	5 896.1
Contribution by subsector (in %)			
Food, drinks and tobacco	36.3%	37.5%	24.3%
Textile and leather	4.0%	3.5%	1.4%
Wood, paper and graphic industry	7.6%	7.6%	4.0%
Petroleum industry	3.2%	3.8%	8.7%
Chemical and pharma industry	18.5%	22.3%	34.3%
Building materials	0.5%	0.7%	9.7%
Basic metals	0.0%	0.0%	6.8%
Machinery (incl. transport means)	18.9%	15.3%	7.3%
Other industry and repair	10.9%	9.3%	3.6%

Note: Small differences in the sectoral definitions across energy and ODE payments and the energy base may remain.
Source: CE Delft (2021[7]) and CBS (2017[8]).

10.1.4. The current free allocation of EU ETS permits may reduce the incentive of business to invest in break-through production-processes that are necessary for decarbonising the sector

The EU ETS adds an additional price signal to industry emissions beyond energy taxes and ODE. It covers a large part of those emissions that benefit from a full tax exemption (Figure 5.9), thereby providing a market-based incentive for emissions abatement beyond the forgone signal from taxation. There is also some overlap between emissions paying the ETS price, energy tax and ODE (e.g. in the food processing sector, Figure 10.2). The overlap of instruments (ETS, energy tax on natural gas, ODE on natural gas) increases the effective price signal for the given emissions base.

The ETS provides an incentive to reduce emissions at the margin. However, the current mechanism of free allocation of EU ETS allowances limits the decarbonisation incentives for Dutch industry. For example, according to CE Delft, the Dutch chemicals, refinery and basic metal sectors have received free allowances in 2019 that amount to approximately 96%, 73% and 85% of their emissions base – acting similarly to an output subsidy. Poorly designed free allocation rules can weaken incentives for firms to invest in break-through low-carbon technologies and undermine the trading system's effectiveness to drive decarbonisation (Box 5.1).

10.1.5. The short-term risk for a 'waterbed effect' in the EU ETS is uncertain, but likely limited thanks to the design of the market stability reserve (MSR)

The effects of the interaction between the national carbon levy and the EU ETS is complex (Flues and Van Dender, 2020[4]; Perino, Ritz and van Benthem, 2020[9]). There is some limited risk that the combination of implementing the national carbon levy in the presence of the EU ETS leads to no 'additional' emission reduction. Because the EU's overall emissions cap is set at the EU level, additional emission reductions that are taking place in the Netherlands may be offset by emission increases in other parts of the EU, the so-called 'waterbed effect'.

However, the current design of the newly established MSR would lead to some invalidation of emissions allowances following the carbon levy, in particular if cleaner products or cleaner production processes of existing products would substitute the Dutch production. Substitution towards cleaner products or production processes likely increases the amount of unused allowances in circulation at the end of each year. This puts pressure on the allowance price but would also increase the number of allowances placed in the reserve. As described in Chapter 5, if more allowances accumulate in the reserve than are auctioned in the previous year, the surplus of allowances will be invalidated keeping in check the waterbed effect. Because the amount of auctioned allowances decreases every year, all else being equal, additional allowances placed in the reserve in the future are likely to be eventually invalidated. The ultimate effect will depend on whether and when the change in production and additional carbon abatement leads to an accumulation of allowances in the MSR (in which case the carbon levy likely has an "additional" effect on emission reductions) or to a contemporary shift of emissions towards dirty producers in other European countries (in which case there may be a waterbed effect).

Independently of the MSR, the combination of the national carbon levy with the EU ETS introduces inefficiencies in the structure of decarbonisation incentives across the EU, when high cost abatement in the Netherlands that is triggered by the levy replaces cheaper abatement in other EU member states in the short term.

Recommendation 3 – Engage in a thorough review of electricity taxation to support the country's need to electrify industrial processes, without burdening small industrial, residential and commercial consumers

With a strong carbon floor price in place, the elimination of the energy tax and the ODE on electricity use – or a strong reduction towards a low and uniform price per GJ across consumption bins – may be envisaged.

To avoid conflicts between environmental and fiscal objectives, the phasing-down of energy tax and ODE on electricity use could be co-ordinated with the removal of energy tax exemptions on natural gas and the phasing-in of an effective carbon floor price in electricity to generate additional revenue.

Eventually, as the energy system is approaching full decarbonisation, electricity taxes could be reintroduced if so desired.

10.1.6. Engaging in a thorough review of electricity taxation to support the country's need to electrify industrial processes without burdening residential and commercial users

The current design of the Dutch energy tax and ODE on electricity consumption does not directly encourage power producers to shift to cleaner sources of energy, and does not provide direct incentives for the decarbonisation of the power sector. The reason is that the electricity tax is not differentiated by energy source but applies per unit of electricity used. Therefore, it increases the price on all energy sources used for electricity generation irrespective of their carbon content. Electricity taxation still incentivises electricity savings in general.

Pricing the fossil fuel inputs to electricity generation, e.g. via the Dutch carbon floor price in electricity and the EU ETS, specifically applied to fossil fuels, would make them more expensive relative to non-fossil energy sources. Given that the energy tax and ODE on natural gas and direct carbon pricing mechanisms are directly levied on the energy product, they also provide direct incentives to increase power plant efficiency – unlike electricity taxes (OECD, 2019[2]).

Another major concern is that the Dutch energy tax and ODE on electricity consumption discourages the electrification of the industry sector, because taxing electricity use makes switching to electricity less profitable for end users, everything else being equal. This can compromise the decarbonisation efforts under the assumption that the electricity mix is green, or at least greener than the alternative. For example, the tax rate in GJ terms is much higher for electricity than for gas use in all but the highest consumption band (Table 10.4). This favours the use of natural gas over electrification of industrial processes, everything else being equal.

The total price differential between electricity and natural gas use becomes more pronounced taking pre-tax prices into account (Table 10.5). In 2020, pre-tax prices in Dutch industry are EUR 4.7 per GJ for natural gas and EUR 17.2 per GJ for electricity for the typical industrial producer. A carbon levy rate of EUR 125 per tonne applying to the entire emissions base translates into a EUR 7 rate per GJ of natural gas, thereby reducing the differential to some extent.

However, it is not straightforward to compare the electricity and natural gas prices as reported in Table 10.5, as the GJ value of electricity and gas are not strictly comparable, mainly because they are affected by conversion efficiencies, amongst others. Upstream, the electricity price depends on the fuel- and technology-specific conversion efficiency to transform primary energy into electricity. For example, using solar or wind power has a high conversion efficiency (typically considered close to one), while the use of natural gas for producing electricity includes substantive losses bringing the conversion efficiency down to roughly 0.5. Such a factor would translate into doubling the natural gas price displayed in the table that is needed to substitute for one GJ of electricity, everything else being equal. Downstream, using natural gas as an input in some industrial processes may entail larger energy losses compared to using electricity. For example, substituting a gas boiler by an industrial heat pump used in low-temperature heat processes leads to fewer conversion losses. Such considerations are technology and process dependent and could lead to further reductions of the price differential between natural gas and electricity.

Table 10.4. Energy tax rates for natural gas and electricity in EUR per GJ, 2021

	Band 1	Band 2	Band 3	Band 4
Natural gas	13.31	2.50	0.91	0.49
Electricity	26.19	14.34	3.82	0.16

Note: Conversion follows the methodology set out in (OECD, 2019[2]) based on IEA *World Energy Statistics and Balances*.

Table 10.5. Pre-tax prices for natural gas and electricity in Dutch industry, Q2/2020

	Natural gas	Electricity
Unit price, excluding taxes [in EUR/GJ]	4.69	17.22

Note: For natural gas, prices refer to the Eurostat consumption band I4 for industry (annual consumption: 0.1-1 PJ). For electricity, prices refer to the Eurostat consumption band ID for industry (annual consumption: 2-20 TWh).
Source: Based on IEA *Energy Prices*.

The design of electricity taxation also raises equity concerns. Currently, key industrial users of electricity do not pay the full Dutch energy tax and surcharge on electricity consumption, either because users are exempt from the tax (for example, electricity generation for own use is exempt) or, for the large electricity users, because they are subject to the lowest possible rate (Table 5.3 and Table 5.9). This treatment favours concentrated, large consumers at the expense of small industrial users and the residential and commercial sector that face the high rate of the lowest band for all consumption (Table 10.6).

Table 10.6. Energy tax and ODE payments on electricity consumption (2017) and energy base (2016)

	Energy tax payments on electricity use (in mio EUR)	ODE payments on electricity use (in mio EUR)	Energy base (electricity) (in mio kWh)
Industry total	186.7	36.48	31 930.7
Contribution by subsector (in %)			
Food, drinks and tobacco	31.4%	33.7%	18.3%
Textile and leather	4.4%	3.1%	1.1%
Wood, paper and graphic industry	11.9%	10.9%	6.9%
Petroleum industry	0.5%	0.6%	2.3%
Chemical and pharma industry	11.9%	14.1%	34.2%
Building materials	3.2%	4.1%	3.9%
Basic metals	0.0%	0.0%	15.1%
Machinery (incl. transport means)	16.9%	17.4%	11.2%
Other industry and repair	19.9%	16.0%	6.9%

Note: Small differences in the sectoral definitions across energy tax and ODE payments and the energy base may remain.
Source: CE Delft (2021[7]) and CBS (2017[8]).

The new carbon price for Dutch power generation puts a floor price on emissions from electricity generation in the EU ETS and is a welcome development as it raises the carbon price on input fuels equally across electricity users and fuels. Rather than increasing the price of electricity for all types of generation, including zero-carbon energy, it provides incentives to shift towards decarbonised electricity. With a strong carbon floor price in place, the elimination of the energy tax and the ODE on electricity users – or a strong reduction towards a low and uniform price per GJ across consumption bins – may be envisaged. It should be noted though that the current rate of the carbon floor price falls well below the EU ETS permit price and therefore currently does not affect the price signal.

