5. Current policy package

This chapter provides an in-depth description of the policy instruments most relevant for the decarbonisation of the Dutch industry and discusses the overall policy package with a view to its potential cost-efficiency, its coherence as well as its consistency with the carbon neutrality 2050 objective. The instruments are grouped into electricity and carbon pricing instruments (including energy taxes), support for R&D and demonstration projects (either horizontal or specifically targeted at low carbon innovation), adoption subsidies for low-carbon technologies, voluntary agreements, command and control instruments, infrastructure programmes and green procurement schemes.

The Dutch government is in the process of introducing new policy instruments geared at achieving the targets of the Climate Agreement (Box 1.1). These instruments come in addition to a set of existing tools that already provide incentives for industry to reduce emissions, resulting in a large number of instruments supporting a low-carbon transition. For example, the International Energy Agency's Policies and Measures database lists 130 policies in the Netherlands to reduce greenhouse gas emissions, improve energy efficiency and support the development and deployment of renewables and other clean energy technologies. An internal inventory by RVO lists 47 instruments that are particularly relevant for the industry sector. Based on this list, to which a few instruments (newly introduced or horizontal policies that might affect low carbon technologies indirectly) were added, and from which closed programmes were removed, around 50 relevant policies or measures were identified (Table 5.1).

5.1. Policy instruments that put a price on electricity or carbon

Carbon pricing is an effective and efficient decarbonisation policy. Depending on the exact design features, carbon pricing can provide a technology-neutral case for low-carbon investment and consumption. It raises the cost of carbon-intensive production and consumption behaviour, making low- and zero-carbon energy more competitive, and incentivises emission reduction by encouraging emitters to find and use economically efficient ways of cutting emissions (OECD, 2018[1]; OECD, 2019[2]).

Carbon pricing is one of the core building blocks for the transition towards a low-carbon economy. It encourages emitters to adopt and innovate low-carbon technologies across sectors of the economy, thereby allowing emission reductions to occur where they are cheapest and avoiding the need to identify and prioritise the most promising technologies, firms or sectors in advance. Well-designed instruments that address additional market or government failures and other barriers may usefully complement carbon pricing as part of a broader policy package.

The design of electricity taxation is also important for decarbonisation. Electricity taxes apply to an energy output (electricity) and are typically not distinguished by energy source. In that case, they make electricity more expensive even when it is produced from clean energy sources and fail to favour decarbonisation of the electricity mix. Therefore, they do not constitute a carbon price. They also may discourage deep cuts in carbon emissions through electrification when electricity generation itself is decarbonised.

The Dutch government employs several policy instruments that effectively put a price on carbon emissions or on electricity use. The industry sector is subject to fuel-specific energy taxes, electricity taxes, a sustainable energy surcharge and the EU ETS. While instruments that are fuel specific (e.g. energy tax on natural gas use, the surcharge on natural gas use) or targeting emissions directly (e.g. EU ETS) effectively put a price on carbon, other instruments (e.g. energy tax on electricity use, the surcharge on electricity use, the indirect cost compensation) effectively price electricity but do not differentiate by fuel and their carbon content. In addition, a 21% VAT rate applies on the purchase of energy products including excise taxes and EU ETS allowances.[1] On top of the existing instruments, the new climate agreement introduced a national carbon levy for industry and implemented changes to the energy surcharge on natural gas and electricity.

The objective of this section is to provide a detailed, numerical assessment of the role that electricity and carbon pricing currently plays in the Dutch industry. It describes policy instruments that effectively, and sometimes explicitly, put a price on electricity or carbon in the Netherlands and how they apply to Dutch industry. It discusses which industrial sectors are covered and which are (partially) exempt from pricing instruments. The section also highlights revenues that are associated with the different instruments. Sections 5.8.1 and 5.8.2 present and analyse two synthetic pricing indicators. First, the effective carbon rate summarising the different carbon pricing instruments and their application in a single measure. Second, an effective tax rate on electricity use. It provides a detailed overview of how the Netherlands price electricity or carbon emissions from energy use in industry, with a focus on the chemicals, metallurgical, food processing and refinery sectors.