The United Kingdom has introduced a Carbon Price Support (CPS) in 2013 at GBP 9 per tonne of CO_2 for emissions in the electricity sector that increased over time reaching GBP 18 in April 2015. Different to the Dutch floor price, the UK CPS was charged on top of the EU ETS permit prices and increased over time. Emissions from the electricity sector decreased by 58% from 2012, before the CPS was introduced, to 2016. The decrease in emissions was explained by a sharp drop in the use of coal for the generation of electricity. Coal use fell by 78% in the same period. It was partly replaced by natural gas, which is about half as emission intensive as coal per unit of energy, and partly by zero-carbon renewables. The British experience shows how fast emissions can decline if carbon prices are at levels high enough to encourage a switch to cleaner fuels (OECD, 2018[1]).

To avoid conflicts between environmental and fiscal objectives, the phasing-down of electricity tax and surcharge could be co-ordinated with the phasing-in of an effective carbon floor price in electricity and the removal of energy tax exemptions and preferential rates to generate additional revenue. Revenues from the energy tax and surcharge on electricity contribute substantially to the general budget and the SDE++. The carbon floor price in electricity and additional revenue from removal of tax expenditures may replace existing electricity taxes and ODE in such a way that overall revenues remain constant. At the beginning, the gradual erosion of the carbon price base would be mitigated by increasing the floor price over time. Eventually, as the energy system is approaching full decarbonisation, electricity taxes could be reintroduced if desired (OECD, 2019[2]).

Recommendation 4 – Re-evaluate provisions aimed at preserving the short run competitiveness of trade-exposed energy-intensive sectors in light of policy developments in the Netherlands and beyond

The Dutch government providing extensive support for key technologies in trade-exposed sectors, likely limits disruptions to competitiveness substantially.

With the EU and more and more non-EU countries committing to carbon neutrality by the second half of the century, competitiveness concerns are likely to fade away rapidly.

Mechanisms to preserve remaining competitiveness concerns should be chosen based on their ability to maintain decarbonisation incentives, instead of decreasing climate policy ambition as tax exemptions and free allocations do.

A variety of measures exists to address concerns over competition that domestic energy users may face from firms located in countries with less ambitious carbon pricing policies. Competitiveness provisions in the Dutch policy toolkit are pervasive. Each carbon pricing mechanism includes a specific provision in that respect. Most recently, the carbon levy phases-in the carbon price and emissions base and provides generous free allocation of dispensation rights in an attempt to give industry enough time to adapt and invest in the necessary low-carbon technologies. The combination of these carbon pricing design features with multiple support instruments for key technologies, most notably the generous technology-specific abatement payment for industrial users (SDE++), likely reduces short-run competitiveness concerns substantially. In addition, with the EU and more and more non-EU countries committing to carbon neutrality by the second half of the century, competitiveness concerns are likely to fade away rapidly.

10.1.7. To avoid conflicts with the Dutch decarbonisation objective, mechanisms should be chosen based on their ability to address remaining competitiveness concerns while maintaining incentives to decarbonise and invest in low-carbon assets and infrastructure

In case international competitiveness remains a concern in the future, alternative mechanisms to generous tax exemptions, regressive rates and free allocation for energy-intensive industry are worth discussing. The current tools are not optimal from a decarbonisation perspective as they erode the carbon-pricing signal. Alternative measures exist that address competitiveness concerns of energy-intensive and trade-exposed sectors, while keeping carbon prices at levels that provide incentives to reduce energy use and shift to low-carbon investment. Such measures can help level the playing field of climate policies by elevating them to the higher level of ambition, instead of decreasing the ambition as exemptions and free allocations do.

Alternative measures can be implemented at different levels of governance, e.g. nationally, at EU level, or internationally. Such national and EU-wide approaches include border carbon adjustments (BCA), carbon consumption charges and abatement payments. The necessity and suitability of such measures in the Dutch context requires a discussion of their design features and implementation. All measures entail advantages and have their limitations. It seems important to start a discussion on these measures at the national and international level.

The European Commission has proposed to implement a European Green Deal that should transform the EU into a modern, resource-efficient and competitive economy with no net GHG emissions by 2050, an economic growth model that is both decoupled from resource use and leaves no-one behind. The Green Deal also aims at proposing a revision of the EU's climate and energy legislation by June 2021, including several pieces that are relevant in this respect. Proposals to revise the European Energy Tax Directive, and the EU ETS directive may further align carbon pricing and energy taxation efforts across EU Member States. The implementation of a potential carbon border adjustment mechanism would directly reduce competitiveness concerns from firms situated outside the EU countries. Several mechanisms for a European carbon border adjustment mechanism are currently being discussed and it remains to be seen whether a mechanism emerges eventually and, if so, what specific design features it entails.

A BCA can be defined as "a measure applied to traded products that seeks to make their prices in destination markets reflect the costs they would have incurred had they been regulated under the destination market's greenhouse gas emission regime" (Cosbey, 2012[10]). The design and implementation of BCAs are challenging, involving trade-offs between effectiveness and feasibility and they need to be designed carefully, taking into account countries' commitment under the multilateral trading system. OECD (2020[11]) provides an overview of different policy instruments that can limit carbon leakage, with a particular focus on BCAs, and offers a technical review of the literature and of the legal specificities around BCA as well as of alternative instruments to BCAs. These include measures that are the result of an internationally co-ordinated effort (e.g. international sectoral agreements of the type of CORSIA in international aviation) and unilateral instruments, such as excise taxes on domestic consumption of specific carbon-intensive goods and abatement payments (as in the Dutch SDE++).

Excise taxes on domestic consumption of certain carbon-intensive material, such as steel, cement or aluminium, (sometimes called carbon consumption charges) represents a policy approach that the Netherlands may envisage in addition to carbon pricing to reply to both policy challenges unilaterally: competitiveness concerns and decarbonisation. Excise tax rates could be based on the average carbon content of the goods or alternatively on the EU ETS product benchmarks. A simple implementation of excise taxes would only price the average emissions or benchmark emissions of goods. Excise taxes would then not create incentives to switch to a cleaner production method of given carbon-intensive goods, such as steel or aluminium. From a decarbonisation perspective, such taxes would therefore need to be complemented by additional incentives, including carbon prices (OECD, 2020[11]). Competitiveness concerns from higher carbon prices would be reduced by passing them on in the value chain, where carbon costs are less important.[5] Carbon consumption charges could also strengthen the incentives to efficiently use, reuse and recycle such materials.

Compared to BCAs, the implementation of excise taxes involves much less administrative complexity. The Netherlands already have experience with differentiating taxes by CO_2 emissions and other environmental criteria, as they levy vehicle registration taxes that differentiate by CO_2 emissions of the car and the benchmarks used in the context of the carbon levy may be used. Compared to abatement payments such as the Dutch SDE++, excise taxes generate additional revenue. Abatement payments, on the contrary, require that sufficient funds are available as well as an efficient design for the allocation of payments, which can be costly. Additional administrative costs arise due to the potential complexity of the scheme.

A broader tax shift in the Netherlands can also, to some extent, attenuate international competitiveness concerns. A tax shift implies that revenues generated through more ambitious carbon pricing provides a rationale for reducing taxes derived from other sources, such as income, profits and employment. For example, in British Columbia parts of the revenues from the carbon tax contribute to lowering corporate income tax rates (Murray and Rivers, 2015[12]). Such a shift could provide business with the full incentive to reduce emissions through a higher carbon price, while keeping their total tax contribution in check. However, it would entail a potentially significant redistribution across sectors, benefiting in particular the service sector, which represent a large share of the economic activity but have a low carbon-intensity.

10.2. A strong support for low-carbon technology deployment

By complementing carbon pricing with strong support for technology deployment, the Netherlands seeks to achieve two policy goals: decarbonising its industrial sector and becoming a world leader in emerging low-carbon technologies. Support intends to bridge the remaining profitability gap of key low-carbon technologies with existing carbon-intensive technologies –a task that the current carbon price alone is unable to achieve – in order to create the necessary business case for their deployment, including CCS, the electrification of heating processes and hydrogen.

The Dutch support policy for low-carbon technology focuses on the cost-efficient deployment of a number of both emerging (e.g. blue hydrogen) and radically new (e.g. green hydrogen) technologies through several subsidy programs, with the new SDE++ being the spearhead. At earlier stages of technology readiness (R&D and demonstration), most policy instruments at the national level focus on demonstration. For R&D, the Netherlands mostly rely on horizontal support and EU funding (Chapter 5). Overall, the support for technology deployment available to Dutch industry is relatively important. While Germany – a much larger economy – plans on a budget of about EUR 5 billion for technology deployment support over the period 2020-30, the part of the SDE++ devoted to the industry amounts to EUR 3 billion alone in the same period (Chapter 6).

Taken together, the analyses of zero-emission scenarios (Chapter 3), of the current policy package (Chapter 5) and of emerging low-carbon technologies (Chapter 7) point to several issues deserving particular attention with a view to the 2050 horizon. First, support chiefly promotes close-to-market technologies, possibly crowding out support for breakthrough technologies required for the net-zero emission economy in favour of bridge technologies. Second, a funding gap seems to exist for large-scale demonstration projects, possibly creating a “valley of death” for breakthrough entrepreneurs and firms. Finally, the myriad of available support instruments, particularly at the demonstration stage, may imply relatively large administration costs and create access barriers for young and small firms.

Recommendation 5 – Ensure greater support for technologies that are still far from the market, as part of a more balanced approach to technology support across levels of technology maturity

Maintain strong and predictable support for low-carbon technology diffusion as the necessary complement to carbon pricing in order to provide investors with the necessary long-term investment incentives and bridge the current cost handicap of key decarbonisation technologies

Leverage either the EU ETS Innovation Fund, the EU Important Project of Common European Interest (IPCEI) or the Dutch National Growth Fund to close the funding gap for large-scale demonstration projects and help breakthrough innovators escape the “valley of death” of clean tech venturing.

10.2.1. Complementing carbon pricing with technology support makes a business case for key decarbonisation technologies and preserves cost-competitiveness

Two key advantages arise from the Dutch decarbonisation strategy consisting in complementing predictable carbon pricing signals at levels compatible with the zero-net emission objective by 2050 with strong support for low-carbon technology deployment. First, it places the Dutch industry on a faster decarbonisation path, as it makes up for the suboptimal level of private investments in technological innovation arising from knowledge externalities, which carbon taxation alone cannot achieve (Chapter 4). Second, it preserves the cost-competitiveness of industrial firms by returning in subsidies what was collected through the surcharge, thereby safeguarding Dutch industrial firms' edges on international markets and ensuring industry buy-in.

In particular, combining technology support via the SDE++ abatement payment with a strong carbon price trajectory can provide strong incentives for the deployment of the key emerging technologies for decarbonising the Dutch industry, specifically to make the business case for CCS, the electrification of heating and, in the near future, hydrogen. The subsidy is expected to cover the operational expenses for most technologies related to CCS and some technologies related to the electrification of heating.

The successful deployment of these key emerging technologies heavily depends on both a predictable and increasing carbon price and strong technology support. The analysis in Chapter 3 on zero-emission scenarios makes the case for maintaining and strengthening these two pillars, where adequate. Specifically, targeting part of the technology support to bridge the cost handicap gap of green hydrogen seems necessary (see below on the SDE++). Simultaneously, the carbon levy needs to "bite" relatively fast and uncertainty about its implementation should be minimised.

In line with best practices, spending should be monitored carefully, as well as the risk of windfall profits to investors for activities they would have undertaken even in the absence of support.

10.2.2. The balance of the technology support package tilts towards short-run cost-efficiency

Most technology support from the Dutch government focuses on deployment (and demonstration to a lesser extent), with the SDE++ scheme as a spearhead. Apart from the SDE++, deployment focuses on incremental energy efficiency with the EIA scheme more than on technology shifts with the MIA (*Milieu-Investerings Aftrek* - environmental investment deduction)/VAMIL (Figure 10.3). By contrast, R&D is mostly funded at the European level, while national support is mostly horizontal, with instruments such as WBSO or the Innovation box. Such balance of the technology support package can make sense in principle: deployment is urgent, while horizontal support ensures technological neutrality and the existence of large cross-country knowledge spillovers from R&D imply that funding at the supra-national level is desirable.

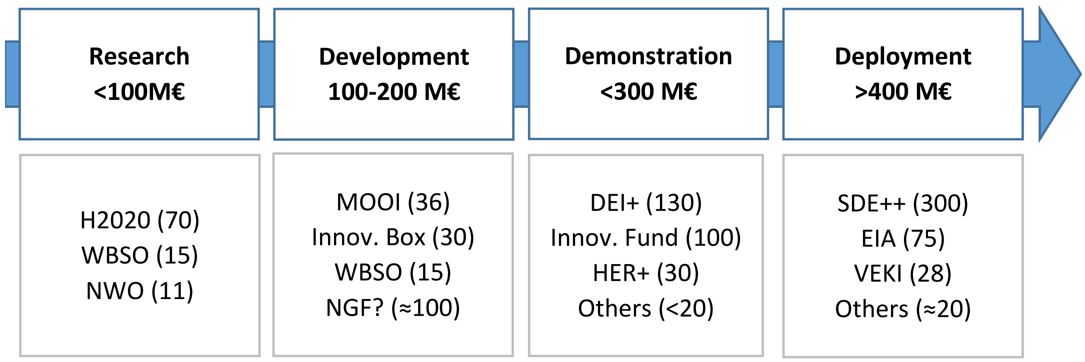
However, such strategy raises several issues pointing to the potential conflict between short-term and long-term cost-effectiveness. First, horizontal measures disproportionately benefit technologies that are closest to the market by design. Yet, the ambitious 2050 objectives and the implied need for radically new technologies might justify a stronger focus on targeted instruments at the R&D stage. Targeting technologies that are further away from market but critical for the long-term decarbonisation objective, such as green hydrogen, could provide incentives that are more compatible with long-run cost-efficiency. Additional R&D support would also be justified in light of the strong focus of the SDE++ scheme on least-cost options (see below).

The strategy also seemingly favours technological absorption over innovation. This makes sense for the Dutch economy, which enjoys a sufficient absorptive capacity given its large stock of human capital, pre-existing infrastructure and availability of financing capital, both private and public. It does, however, risk to be insufficient to induce leadership in low-carbon technologies and maintain the Netherlands position as an industrial leader in the transition to the net-zero emission economy.

The current package's apparent funding gap for large-scale demonstration projects also contributes to tilting technology towards short-run cost-efficiency. Leveraging either the EU ETS Innovation Fund, the EU IPCEI or the Dutch National Growth Fund and/or re-balance the innovation policy package to close the funding gap for large-scale demonstration projects would help breakthrough innovators escape the "valley of death" of clean tech venturing (Section 10.3).

Figure 10.3. Tilting towards deployment

Estimated amounts of annual public funding available for technology support, by stage (EUR million)



Note: See Chapter 5 for details. The maximum budgeted expense on SDE++ subsidy for CO_2 reduction in industry increases from EUR 50 mln in 2022 to EUR 550 mln in 2030 for a total of EUR 2.675 bln over the 2022-30 period, or about EUR 300 mln per year on average. Whether these amounts are structural remains subject to uncertainty due to current discussions regarding ODE reforms and the need to fund more expensive abatement in other sectors in the long run.

Recommendation 6 – Consider changes in the design of the SDE++, in particular holding different tenders by technology or production process, and at least partially accounting for the savings from the carbon levy

Ensure that SDE++ does not only fund close-to-market technologies by allocating the tender across different TRLs in order to also support breakthrough technologies

Take the carbon levy into account when calculating the subsidy to avoid over-subsidizing technologies close to breaking even.

10.2.3. The technology deployment package favours close-to-the-market technologies, possibly crowding out funding for needed breakthrough technologies

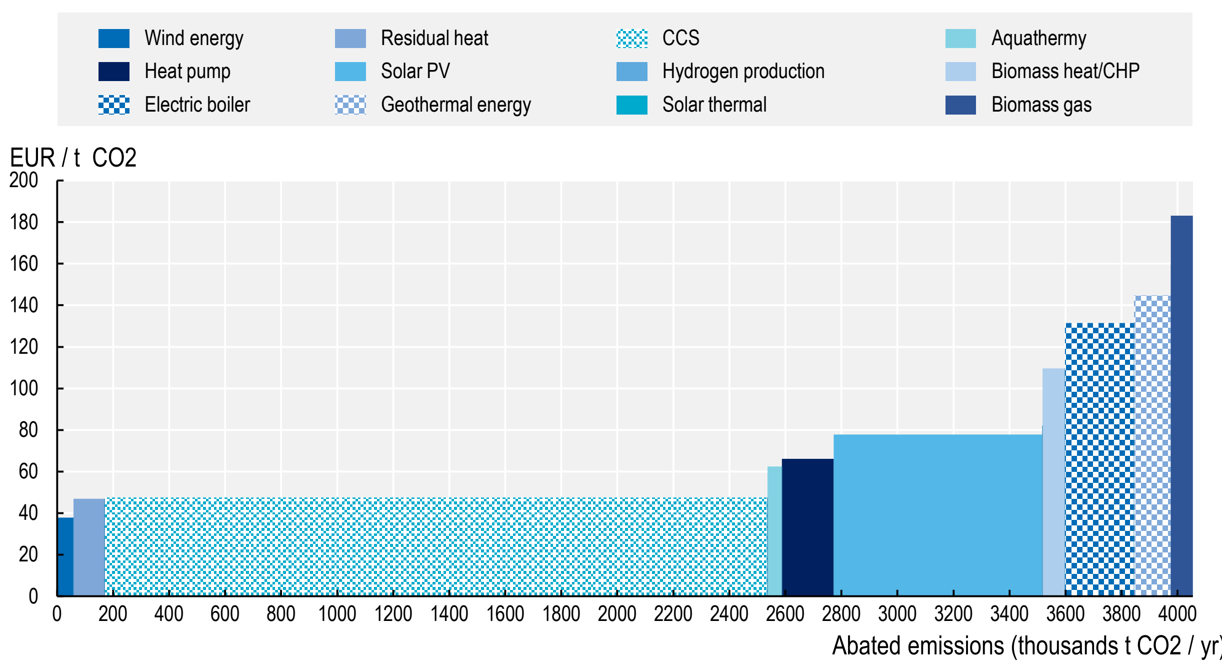
The Dutch government implements three major schemes to support the deployment of low-carbon technologies – SDE++, VEKI and MIA/Vamil –, with an estimated yearly budget in the long run of about EUR 350 million for the industry sector. By far the more important is the SDE++, which essentially subsidises the revenue shortfall of low-carbon technologies to make up for the difference with current carbon-intensive technologies. The other schemes, the VEKI grant and the MIA/Vamil tax allowances, subsidise capital expenses for low carbon technologies and their budget is expected to be significantly lower (Chapter 5). Another deployment scheme with substantial funding, the EIA focuses on marginal energy efficiency improvement rather than on new low-carbon technologies.

In principle, the SDE++ allocates subsidies on a pure cost-efficiency basis as all subsidy requests are pooled in one single tender. This tends to favour close-to-the-market technologies, for which the revenue shortfall with respect to business as usual technologies is small. Preliminary analysis of SDE++ subsidy applications confirms this built-in characteristic. A large share of the total amount of requested subsidies in categories that are potentially relevant for industrial applications concern CCS, a technology with TRL 7, i.e. system prototype demonstration in operational environment. By contrast, a negligible share of applications concerns green hydrogen, a breakthrough technology with lower TRL (Table 10.7). The data also partly reveals the private sector's marginal carbon abatement costs, pointing to large disparities across technologies (Figure 10.4). The technology-specific average subsidy per tCO_2 abated requested by the private sector does not necessarily align with the subsidy intensity defined by PBL.

Reforming the design of the SDE++ to re-balance the tender allocation across TRLs instead of solely favouring low-cost options would contribute to promoting investment in breakthrough low-carbon technologies. Put differently, the SDE++ currently trades off the promotion of less mature technologies for short-term cost efficiency, thereby potentially compromising long-term cost efficiency. Ensuring that support is distributed more evenly across the TRL scale (e.g. through exploiting synergies between DEI and SDE++) would contribute to avoiding budget gaps and overcoming the "valley of death". The cap on CCS will partially achieve such redistribution across TRL but only in the future when the cap is binding. The four successive application windows could be exploited for the purpose of ensuring that part of the tender goes to higher-cost breakthrough technologies. In that case, it should be made explicit and assessed against this objective.