Table 5.1. Overview of policy instruments

Instrument type	Policy instruments
Electricity and carbon pricing instruments	Taxes on energy use Energy surcharge (Opslag Duurzame Energie [ODE]) EU Emission Trading System (ETS) (including indirect cost compensation) National carbon levy
Voluntary Agreements	Multi-year agreements on energy efficiency (Meerjarenafspraken energie-efficiëntie [MJA-3/MEE]) (ended 2020) Front runner programmes/regional industry cluster programmes
R&D / demonstration support - generic	European programmes: H2020; EU SME Instrument; European Innovation Council (EIC); ERANET Domestic: National Science Agenda, TO2 Tax incentives: WBSO & Innovation box Nationaal Groeifonds SMEs: Innovation vouchers, DVI, SBIR Guarantees: SME credit guarantee scheme (BMKB); Growth facility Top Consortia for Knowledge and Innovation (TKI) Top Sectors: Topsectorenaanpak, PPS/TKI, Knowledge and Innovation Covenant (KIC), MOP; SME Innovation Support Top Sectors (MIT); Dutch Research Council (NWO)-KIC
R&D / demonstration support - specific	European: NER300/Innovation Fund; InnovFin EDP; SET Plan Top Sectors: GoChem; TSE-R Integrated Knowledge & Innovation Agenda Climate (IKIA) Mission-driven research, development and innovation (MOOI) Multi-year Mission Driven Innovation Programmes (MMIPs) Demonstration Energy and Climate Innovation (DEI, DEI+, DEI+ CE, HER+) Invest NL
Oes Deployment/ adoption subsidies	Stimulation of sustainable energy production and climate transition (SDE++) Energy investment allowance (EIA) Accelerated climate investment in industry (VEKI) MIA (*Milieu-InvesteringsAftrek* - environmental investment deduction) and Arbitrary depreciation of environmental investments (VAMIL) Investment Subsidy Sustainable Energy (ISDE) Green project scheme EU LIFE programme Small-scale investment allowance (KIA)
Command and control	Environmental Management Act: Obligation for investment in energy savings
Infrastructure programmes	European Structural and Investment Funds (ESIF): European regional development fund (ERDF) Porthos and Athos CO_2 network North Sea Wind Power Hub Taskforce Infrastructure Climate Agreement Industry (TIKI) Multi-year Program Infrastructure Energy and Climate (MIEK) National Program Regional Energy Strategy (RES)

5.1.1. Taxes on energy use

Taxes on energy use, such as taxes on fuel or electricity, set a tax rate per physical unit. Different from electricity taxes, fuel taxes translate into an effective carbon tax rate, in the sense that they can be converted into a rate on the carbon content of each form of energy. Although not explicitly linked to a carbon price, fuel taxes effectively put a price on carbon similar to carbon taxes in the sense that the tax liability increases proportionally to fossil fuel use. The authority responsible for implementing taxes on energy use (fuels and electricity) is the Ministry of Finance. Tax payments are made to the Netherlands Tax and Customs Administration by the consumers' respective energy supplier, who collects energy taxes via the energy bill.

The central policy objective of the Dutch Energy Tax is to fund the general budget of the State.

Tax rates

The Netherlands levies taxes on energy use within the framework of the EU Energy Tax Directive (2003/96/EC), which sets minimum rates for the taxation of energy products in EU member states. Effective 1 July 2020, the following rates apply within this framework. A coal tax of EUR 0.4755 per gigajoule (GJ) applies to coal and coke products used as a heating fuel (European Commission, 2020[3]). Coal used for other means than combustion and coal used in the generation of electricity are exempt from the tax. An excise duty applies to liquid fuels, such as diesel and gasoline. The rate for diesel use in the industry sector, either in stationary motors or for heating, is EUR 503.62 per 1 000 litres (European Commission, 2020[3]).

An additional energy tax applies to natural gas and electricity consumption in industry.[2] The tax rate for natural gas and electricity changes with consumption based on a four-bracket system. The system provides a schedule of rates that decrease with consumption. On average, a small energy user will pay a higher effective rate per unit of all energy consumed than a large energy user. Table 5.2 and Table 5.3 show the tax rates for natural gas and electricity in 2020 as reported in the Environmental Taxes Act. The energy tax does not apply to fuels used for other means than combustion, for instance the use of gas as a raw material for production of fertiliser, methanol or hydrogen. Additional sector specific exemptions apply, as discussed below. Table 5.5 and Table 5.6 provide context of how the main industrial subsectors distribute across these bands.

Table 5.2. Energy tax rates for natural gas in 2021, by consumption level

	0-170 000 m^3	170 001-1 million m^3	> 1-10 million m^3	> 10 million m^3
Tax rates for natural gas (in EUR per m^3)	0.34856	0.06547	0.02386	0.01281

Note: Bands are defined for a 12-month consumption period. Different rates apply to the horticultural industry. The first band covers block heating.
Source: Environmental Taxes Act.

Table 5.3. Energy tax rates for electricity in 2021, by consumption level

	0-10 000 kWh	10 001-50 000 kWh	50 001-10 million kWh	> 10 million kWh
Tax rates for electricity (in EUR per kWh)	0.09428	0.05164	0.01375	0.00056

Note: Bands are defined for a 12-month consumption period.
Source: Environmental Taxes Act.

Energy-intensive users in the Netherlands benefit from relatively low energy tax rates compared to Dutch users that consume relatively less energy, thanks to the regressive rate structure for natural gas and electricity taxes. The main reasons for providing relief to large industrial users are concerns over competition, i.e. that these domestic users may face competition from firms in countries where energy taxes are lower. Higher domestic taxes could eventually lead to carbon leakage, whereby foreign emissions increase because production moves to countries with less ambitious climate policies (Fowlie and Reguant, 2018[4]). The small and open structure of the Dutch economy may explain the efforts to shield domestic industry from international tax competition.[3] However, the current structure of the energy tax provides relief on the sole criterion of energy use, with no differentiation based on the actual exposure of a sector to international competition. Alternatively, in the EU ETS, measures to address competitiveness concerns relate to the trade-exposure and energy-intensity of production, see below.

The regressive rate structure leads to average tax rates per unit of output that differ across producers. Such preferential treatment of large producers compared to small producers may conflict with the principle of horizontal equity, particularly if companies of different sizes produce substitute goods. Consider a small, local producer of goods or services, who pays the high tax rate of the first or second consumption bracket on the entirety of its consumption, and who competes with other producers of the same goods or services on the local market. Some of these competitors may be large and some part of their consumption may fall into the higher consumption brackets. The large consumer would then benefit from preferential tax treatment only because of its size and would pay proportionally less in taxes than the local producer does.[4] If such treatment were justified to encourage economies of scale, one would need to carefully assess the context and justification for providing such types of input subsidies.

The current rate structure does not take into consideration the carbon-intensity of energy use either.[5] Even if carbon reduction may not be a stated policy objective for the energy tax, providing reduced energy tax rates for natural gas to large energy users may provide incentives that are misaligned with the decarbonisation plans of the government, especially if these users currently rely on carbon-intensive energy sources. At the very least, smaller users of natural gas will face higher effective carbon rates than larger ones. As discussed in Chapter 9, alternative measures exist that provide targeted relief to firms that are exposed to international tax competition, while keeping the incentive to decarbonise in place. Internal and external evaluations of the Dutch energy tax are being conducted in this context.

Tax bases

Looking at the actual distribution of energy use across the different consumption bands shows that the majority of natural gas and electricity used in the Dutch industry sector is subject to the lowest available energy tax rate (Table 5.4). 89% of all gas use and 96% of all electricity use in industry are situated in the highest two consumption bands, i.e. those subject to the lowest tax rates.

Table 5.4. Distribution of energy use across consumption bands in industry, 2016

	Band 1	Band 2	Band 3	Band 4
Natural gas	5%	6%	16%	74%
Electricity	2%	3%	37%	59%

Source: CBS (2017[5])

Considering the most energy-intensive sectors in the Netherlands, the distribution of energy use across bands is particularly skewed towards the consumption bands with the lowest rates (Bands 3 and 4). Table 5.5 shows the distribution of natural gas consumption in industry by sector. The left-hand side panel shows the share of each sector in total industry natural gas use, while the right hand-side panel shows the distribution of natural gas use by consumption band. For example, the chemical sector consumes 34.3% of all natural gas that is used in Dutch industry, and the vast majority of this consumption (72.9%) falls in the fourth consumption band. This picture looks quite different for the food-processing sector, which is responsible for 24.4% of natural gas use in industry, and where 31% of energy use is subject to the highest tax rates (Bands 1 and 2).