Figure 10.4. CCS might crowd out less mature technologies from the SDE++

SDE++ subsidy demand curve in first tender



Note: Areas represent the expected subsidy payment based on RVO's long-term prices; actual payout will depend on market prices and RVO's decision. Category CCS includes "blue hydrogen"; category hydrogen production is "green hydrogen". Amount tendered to hydrogen production and solar thermal is barely visible. Average subsidy per tonne CO_2 at the technology category level and cumulated abated emissions calculated based on RVO data.
Source: Based on RVO data.

Table 10.7. The tilt towards short-run cost efficiency

SDE++ 2020 tender application data

Category	Number of applications	Requested budget (EUR mln)
Solar PV	3 989	2 360
CO_2 capture and storage	*7*	*2 135*
Electric boiler	*27*	*618*
Geothermal energy	6	355
Heat pump	*38*	*240*
Biomass gas	8	215
Biomass heat and CHP	5	139
Waste heat	*5*	*137*
Wind energy	16	100
Aquathermy	4	96
Hydrogen production	*1*	*2*
Solar thermal	6	1
Total	4 112	6 398
of which relevant to industry	*78*	*3 132*

Note: Italic indicates main relevant technologies for the industry.
Source: Rijksdienst voor Ondernemend Nederland (RVO).

10.2.4. The SDE++ tends to over-subsidise bridge technologies but stays short of making breakthrough technologies profitable

Two case studies of low-carbon alternative to business-as-usual production of hydrogen illustrate the built-in bias of the SDE++ scheme in favour of high-TRL technologies (Chapter 5). On one hand, the blue hydrogen alternative (adjunction of CCS on the standard steam-methane reforming) is a mature technology with the potential to bridge several chemical and refinery activities to the low-carbon economy. On the other hand, the green hydrogen technology alternative (renewable electricity-based electrolysis) lies at a lower TRL and requires further scale-up and greater cost reductions.

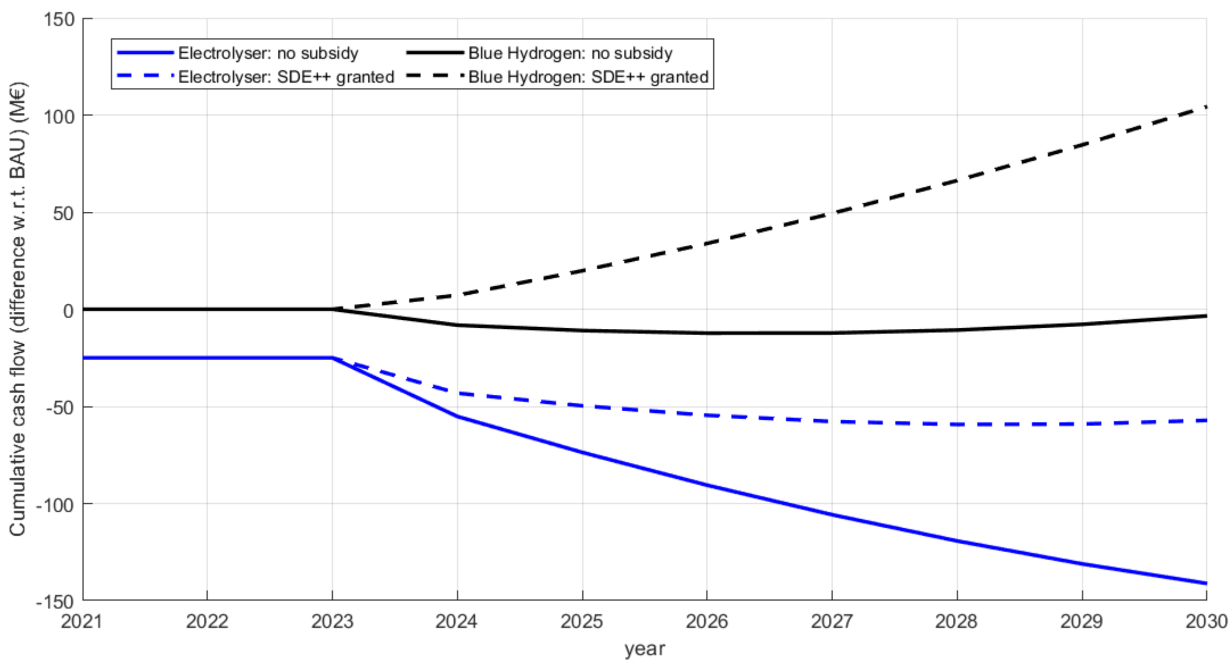
These two cases illustrate the interplay of the carbon levy and the SDE++ by contrasting the cumulative net cash flows associated with the two projects as analysed in Chapter 5 conditional on a conservative scenario of low energy prices and average carbon transportation costs (Figure 10.5). The solid lines on the chart correspond to a scenario where no subsidy is received, while the dashed lines show the cumulative cash flows when SDE++ support is granted. All scenarios take the savings from the carbon levy into account, with assumed dispensation rights based on EU benchmarks and counterfactual (BAU) projects' emission intensity. For the blue hydrogen project (black line on the chart), the cost savings on the carbon levy partially make up for the additional cost of CCS and the SDE++ subsidy is large enough to make the project immediately profitable. Under somewhat more favourable energy and/or carbon transportation prices, the blue hydrogen project would not even need the subsidy to break even. By contrast, the cost savings on the carbon levy are largely insufficient to make up for the cost of the investment in the case of the green hydrogen project (blue line on the chart) and the SDE++ subsidy fails to make up for the revenue shortfall.[6]

Besides vindicating the Climate Agreement's limit on the subsidisation of CCS and making the case for targeting part of the SDE++ subsidies for green hydrogen, the elements above raise the question of the sufficiency of the SDE++ to incentivise industry investment in breakthrough technology. A 100MW electrolyser capable of decarbonising feedstock for roughly 1-2% of the Dutch ammonia production costs EUR 50 million to build alone. The abatement subsidy required to make up for such large initial investment is very large and the available SDE++ budget may not be sufficient (about EUR 300 million per year on average until 2030 in total for all technologies [Chapter 5). Here too, resorting to the EU IPCEI or the Dutch

National Growth Fund could offer a way forward. Alternatively, making green hydrogen projects capital expenditures eligible under the DEI scheme would create synergies with the funding of the operational expenses under the SDE++.

Figure 10.5. CCS requires less support than green hydrogen

Cumulative net cash flows, with and without SDE++ support



Note: Net cash flows calculated by differencing out the business-as-usual (carbon-intensive) alternative. Scenario of high electricity prices and average carbon transportation costs, taken as the mean of the PBL estimate and the Gasunie/EBN estimate. Feasibility study cost incurred in 2021. Capital investment incurred in 2024. Savings from the carbon levy account for dispensation rights based on EU benchmarks and counterfactual (BAU) projects' emission intensity. See Chapter 5 for details on hypotheses, methodology, subsidy schemes considered and detailed discussion of the results.

Recommendation 7 – Ensure adequate support at all RD&D stages in areas where Dutch inventors have (or potentially have) a comparative advantage, including CCUS and biomaterials, to enable technological leadership, and boost absorptive capacity in the others

Aim at technological leadership in areas of strong technological advantage, such as CCS and bio-based materials.

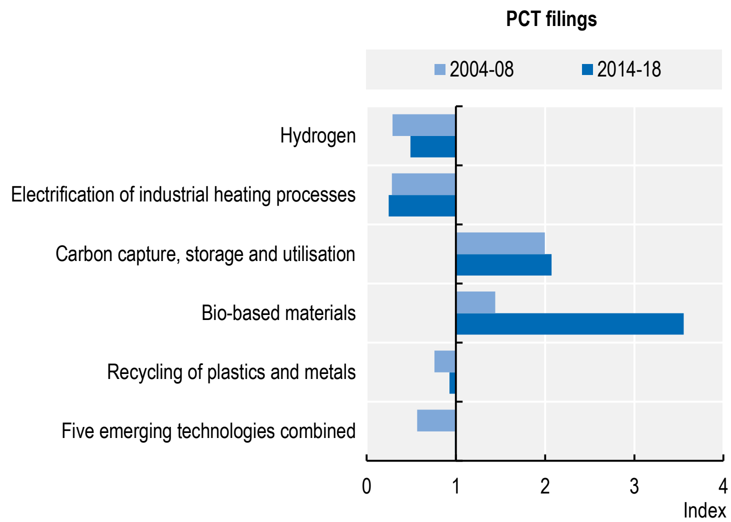
Boost absorptive capacities in the other technological areas, both through R&D activity and adequate framework conditions.

10.2.5. The Dutch industry has high leadership potential in selected technologies such as CCS and bio-based materials but needs to build enough absorptive capacity for other technologies

Over the past 15 years, Dutch inventors have had a strong relative technological advantage in such key bridge technologies as carbon capture, storage and utilisation (CCUS) (Figure 10.6). Moreover, specialisation in bio-based materials has markedly increased over the last fifteen years.

Figure 10.6. The Netherlands' high leadership potential in CCS and bio-based materials

Relative technological advantage



Note: Index computed as the ratio of the share of patents filed for the selected technology by inventors located in the Netherlands to the share of patents in the same technology filed by inventors located in the rest of the world.
Source: Calculations based on STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats, January 2021.

As R&D activity is mostly funded at the supra-national (EU) level and includes fixed costs, public support to such technological specialisation makes sense in the case of the Netherlands, a relatively small country with pre-existing infrastructure amenable to CCUS. The Netherlands has the potential to aim at leadership in a few low-carbon technologies and absorb the rest. In that context, ensuring support for the other area of specialisation, bio-based material, would be a good step in promoting technological leadership in longer-term decarbonisation solutions.

A key enabler regarding specialisation in selected technologies regards the absorptive capacity of the Dutch industry. The availability of human capital, such as green skills and know-how, is a necessary condition for technology diffusion (see below).

Recommendation 8 – Streamline the innovation support package, particularly at the demonstration stage, in order to improve administration cost efficiency and reduce transaction costs for young firms and SMEs

Assess available innovation support instruments and streamline where necessary in order to improve administration cost efficiency and reduce the cost to access these schemes for young firms and SMEs.

10.2.6. The large number of small or overlapping programs create administrative costs for the government, and transaction and compliance costs for business

The Dutch policy support package for decarbonisation includes a relatively large number of schemes, which may create inefficiencies on both the government and firms' side. First, the multiplication of fixed implementation, allocation and monitoring costs are unnecessary for the government. Second, the existence of so many different and potentially overlapping programmes creates complexity and leads to information and transaction costs for firms in terms of searching for the best instrument and application costs. These information and transaction costs disproportionately affect young firms and SMEs, which might not even be aware of their eligibility for subsidies.