Similarly, Table 5.6 shows the distribution of electricity consumption in industry by sector. The left-hand side panel shows the share of each sector in total industry electricity use, while the right hand-side panel shows the distribution of electricity use by consumption band. The table shows that the chemical sector consumes 34.2% of all electricity in the industry sector, with nearly 100% falling in Bands 3 and 4.

Table 5.5. Distribution of natural gas consumption by industry sub-sector, 2016

Industry sub-sector	Share in total industry natural gas use	Distribution of energy use within each sub-sector			
		Band 1	Band 2	Band 3	Band 4
Chemicals	34.3%	2.1%	4.7%	20.3%	72.9%
Food processing	24.3%	14.9%	16.3%	36.4%	32.4%
Building materials	9.7%	2.9%	7.2%	41.1%	48.8%
Refineries	8.7%	0.3%	0.7%	7.0%	92.0%
Basic Metals	6.8%	3.6%	8.4%	20.7%	67.3%
Metal products, machinery	6.2%	41.7%	19.3%	19.8%	19.2%
Other industry	10.0%	32.2%	21.5%	40.0%	6.3%

Note: The second column shows the relative contribution of each sub-sector to total natural gas consumption in industry. Natural gas used as a feedstock is not included. Columns 3 to 6 present the distribution of natural gas consumption within each sub-sector across the four consumption bands. *Building materials* (ISIC 23) includes manufacture of some non-metallic mineral products, such as cement, clay, glass, lime and plaster. *Basic metals* (ISIC 24) include manufacture and casting of iron and steel, basic precious and other non-ferrous metals (including, for example aluminium, copper, lead, nickel etc.). *Metal products and machinery* (ISIC 25-28) excludes transport equipment.
Source: Based on CBS (2017[5]).

Table 5.6. Distribution of electricity consumption by industry sub-sector, 2016

Industry sub-sector	Share in total industry electricity use	Distribution of energy use within each sub-sector			
		Band 1	Band 2	Band 3	Band 4
Chemicals	34.2%	0.1%	0.3%	13.5%	86.2%
Food	18.3%	0.8%	2.9%	53.2%	43.1%
Basic metals	15.1%	0.1%	0.2%	10.1%	89.6%
Metal products, machinery	9.4%	1.8%	4.3%	57.7%	36.3%
Other industry	22.9%	3.5%	4.7%	47.6%	44.2%

Note: The second column shows the relative contribution of each sub-sector to total electricity consumption in industry. Columns 3 to 6 present the distribution of electricity consumption within each sub-sector across the four consumption bands
Source: Based on CBS (2017[5]).

Exemptions and refunds

In addition to benefiting from the regressive rate of the energy tax, some energy-intensive natural gas and electricity users are exempt from energy taxes according to the Environmental Taxes Act. Sections 5.8.1 and 5.8.2 present the detailed effective tax rates on natural gas and electricity by industrial sector taking into account exemptions and refunds.

In particular, the energy tax applies to gas and electricity supplied via a connection to the energy grid, leaving electricity and natural gas production for own use ("auto-generation") untaxed (Art. 50). Electricity auto-generation from renewable energy sources is also exempt.

Natural gas and electricity used in combined heat and power (CHP) generation is also exempt from the energy tax for installations with an electrical efficiency of at least 30% and electric power of at least 60 kW (Art. 64, Environmental Taxes Act). The rationale for this exemption is to prevent double taxation of CHP-*generated* electricity as it is subject to the electricity tax. However, the current design of this exemption also leads to CHP-generated heat not being subject to a tax. Finally, this exemption also includes electricity produced for own use and gas produced for own heating consumption, which are both exempt from the energy tax and where no risk for double taxation exist.

In addition, specific industrial sectors benefit from a tax exemption, notably, natural gas used in metallurgical processes (i.e. the manufacture of metals in primary form, the forging, pressing, stamping and roll forming of metal and the surface treatment consisting of hardening or heat treatment of metals). This encompasses activities belonging to Code 24 or 25 of the Standard Industrial Classification of 21 July 2008 by the Central Bureau of Statistics. Natural gas is also exempt when used for mineralogical processes, including the manufacture of glass and glassware, ceramic products, cement, lime or gypsum, sand-lime bricks or aerated concrete and rock wool (Art. 64, Par 4). This includes companies with an activity assigned to code 23 of the Standard Industrial Classification of 21 July 2008 by the Dutch Central Bureau of Statistics. The use of electricity is also exempt for chemical reduction, electrolytic and metallurgical processes (Art. 64, Par 3). Sections 5.8.1 and 5.8.2 map tax exemptions to the effective energy base in the Netherlands and provide summary indicators for carbon and electricity pricing.

Businesses can request an additional tax refund for electricity consumption above 10 million kWh (excluding consumption that benefits from other exemptions) per year when they meet two criteria (Art. 66). First, businesses need to have undertaken a commitment to improve energy efficiency within one of the long-term agreements that industrial sectors have signed with government. Second, their activity needs to be considered energy-intensive in the sense that businesses need to participate in the voluntary Multi-year Energy Efficiency Agreement for EU ETS companies (MEE agreement) (Section 5.2.1). The refund is calculated as the difference between the actual tax liability on electricity supplied for business consumption in the calendar year and the potential tax liability on a quantity of 10 million kWh. Or, if the amount would be higher, the difference between the actual tax liability and the hypothetical tax liability on all business electricity consumption would apply a minimum tax rate as defined in the EU Energy Tax Directive (2003/96/EC).

Revenues

There is no direct earmarking of revenues from energy taxes[6] in the Netherlands, albeit there is a political commitment for a green tax shift, i.e. to use additional revenues from the energy tax to reduce taxation on labour and capital income. More precisely, revenues collected through the energy tax are generally assigned to the Dutch overall budget. When policy decisions are made to raise energy tax rates, the projected revenue is used to finance tax cuts on direct taxes, such as personal income and corporate income taxes. The Dutch government does not, however, track the amount of revenues generated from increases in energy tax rates (Marten and Van Dender, 2019[6]).

The generous exemptions for specific industries and the relatively low tax rates related to consumption Band 4 limits the energy tax liability of energy-intensive industrial users. This implies that energy-intensive users will contribute relatively little to the Dutch green tax shift efforts.

Table 5.7 provides a first overview on how the preferential tax treatment provided in the energy tax law spreads across industry subsectors in the Netherlands. It shows the total energy taxes on natural gas and electricity paid by the industry sector in 2017 and contrasts these tax payments to the industry sectors energy base in 2016. The figures for tax payment are net of exemptions and refunds and reflect the regressive rate structure, i.e. differing rates across consumption bands. By highlighting each industrial subsector’s contribution to the industry totals, the table shows which sectors receive most of the preferential treatment. For example, cases where a subsector contributes less to total industry tax payments than it contributes to the total energy base imply a generous level of preferential tax treatment. This is the case in the petroleum, chemical, building material and metallurgical sectors.

Summary indicators on the effective tax rates per industry subsector are displayed and discussed in the carbon pricing profiles in Sections 5.8.1 and 5.8.2.

Table 5.7. Energy tax payments (2017) and energy base (2016) per industry sub-sector

	Natural Gas		Electricity	
	Tax payments (in EUR mln)	Energy base (in mln m³)	Tax payments (in EUR mln)	Energy base (in GWh)
Industry total	221.6	5 896.1	186.7	31 930.7
Contribution by subsector (in %)				
10-13 Food, drinks and tobacco	36.3%	24.3%	31.4%	18.3%
13-15 Textile and leather	4.0%	1.4%	4.4%	1.1%
16-18 Wood, paper and graphic industry	7.6%	4.0%	11.9%	6.9%
19 Petroleum industry	3.2%	8.7%	0.5%	2.3%
20, 21 Chemical and pharma industry	18.5%	34.3%	11.9%	34.2%
23 Building materials	0.5%	9.7%	3.2%	3.9%
24 Basic metals	0.0%	6.8%	0.0%	15.1%
25-30 Machinery (incl. transport means)	18.9%	7.3%	16.9%	11.2%
31-32, 22 Other industry and repair	10.9%	3.6%	19.9%	6.9%

Note: Small differences in the sectoral definitions across tax payments and the energy base may remain.
Source: CE Delft (2021[7]) and CBS (2017[5]).