Streamlining could reduce fixed administrative costs, provide clarity and contribute to making it easier for industrial firms to implement carbon emission reduction projects. For example, there exist many targeted R&D instruments with little individual funding. When it comes to deployment, support is spread across many instruments, some of which have a very similar mechanism. Moreover, the SDE++ sometimes overlaps with MIA and EIA, even though these two schemes are meant for installing mature technologies.

10.3. The key role of complementary policies and framework conditions

The industry decarbonisation strategy combining carbon pricing and technology support is not implemented in a vacuum: its success will depend on whether the business environment is conducive to the shift towards a low-carbon economy. This section highlights requirements regarding infrastructure, the level playing field, the provision of green skills and the availability of venture capital.

Recommendation 9 – Update the regulatory framework for decarbonisation technologies (particularly CCS) and ensure standardisation (especially for hydrogen and recycling), if possible at the European level

Create and update the regulatory and legal framework for decarbonisation technologies to reduce risk of investing.

In particular, define liabilities for CCS and build international regulatory standards for hydrogen and recycling technologies.

10.3.1. Uncertainty, outdated regulatory frameworks and lack of standardisation are barriers to investment in low-carbon technology

Reducing regulatory uncertainty is an important and cost-effective way to promote the necessary investments in industry decarbonisation technologies. In particular, defining liabilities related to carbon leaks is key to enable investors to price the risk of CCS project accurately and potentially make CCS risks insurable.

Regulatory standards are another way to promote investments in low-carbon technologies by improving transparency and avoiding unnecessary frictions across countries. At the EU level, they can help to ensure the inter-operability and transparency of low carbon technologies across countries, thereby increasing the size of the market and the incentives to develop new solutions. The importance of standardisation is perhaps most obvious for hydrogen, as it promotes complementarity with other instruments in the presence of network externalities. Key items include international standardisation on guarantees of origin (e.g. blue or green) but also on hydrogen purity, the design of liquefaction/conversion and regasification/reconversion facilities, for equipment specifications and for blending hydrogen into the gas grid.

Regulatory standards are also important for the definitions and regulations of waste and scrap, as the absence of clear and harmonised regulations hamper the development of recycling. For example, the labelling of steel production by-products as “waste” makes it difficult to trade, especially across borders, and creates shortages. Relabelling by-products of steel production at the European level (e.g. slag and fly ash) from 'waste' to 'product', with all due care to reduce pollution hazard, would reduce the administrative burden associated with purchasing scrap for companies and increase imports opportunities.

Recommendation 10 – Encourage the creation of markets for the circular and bio-based economy in order to address Scope 3 emissions by setting minimum content standards for recycled plastics and bio-based products, and re-labelling by-products of steel production from “waste” to “product” to ease scrap purchase

Introduce minimum content standards and use public procurement to create separate circular economy markets for recycled plastics and bio-based products.

Remove fossil fuel subsidies and align subsidies across different uses of biomass.

Increase R&D to further develop chemical recycling and the recycling of minor metals.

Review the definition and labelling of waste and scrap, with all due care to avoid pollution hazard, to reduce administrative burden and promote the development of recycling.

A carbon-neutral society implies the existence of a thriving circular economy. Recycling of plastics and metals and the use of bio-based products are important pillars for realising this circular economy, and their technological readiness levels and main policy challenges are discussed in detail in the circular economy and bio-based materials sections in Chapter 7.

The main problem for the circular economy is that there is no separate market for recycled and bio-based products and that fossil fuel based plastics are cheaper (OECD, 2018[13]). Additional policies are therefore required to create these separate markets, in particular for synthetic and bio-based feedstock. Demand-pull policies such as minimum content standards and public procurement can help to create these markets.

While such policy effort would be ideally implemented at the EU level, national minimum content standards and public procurement could already give a necessary boost to the recycling and bio-based industry.

Moreover, the existence of fossil fuel subsidies constitutes a barrier to the development of the circular economy. Removing fossil fuel subsidies is necessary for achieving the level playing field needed to give recycled and bio-based materials a fair chance.

A level playing field should also be created by applying subsidies for bioenergy and biofuel in the same way to biomaterials and biochemicals, as more biomass should flow to the latter (OECD, 2018[14]). Not only because the added value for bio-based materials and chemicals is higher, but even more importantly because the massive use of biomass for energy production raises concerns about unintended negative effects, such as illegal logging elsewhere in the world. Therefore, biomass should primarily be used to produce bio-based materials and chemicals for which no carbon-free alternative exists.

For the recycling of plastics, mechanical recycling of plastics is preferred to chemical recycling from an environmental point of view, but chemical recycling is still preferred to the incineration of waste for heat or energy production. Since possibilities for further increasing the use of mechanical recycling are limited, R&D support to further develop both mechanical and chemical recycling is required. Recycling rates for minor metals that are still low should also be improved.

For the bioeconomy, it is important that policies reduce risks to private sector investments in biofoundries. Biofoundries are facilities that enable the rapid design, construction and testing of biotechnology applications and research. Biofoundries can increase returns and therefore stimulate the bioeconomy by creating an ecosystem of industrial symbiosis. Within these biofoundries, priority should be given to conversion technologies, as feedstock is often bio-based, but conversion technologies are often still chemistry based (Kitney et al., 2019[15]).

Recommendation 11 – Provide visibility on the infrastructure programmes related to the transportation of hydrogen, electricity, heat and captured carbon, and clarify the role of the National Growth Fund in funding the low-carbon industrial infrastructure

Make the MIEK process operational.

Prop up the Infrastructure Programme for a Sustainable Industry (PIDI) in its role of stakeholder co-ordination and decision-making body, and make it operational as soon as possible, in order to promote the development of the infrastructure necessary to the diffusion of key low-carbon technologies, in particular for the transportation of hydrogen, electricity, heat and captured carbon.

Develop a clear and predictable methodology to select infrastructure programs.

Clarify the role of the National Growth Fund in funding the low carbon industrial infrastructure.

Promote co-ordination beyond industrial sectors and with neighbouring countries.

10.3.2. The uptake of low-carbon technology requires urgent infrastructure investments and hinges on the supply of large quantities of renewable energy

Infrastructure needs are extremely important for the decarbonisation of the Dutch industry, as it appears clearly from the scenario analysis in Chapter 3. In particular, the transition to a low-carbon industry requires infrastructure regarding the heat network, hydrogen production and distribution, and carbon transportation (potentially using the existing gas pipeline infrastructure). Moreover, industry decarbonisation hinges on the supply of large quantities of sustainable electricity, which creates further infrastructure needs regarding the electricity grid and renewable energy capacities.

Infrastructure is a necessary condition for the uptake of most low-carbon technologies in the industry. Decarbonisation requires the delivery of complementary low-carbon infrastructure projects in a range of technologies. These infrastructure needs were established by the Taskforce Infrastructure Climate Agreement Industry (TIKI) and the Multi-year Program Infrastructure Energy and Climate (MIEK). The six regional industry cluster plans also consider infrastructure one of the most important enablers of the transition toward a carbon-neutral industry.

The Dutch government envisages a model where grid operators finance and manage the energy transportation infrastructure – either electricity, heat, hydrogen or captured carbon – while firms pay user fees, which can be subsidised by the relevant instruments (e.g. cost of carbon transport in SDE++). The Porthos project illustrates this model. Porthos is building a transportation network for the CO_2 captured by firms in the Rotterdam cluster to be stored in depleted gas and oil fields beneath the North Sea. The infrastructure is joint venture between the Port of Rotterdam Authority, Gasunie and EBN, and benefits from substantial funding from the EU's Connecting Europe Facility (CEF) fund. CO_2-capturing firms will pay a fee for transport and storage. To bridge the current difference between the current level of carbon pricing and the fee-inclusive cost of CCS, firms can apply for an abatement subsidy within the SDE++ scheme (see above).The timing of infrastructure rollout is a key challenge for achieving the zero-net emission economy in 2050. On one hand, infrastructure building is a typically long process. On the other, industrial firms need immediate clarity on the availability of new energy sources in order to undertake investments in low-carbon technologies. Therefore, prioritisation is needed to ensure that the green transition is not delayed by infrastructure constraints.

The Ministry of Economic Affairs and Climate has recently announced the creation of a national Infrastructure Programme for a Sustainable Industry (PIDI). PIDI is a co-ordination body emanating from the Ministry and tasked with speeding up decision-making concerning the national energy infrastructure (hydrogen, carbon dioxide, electricity, heat, gas, circular economy) required for decarbonising the industry. Stakeholders include the clusters, the national and provincial governments, industrial firms and infrastructure companies. PIDI acts as the safe house for data on infrastructure investment projects and has decision-making power regarding the allocation of infrastructure projects based on feasibility studies.

The creation of PIDI is a step in the right direction. In view of the infrastructure needs implied in the scenario analysis, accelerated action at the national, regional and local levels seems pressing for the timely rollout of energy infrastructure. The National Growth Fund may contribute to financing infrastructure projects following PIDI's recommendations. Therefore, making PIDI operational should be a priority so that investments can take place. The Netherlands can leverage its experience gained from water infrastructure investments under the Delta Programme, which informs the OECD's best practice for developing robust project pipelines for low-carbon infrastructure, in particular regarding its combination of a long-term perspective, an iterative decision-making cycle and a dedicated fund to guide and implement investments (OECD, 2018[16]).

Further, infrastructure investment and management pose two key challenges, which should be carefully addressed. First, dynamic cost efficiency should be considered, in particular the risk of following too many technology routes that may prove unnecessary or even mutually exclusive, at great cost to public finance. Second, pricing the use of this monopoly infrastructure should be designed to take into account the pricing of externalities such as the integration of more renewables into the grid or demand schedule pricing allowing for intermittencies.

10.3.3. Co-ordination with other infrastructure programmes is key, both beyond industry and in neighbouring countries

PIDI makes infrastructure decisions on the grid operators side. However, co-ordination is necessary with the supply side of the system. In the Netherlands, wind energy from the North Sea is expected to be one of the main drivers of the energy transition. Therefore, it is crucial that PIDI collaborates with the Exploration of Landing Wind at Sea (VAWOZ) programme. Linking demand and supply, the Energy Main Structure (PEH) programme is tasked with designing the energy structure for the 2030 and 2050 horizons.