5.1.2. ODE

The ODE was implemented as of 1 January 2013 to stimulate the transition from fossil fuels to sustainable energy. The ODE is a separate levy on natural gas and electricity that comes in addition to the energy tax described in the Section 5.1.1. It mirrors the structure of the energy tax in the sense that ODE rates vary across the same consumption bands, decreasing with the amount of energy used. Identical exemptions apply. The central policy objective of the ODE is to fund payments to renewable energy projects in the context of the Sustainable Energy Production Scheme (SDE+). The scope of the instrument was recently extended through the Climate Agreement as detailed below.

The authority responsible for implementing ODE is the Ministry of Finance, while ODE payments are made to the Dutch Tax and Customs Administration by the respective energy supplier, who collects ODE payments via consumers' annual energy bills.

ODE rates and exemptions

The government sets the ODE rates annually to cover the budget of the SDE scheme. Rates have been increasing over the years alongside the growing financing needs for renewable energy (Table 5.8 and Table 5.9). The same consumption bands apply as for the energy tax. For example, ODE receipts amounted to EUR 97 million in 2013 and increased yearly to reach EUR 1 632 million in 2019 (CBS, 2020[8]). Up until 2020, households and business contributed equally to the ODE-SDE budget (Government of the Netherlands, 2019[9]).

As with the energy tax, the regressive rate structure provides relief to energy users on the sole criteria of energy-intensity, with no differentiation on the sector's actual exposure to international competition or the carbon-intensity of energy use. Providing preferential treatment to large producers at the expense of small producers, who produce substitute goods, disadvantages local producers and introduces distortions. Overall, the same remarks apply as made in Section 5.1.1.

Table 5.8. ODE rates for natural gas, by consumption level (EUR/m³)

Year	0-170 000 m³	170 001- million m³	> 1-10 million m³	> 10 million m³
2020	**0.07750**	**0.02140**	**0.02120**	**0.02120**
2019	0.05240	0.01610	0.00590	0.00310
2018	0.02850	0.01060	0.00390	0.00210
2017	0.01590	0.00740	0.00270	0.00130
2016	0.01130	0.00420	0.00130	0.00090
2015	0.00740	0.00280	0.00080	0.00060
2014	0.00460	0.00170	0.00050	0.00040
2013	0.00230	0.00090	0.00030	0.00020

Note: Bands are defined for a 12-month consumption period. Different rates apply to the horticultural industry. Block heating is covered by the first band.
Source: Belastingdienst (2020[10]).

Table 5.9. ODE rates for electricity, by consumption level (EUR/kWh)

Year	0-10 000 kWh	10 001-50 000 kWh	50 001-10 million kWh	> 10 million kWh
2020	**0.0273**	**0.0375**	**0.0205**	**0.0004**
2019	0.0189	0.0278	0.0074	0.0003
2018	0.0132	0.018	0.0048	0.000194
2017	0.0074	0.0123	0.0033	0.000131
2016	0.0056	0.007	0.0019	0.000084
2015	0.0036	0.0046	0.0012	0.000055
2014	0.0023	0.0027	0.0007	0.000034
2013	0.0011	0.0014	0.0004	0.000017

Note: Bands are defined for a 12-month consumption period.
Source: Belastingdienst (2020[10]).

As of 2021, the new Climate Agreement increases the scope of the SDE scheme. The extended SDE++ scheme covers low-carbon technologies and production processes beyond renewable energy, in particular technologies with the potential to reduce CO_2 emissions in the industry sector (e.g. hydrogen, carbon capture and storage [CCS], the use of residual heat). In this context, the Agreement also restructured ODE. As of January 2021, business will contribute a higher share to the overall ODE budget, from the current 50% to 67%. The Agreement also indicates that consumers in the two highest consumption bands will take on the additional charge from the extension of the SDE scheme. "This increase will be collected in full in the highest tax brackets (third and fourth brackets)" (Government of the Netherlands, 2019[9]).

The new structure of the combined ODE-SDE mechanism aims to restructure industry and strengthen abatement incentives via a revenue-neutral approach (within industry). Until 2030, industrial energy users would eventually contribute EUR 550 million per year to the ODE budget. The same amount would then be recycled back to industry in the form of SDE++ subsidies for CO_2 reductions.