Given the interconnectedness in the region, infrastructure programs should be designed in close co-operation with neighbouring countries, in particular Germany and Belgium. The Porthos project, which will build and operate a CO_2 transport network between the port of Rotterdam, the port of Antwerp, the North Sea Port and depleted gas and oil fields beneath the North Sea is an example of such cross-country infrastructure planning with significant financing by the Connecting Europe Facility (CEF) of the European Commission. The Athos project, which is less advanced, is planning to transport CO_2 from the Amsterdam region to the North Sea.

Several levels of governance matter regarding the provision of infrastructure in relation with clusters (van der Reijden et al., 2021[17]). With their own industrial structure and historic legacies, clusters are well-placed for co-ordinating local firms and energy suppliers. Clusters are also key stakeholders for the implementation of policies that support the transition. By contrast, co-ordination between national clusters and between clusters and the rest of the economy lies at the national level, while the overall co-ordination of the industrial transition and cross-country linkages between clusters is better left to the EU level. This includes financing the low-carbon transition or regulatory interventions to facilitate the transition.

Recommendation 12 – Foster competition within and between clusters, ensuring a level playing field for young firms and SMEs, and an adequate supply of green skills

Ensure a level playing field for young firms and SMEs to benefit from the bottom-up, cluster-based decarbonisation support strategies in order to enable the emergence of innovative clean tech start-ups.

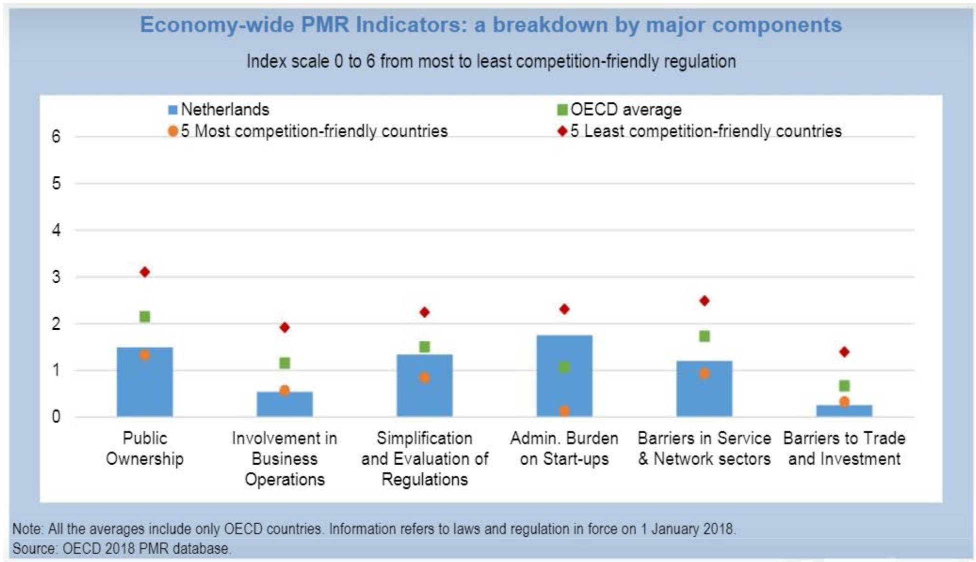
Ensure the necessary supply of green skills through re-skilling and up-skilling of displaced workers from emission-intensive industries.

10.3.4. Promoting business dynamism within and between clusters will ensure that innovation can flourish while taking advantage of scale economies

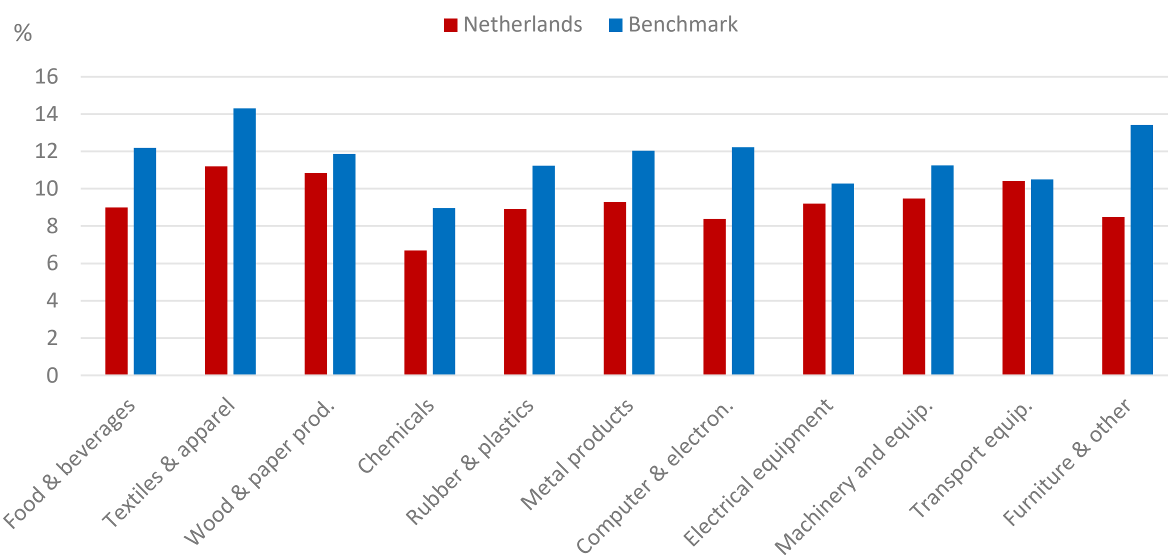
The reliance on infrastructure for achieving decarbonisation is a consequence of the geographic structure of the Dutch industry around highly integrated clusters. This cluster structure contributes to the cost efficiency of decarbonisation as it promotes the internalisation of scale economies and knowledge spillovers, e.g. the efficient provision of energy carriers and the exploitation of synergies. However, it may also contribute to locking in sectoral and geographical allocation of resources at the expense of efficiency-enhancing dynamism, therefore coming at a cost in terms of flexibility and adaptability in the longer run – potentially a major issue at the 2050 horizon, given the uncertainty regarding the technologies that will eventually emerge in the low-carbon transition.

Figure 10.7. Relatively low business dynamism

A. Product market regulation indicators



B. Job reallocation rate among incumbent firms



Note: Panel B, churning rates of incumbents defined as the sum of the job creation rates and job destruction rates of incumbent firms, reported by SNA A38 as averages over the period of 2012-15. Benchmark countries include Austria, Belgium, Brazil, Canada, Costa Rica, Finland, France, Hungary, Italy, Japan, Portugal, the Netherlands, New Zealand, Norway, Spain, Sweden and Turkey.
Source: OECD Indicators of Product Market Regulation: Netherlands, https://www.oecd.org/economy/reform/indicators-of-product-market-regulation/# (Panel A); OECD calculations based on DynEmp3 Database (August 2019, Panel B).

The Dutch clusters typically harbour a few large players that considerably contribute to international competitiveness. However, young firms and start-ups are also key to foster innovation and enable the emergence of the next generation of technological leaders. Therefore, maintaining a sufficient level of competition is key to minimise the downsides of the cluster structure. First, competition should be sufficient *inside* the clusters, so that new firms can effectively enter into these structures, compete and eventually challenge large incumbents. Enabling the reallocation of production factors can have an indirect positive effect on both challengers' and incumbents' incentives to innovate. Second, resource reallocation should be enabled *between* the clusters and the rest of the country, so as to allow and foster the emergence of alternative decarbonisation options that do not rely on large infrastructure and can be implemented for scattered industries when relevant.

Moreover, ensuring that the cost of carbon emissions and the level of support is the same across sectors and across small and large firms is equally important to avoid favouring large firms that are already in clusters and locking in the current industry structure at a time where the low-carbon transition requires significant reallocation of capital and labour resources. In that respect, the pervasive energy tax and surcharge exemptions enjoyed by incumbent energy-intensive industries contribute to shielding them from the potential competition of innovative green entrants. Such detrimental impact on business dynamism is another rationale for phasing them out (see above). Overall, firms in the Netherlands enjoy among the most accommodative regulatory conditions for doing business in the OECD (Figure 10.7, Panel A). However, the administrative burden on start-ups and the cost for starting a business remain comparatively high (OECD, 2019[18]). Such barriers typically increase the cost of entrepreneurship; hence they reduce market entry and weaken innovation incentives. Indeed, entry rates in Dutch manufacturing industries are lower than in other countries (OECD, 2019[19]) Moreover, relatively low job reallocation rates across incumbent firms in Dutch manufacturing industries including metallurgy, food processing and chemical industry suggest a lack of business dynamism compared to other OECD countries (Figure 10.7, Panel B). Enhancing business dynamism through facilitating entry and labour reallocation would contribute to enabling innovative clean tech companies to emerge.

10.3.5. Adequate green skills supply is a necessary condition for industrial firms to invest in decarbonisation and absorb new technologies

Decarbonisation and the transition to the net-zero emission economy will affect both labour supply and demand in the industry. On the one hand, skilled installation and maintenance workers are already in short supply in the industry (Climate Agreement, 2019) and will be increasingly demanded in the low-carbon economy, given the massive necessary capital investments. For example, it is expected that the Netherlands will need 10 000 bioeconomy experts by 2026 (Biomass Research Wageningen, 2016[20]). On the other hand, decarbonisation will bring about large labour reallocation of economic activity. For example, the capacity of refineries is projected to decrease by (at least) 40% between 2020 and 2050 (Chapter 3).

Workers with the skills to navigate changes in products and processes due to climate change and to environmental requirements and regulations are a key complement to technological supply-push policies. Adequate green skills supply is particularly important for firms engaging in low-carbon technology deployment and scale-up, and likely to promote investment. More generally, it contributes to the overall absorptive capability of the Dutch industry, which is a necessary condition for reaping the benefits of supra-national (mostly European) R&D and translate it into local deployment.