Comparing ODE rates across consumption bands for 2021, it is not immediately evident to what extent energy-intensive industrial users actually contribute to the additional ODE effort as outlined in the Climate Agreement. Table 5.10 shows the new ODE rates for 2021 as indicated by the central government, and percentage changes related to 2019 rates. Between 2019 and 2021, tax rates in each consumption band increase, with the largest total rate changes arising in the third and the fourth bands (except for electricity Band 4) where 2019 rates are lowest. Table 5.11 shows the estimated ODE rates for 2025. However, these bands also receive generous exemptions. In particular, exemptions from ODE align exactly with the exemptions from the energy tax discussed above as defined by Article 64 of the Environmental Taxes Law.

As a consequence, it is far from straightforward to analyse the total contribution of different consumption bands to the ODE budget, as well as the contribution by industry sub-sectors.

Table 5.10. ODE rates in 2021 and changes compared to 2019, by consumption level

	Band 1		Band 2		Band 3		Band 4	
	2021 Rate	Change to 2019	2021 Rate	Change to 2019	2021 Rate	Change to 2019	2021 Rate	Change to 2019
Natural gas rate (EUR/m³)	0.0851	+62.4%	0.0235	+46.0%	0.0232	+293.2%	0.0232	+648.4%
Electricity rate (EUR/kWh)	0.03	+58.8%	0.0411	+47.8%	0.0225	+204.1%	0.0004	+33.3%

Source: Calculations based on Rijksoverheid (2020[11]).

Table 5.11. ODE rate projections for 2025 and changes compared to 2019, by consumption level

	Band 1		Band 2		Band 3		Band 4	
	Rate	Change to 2019	Rate	Change to 2019	Rate	Change to 2019	Rate	Change to 2019
Natural gas rate (EUR/m³)	0.1028	+96.2%	0.0283	+75.8%	0.0281	+376.3%	0.0281	+806.5%
Electricity rate (EUR/kWh)	0.03618	+91.4%	0.04968	+78.7%	0.02723	+277.0%	0.00054	+80.0%

Note: Nominal rates are reported. Projections assume there is no change in the levy base. If the base erodes over time, e.g. thanks to effective climate policy instruments, the projected rates would need to be adjusted.
Source: PBL from communication with CE Delft.

Revenue

Until 2020, ODE revenues have been fully earmarked to finance measures that stimulate the production of sustainable energy (SDE+). Starting at around EUR 100 million in 2014, the budget reached EUR 2411 million by 2020 (Table 5.12), as reported by Statistics Netherlands and the Ministry of Economic Affairs and Climate Policy (2021[12])

Table 5.12. Past government receipts from ODE on electricity and natural gas

	2013	2014	2015	2016	2017	2018	2019	2020
ODE receipts per year (EUR million)	97	174	279	421	635	1 033	1 733	2 411

Source: CBS (2020[8]) and Ministry of Economic Affairs and Climate Policy (2021[12])

Looking at the sectoral contributions to the ODE budget, the industrial sector contributed EUR 11 million to ODE in 2019 (Ministry of Economic Affairs and Climate Policy, 2021[12]). With the transformation of the ODE-SDE scheme in the year 2021, the industry sector is supposed to contribute (and receive) a maximum of EUR 550 million annually. Table 5.13 shows the industrial sector's ODE payments in 2017, differentiated by natural gas and electricity, and the contribution of different sub-sectors to total revenues in percentage. These figures are net of exemptions and account for the different rates across consumption bands in 2017.

The table also contrasts each sub-sector ODE contribution in 2017[7] to its energy base in 2016, shedding light on how preferential treatment distributes over sectors. As with revenues from the energy tax, both the generous exemptions and the lower tax rates in the third and fourth consumption band limits the contribution of energy-intensive industrial users to the ODE-SDE redistribution mechanism. If the framework for providing exemptions is not reformed in the future, small energy consumers risk contributing highly to the expanded SDE++ budget, while potentially having little opportunity to claim SDE++ subsidies, which are directed mainly at technologies for energy-intensive industry.

Sections 5.8.1 and 5.8.2 provide a more detailed picture on how fiscal instruments that put a price on carbon or electricity distribute over the CO_2 emissions base in the main sectors, highlighting in detail how strongly each tonne of carbon is priced and where the bulk of exemptions applies.