Re-skilling and up-skilling displaced workers with green skills through active labour market policies and adult training is immediately necessary to both address social concern and contribute to reducing skill shortages in the future low-carbon industries. Cross-sector training programmes can ease labour market transitions from surplus to shortage sectors. Timely and transparent information on sectoral labour markets can help workers to anticipate future labour needs and policy makers to monitor and accompany the changes. With a view to the longer run, education programmes need to incorporate new material and competences in curricula, so that the next cohort of workers can cope with the low carbon transition in the workplace. This implies re-training teachers so they can teach the new curricula.

In the Netherlands, the Social and Economic Council (SER) co-ordinates labour market and training matters, facilitates the development of sectoral training and labour market agendas and liaises with relevant institutions to ensure information dissemination on labour market policies and training. In that capacity, there is a guaranteed insight into the general and sector-specific progress on the agreements of the Climate Agreement. Special SER committees are tasked with identifying the threat and opportunities posed to employment by the low-carbon industrial transition. In its 2018 *Energy Transition and Employment* advisory report, the SER points to the necessary support to displaced workers, with a focus on lifelong learning, in close co-operation with the Top Sectors, as well as other platforms of public and private stakeholders aiming at addressing technological skill mismatch (the Technology Pact) and strengthening the green knowledge system in the Netherlands (the GroenPact).

The Top Sectors are also key stakeholders regarding the provision of green skills. Through their Human Capital Roadmap 2020-23, the top sectors aim at promoting better quality, equality and accessibility of education, including the acquisition of skills that are relevant for the low-carbon transition. They mostly act as facilitators and foster co-operation between all relevant stakeholders for the provision of skills.

The climate agreement contains provisions regarding the development of a sectoral agenda for skills in the industry, building on the 2018-22 implementation agenda for smart industry and the Chemicals and High-Tech Systems and Materials Top Sectors. It also points to the necessity of proactive labour market policy with sufficient training facilities at the regional level, with a special focus on the regions in which the five industrial clusters are located. Given the large structural transformation arising from the low-carbon transition, transforming this ambitious agenda into concrete policy steps is urgent.

Recommendation 13 – Ensure sufficient funding for green start-ups, in particular through venture capital

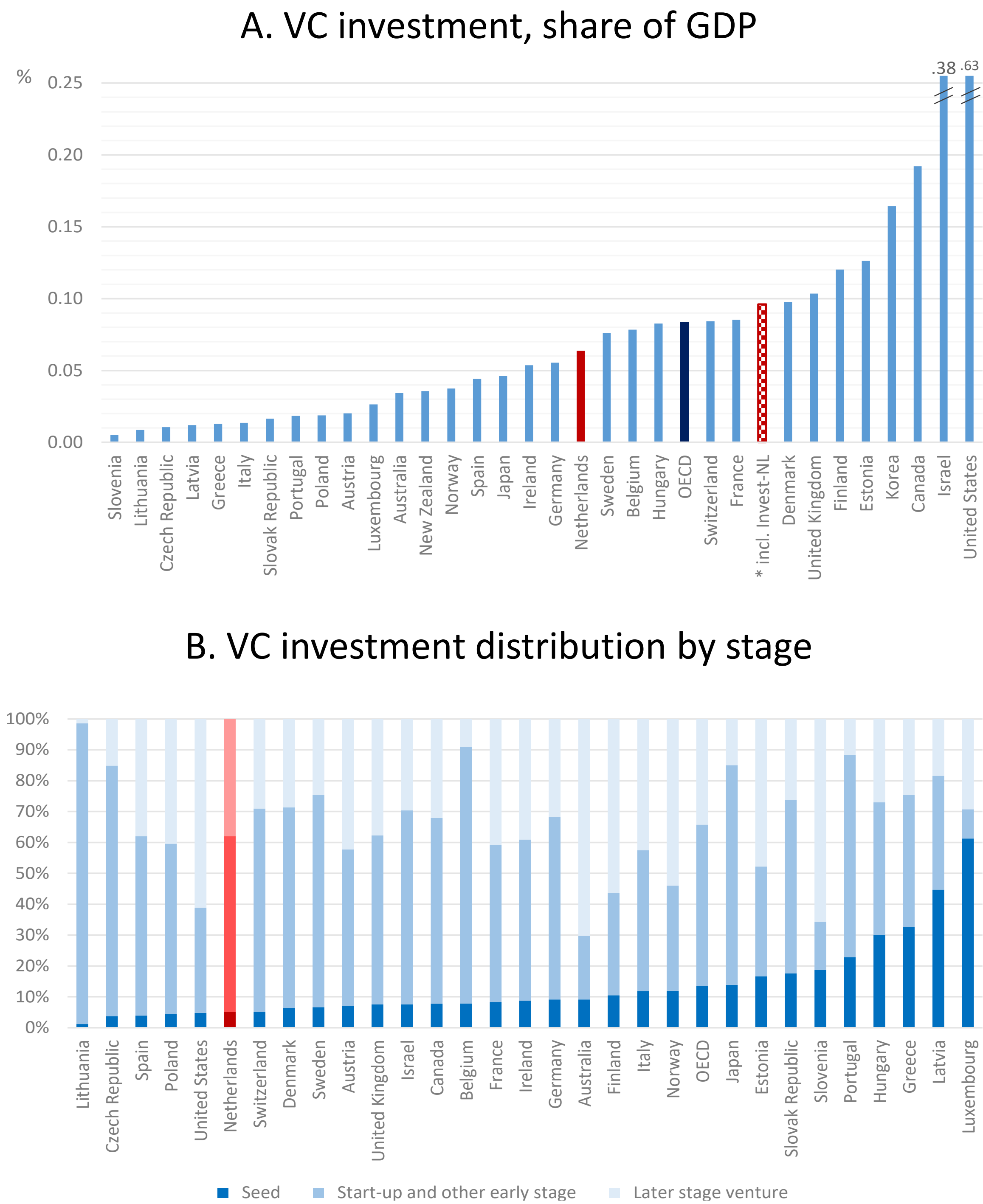
Monitor the venture capital (VC) investment and needs of green tech start-ups in order to assess whether INVEST-NL contributes to promoting industry decarbonisation by complementing the bottom-up, cluster-based approach.

10.3.6. Venture capital complements government technology support and help escape the "valley of death"

Venture capital is instrumental in creating markets and scale-up for the most market-ready technologies, by providing finance and imposing private capital market discipline. VC is a key complement to government support for technology, as it helps entrepreneurs through the "valley of death" by financing pilots and demonstrations of innovative ideas and prospective technologies, which are often the output of government-funded R&D (Stefano Breschi et al., 2019[21]). VC is also important for small companies to move beyond an initial niche market. Moreover, VC contributes to knowledge transfer across venture capitalists' portfolios (Bottazzi, Da Rin and Hellmann, 2008[22]). Data on VC deals suggest that private investors anticipate growing market opportunities in low-carbon technologies, driven by expectations of more stringent environmental policies (IEA, 2020[23]).

In the Netherlands, total VC investments amount to 0.064% of gross domestic product (GDP) in 2019, on a par with the OECD median (Figure 10.8, Panel A). However, when looking at different investment stages, the Netherlands performs less well regarding early stage VC investments (Figure 10.8, Panel B). The government is very involved in providing VC, a common trend in other European countries. About half of VC invested in the Netherlands was related to a government entity as of 2015, either directly with the government as "general partners" managing the VC fund or as a "limited partner" behaving like a passive investor (Alperovych, Quas and Standaert, 2018[24]). The Dutch government is targeting high-potential SMEs and supports tech initiatives. Examples include the Dutch Venture Initiative II, a EUR 200 million venture and growth capital fund-of-funds that invests in sectors such as ICT or clean or medical tech; and the EUR 100 million Dutch Growth Co-Investment Programme, which targets the second equity gap that start-ups face when they intend to grow (OECD, 2019[25]).

Figure 10.8. VC market in the Netherlands



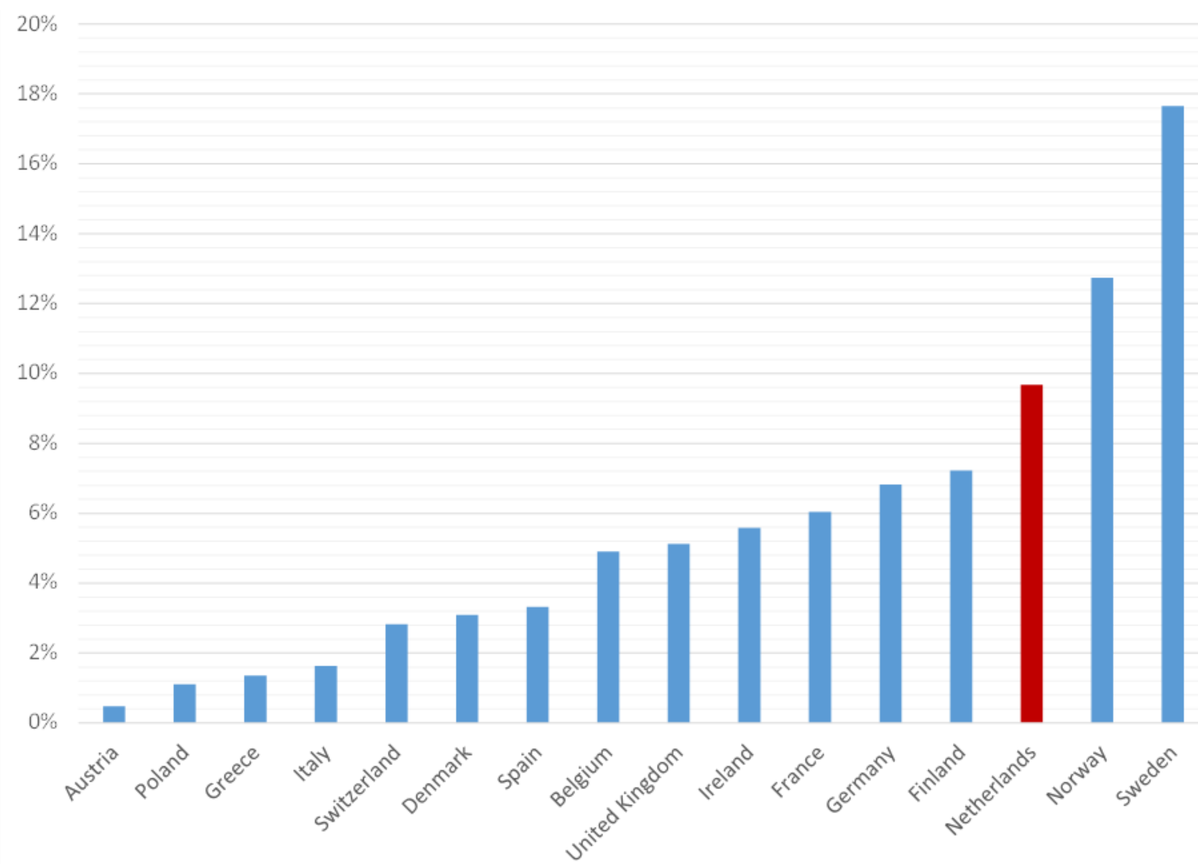
Note: VC investment is the sum of early stage (including pre-seed, seed, start-up and other early stage) and later stage VC. Given the absence of harmonised definitions across venture capital associations and other data providers, original data have been re-aggregated to fit the OECD classification of VC by stages. Data from 2019 or latest year available.
Source: OECD Entrepreneurship Financing Database

10.3.7. Invest-NL will be key in bringing low-carbon innovation to the market and its assessment should be a priority

A relatively large share of VC investments focus on sustainable energy technologies in the Netherlands. Data on VC deals in Europe suggest that over the period 2016-20, a yearly average of about 10% of total VC investments in the Netherlands concern “affordable and clean energy” technology firms, leading most other European countries (Figure 10.9). The share of these technologies in the total yearly value of VC deals was relatively stable in the Netherlands over the considered period, reflecting a long-standing interest in sustainable energy production. At the global level however, that share has fallen from around 10% to around 5% since 2012 as VC capital funded other technology areas such as biotechnology and information technology (IEA, 2020[23]). In the clean technology area, energy storage, hydrogen, CCUS, smart grid and bioenergy saw the most growth (IEA, 2020[23]).

Figure 10.9. VC investments in sustainable energy technologies

Average yearly share of total VC investment, 2016-20 or available years



Note: VC investment in sustainable energy technologies in a given country defined as the value of all VC deals classified as “affordable and clean energy” by the data provider. Total VC investment is the total value of VC deals taking place in that country.
Source: OECD calculations based on DealRoom data

The launch of Invest-NL is expected to radically alter the Dutch VC landscape, in particular for low-carbon technologies. Announced in 2017 and launched in January 2020, this government-owned national investment fund has a mandate to finance the energy transition through both equity financing and loans, with a focus on electrification and energy, circularity, agrifood and the built environment, and the scale-up of innovative high-growth firms in industrial technologies.[7] It works as a revolving fund with EUR 1.7 billion capital, amounting to a ~EUR 242 million investment capacity per year assuming seven year investment horizon, that is, ~.032% GDP, implying a 50% increase in Dutch VC market volume (0.064% of GDP in 2019).

By launching Invest-NL, the Dutch government signals that VC will be key in funding the transition to the net-zero emission economy and provides the necessary strike force for complementing its technology support policies. VC will bring capital market discipline within the bottom-up, cluster-based overall decarbonisation strategy. Against this background, both VC investments and the needs of green tech start-ups should be monitored in order to assess to what extent Invest-NL contributes to promoting industry decarbonisation.

References

Alperovych, Y., A. Quas and T. Standaert (2018), "Direct and indirect government venture capital investments in Europe", *Economics Bulletin*, Vol. 28/2, http://www.accessecon.com/Pubs/EB/2018/Volume38/EB-18-V38-I2-P117.pdf. [24]

Biomass Research Wageningen (2016), *The Biobased Economy and the Bioeconomy in the Netherlands*. [20]

Bottazzi, L., M. Da Rin and T. Hellmann (2008), "Who are the active investors?. Evidence from venture capital", *Journal of Financial Economics*, Vol. 89/3, pp. 488-512, http://dx.doi.org/10.1016/j.jfineco.2007.09.003. [22]

CBS (2017), *Uitsplitsing verbruik elektriciteit en aardgas*, https://www.cbs.nl/nl-nl/maatwerk/2019/14/elektriciteit-en-aardgas-naar-energiebelastingschijf. [8]

CE Delft (2021), *Correspondance with CE Delft, February 2021*. [5]

CE Delft (2021), *Policy instruments stimulating the low carbon transition of Dutch Industry: an overview of existing policies in the field of climate and energy in the Netherlands*. [7]

Cosbey, A. (2012), *A Guide for the Concerned: Guidance on the elaboration and implementation of*, International Institute for Sustainable Development, https://www.iisd.org/library/guide-concerned-guidance-elaboration-and-implementation-border-carbonadjustment. [10]

Flues, F. and K. Van Dender (2020), "Carbon pricing design: Effectiveness, efficiency and feasibility: An investment perspective", *OECD Taxation Working Papers*, No. 48, OECD Publishing, Paris, https://doi.org/10.1787/91ad6a1e-en. [4]

IEA (2020), *Energy Technology Perspectives 2020 - Special Report on Clean Energy Innovation*, OECD Publishing, Paris, https://dx.doi.org/10.1787/ab43a9a5-en. [23]

IEA (2020), *Extended world energy balances*, https://doi.org/10.1787/data-00513-en (accessed on 14 December 2020). [3]

Kitney, R. et al. (2019), "Enabling the Advanced Bioeconomy through Public Policy Supporting Biofoundries and Engineering Biology", *Trends in Biotechnology*, Vol. 37/9, pp. 917-920, http://dx.doi.org/10.1016/j.tibtech.2019.03.017. [15]

Murray, B. and N. Rivers (2015), "British Columbia's revenue-neutral carbon tax: A review of the latest "grand experiment" in environmental policy", *Energy Policy*, Vol. 86, pp. 674-683, https://doi.org/10.1016/j.enpol.2015.08.011. [12]

Neuhoff, K. et al. (2016), *Inclusion of Consumption of carbon intensive materials in emissions trading*, Climate Strategies, https://climatestrategies.org/wp-content/uploads/2016/10/CS-Inclusion-of-Consumption-Report.pdf. [26]

OECD (2020), *Climate policy leadership in an interconnected world: What role for border carbon adjustments?*, OECD Publishing, Paris, https://doi.org/10.1787/8008e7f4-en. [11]

OECD (2019), *Netherlands: Business dynamism*, https://www.oecd.org/sti/ind/oecd-business-dynamics-insights-netherlands.pdf. [19]

OECD (2019), *OECD SME and Entrepreneurship Outlook 2019*, OECD Publishing, Paris, https://doi.org/10.1787/34907e9c-en. [25]

OECD (2019), *SME and Entrepreneurship Outlook 2019: The Netherlands*, OECD Publishing, Paris, https://doi.org/10.1787/10e63d8e-en. [18]

OECD (2019), *Taxing Energy Use 2019: Using Taxes for Climate Action*, OECD Publishing, Paris, https://doi.org/10.1787/058ca239-en. [2]

OECD (2018), *Developing Robust Project Pipelines for Low-Carbon Infrastructure*, OECD Publishing, Paris, https://doi.org/10.1787/9789264307827-en. [16]

OECD (2018), *Effective Carbon Rates 2018. Pricing Carbon Emissions Through Taxes and Emissions Trading*, OECD Publishing, Paris, https://doi.org/10.1787/9789264305304-en. [1]

OECD (2018), "Enabling bio-based materials policy", in *Meeting Policy Challenges for a Sustainable Bioeconomy*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264292345-12-en. [14]

OECD (2018), *Improving Markets for Recycled Plastics: Trends, Prospects and Policy Responses*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264301016-en. [13]

OECD (2016), *Effective Carbon Rates: Pricing CO2 through Taxes and Emissions Trading Systems*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264260115-en. [6]

Perino, G., R. Ritz and A. van Benthem (2020), "Overlapping Climate Policies", *Cambridge Working Papers in Economics*, No. 20111, http://www.econ.cam.ac.uk/research-files/repec/cam/pdf/cwpe20111.pdf. [9]

Stefano Breschi, J. et al. (2019), "Public research and innovative entrepreneurship: Preliminary cross-country evidence from micro data", *OECD Science, Technology and Industry Policy Papers*, No. 64, OECD Publishing, Paris. [21]

van der Reijden, R. et al. (2021), *Transforming industrial clusters to implement the European Green Deal*, Climate Strategies, https://climatestrategies.org/wp-content/uploads/2021/01/CFM-Industrial-Clusters-briefing_FINAL.pdf. [17]

Notes

[1] The terms *energy tax on natural gas* and *fuel excise* are used interchangeably in the text.

[2] The terms *ODE* and *surcharge* are used interchangeably in the text.

[3] In the analysis the national component of the carbon levy is set to zero for 2021 because of the large amount of excess dispensation rights in 2021 that are not bankable, thereby losing their value for future trading periods.

[4] Dispensation rights are, to some extent, the levy's analogue to free allocation and are attributed yearly following EU ETS benchmarks. Installations have to pay the levy on their annual emissions that are not covered by a dispensation right. The amount of dispensation rights that is distributed decreases over time, i.e. the levy base phases in over time.

[5] Neuhoff et al. (2016[26]) propose to combine an ETS that allocates permits for free based product benchmarks with excise taxes on carbon intensive products, where the excise taxes rate is derived from the product benchmark. The idea is that permit prices provide a marginal incentive to improve the carbon efficiency of existing products and that the excise taxes encourage the consumption of more carbon efficient goods.

[6] If the SDE++ subsidy is granted at all. This is not the most likely outcome, given the cost-efficiency allocation criterion (see chapter 5 and Figure 10.4).

[7] The aim of Invest-NL is to "contribute to the financing and realisation of societal transition tasks carried out by companies and to facilitate access to corporate financing, in cases where the market does not sufficiently provide these provisions" (Section 3 of the Invest-NL Foundation Act, adopted by both houses of parliament in 2019). In line with parliamentary decision and in agreement with the Ministry of Economic Affairs and Climate Policy, financing the energy transition was set as Invest-NL's priority, with a focus on scale-ups (www.invest-nl.nl).

From:

Policies for a Carbon-Neutral Industry in the Netherlands

Access the complete publication at:

https://doi.org/10.1787/6813bf38-en

Please cite this chapter as:

OECD (2021), "Policies for decarbonising Dutch industry", in *Policies for a Carbon-Neutral Industry in the Netherlands*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/853c5389-en