Table 5.13. ODE payments (2017) and energy base (2016) per industry subsector

		Natural Gas		Electricity	
		ODE payments (in mio EUR)	Energy base (in mio m^3)	ODE payments (in mio EUR)	Energy base (in mio kWh)
Industry total		21.06	5 896.1	36.48	31 930.7
Contribution by subsector (in %)					
10-13	Food, drinks and tobacco	37.5%	24.3%	33.7%	18.3%
13-15	Textile and leather	3.5%	1.4%	3.1%	1.1%
16-18	Wood, paper and graphic industry	7.6%	4.0%	10.9%	6.9%
19	Petroleum industry	3.8%	8.7%	0.6%	2.3%
20, 21	Chemical and pharma industry	22.3%	34.3%	14.1%	34.2%
23	Building materials	0.7%	9.7%	4.1%	3.9%
24	Basic metals	0.0%	6.8%	0.0%	15.1%
25-30	Machinery (incl. transport means)	15.3%	7.3%	17.4%	11.2%
31-32, 22	Other industry and repair	9.3%	3.6%	16.0%	6.9%

Note: Small differences in the sectoral definitions across ODE payments and the energy base may remain.
Source: CE Delft (2021[7]) and CBS (2017[5]).

5.1.3. EU ETS

Emissions from Dutch industry are subject to the EU ETS. The EU ETS was set up in 2005 and follows a cap and trade principle to set a price on carbon emissions. It fixes the quantity of carbon to be emitted by all installations in the system (cap), which decreases over time. The newly established market stability reserve modifies this principle (see below). Installations in the EU ETS need to surrender tradable emission permits (allowances) for all their emissions of the previous year. The allowance price is determined by the market, either by an auction or the secondary market, at the intersection of the allowance supply and demand.

Since the beginning of Phase 3 of the EU ETS (2013-20), a single EU-wide cap replaces the previous system of national caps. From the beginning of Phase 4 (2021-30), the number of allowances that are put into circulation will decrease at a rate of 2.2% annually. Installations either receive emission allowances for free, based on product-specific benchmarks, or have to buy them via auctions or on a secondary market. A company can bank unused allowances for future use or trade it with other companies in the market.

The extent to which allowances are auctioned, as opposed to freely allocated, varies across sectors. While electricity generators have not received free allowances since 2013 in most countries,[8] the manufacturing sector received free allowances for 80% of its emissions in 2013 in those industrial sectors where the risk for carbon leakage was not considered to be significant. This share decreased to 30% in 2020 and is foreseen to phase out after 2026 to 0 at the end of phase 4 (2030) “unless a review of the Directive determines otherwise”. (European Commission, 2020[13]). Free allocation to these sectors is planned to be phased out after 2026. Industrial installations considered to be "at significant risk of carbon leakage" (reflecting a sector's trade and emissions intensity) receive most of their allowances for free with the objective to preserve their competitiveness. That is, they receive free allowances for 100% of the benchmark emissions, which correspond to the average emissions of the 10% most efficient installations in the sector. European legislation (Decision 2019/708) determines the sectors and subsectors that are deemed at risk of carbon leakage. With regards to the industry sectors in the focus of this analysis, several subcategories in the basic metal, chemicals and food subsectors are deemed at risk. The entire refinery sector is also included.[9]

The Dutch Emissions Authority (NEa) implements and monitors the EU ETS in the Netherlands. Before the end of March each year, all EU ETS installations have to report the emissions of the past year via a verified emissions report. At the end of April, they have to surrender enough allowances to cover all reported emissions. The NEa monitors compliance and can take enforcement action if needed.

Permit prices

The average auction price of EU ETS emission allowances in 2020 was settled at EUR 24.35 per tonne of CO_2.[10] Over the course of the year allowance prices moved between a range of EUR 14.60, on 23 March 2020, and EUR 30.92, on 14 December 2020 (EEX, 2020[14]).

A market stability reserve (MSR) started operating at the beginning of 2019. The objective of the MSR is to address the existing surplus of allowances in the EU ETS and to adjust the future supply of allowances in the event of major economic shocks. The MSR would stabilise the EU ETS price by regulating the quantity of allowances in the market (European Commission, 2020[15]).[11] Contrary to other trading systems, e.g. the Californian Cap and Trade Program, it does not specify a price threshold for delivering stability support and therefore provides no guarantee against low permit prices (Flues and Van Dender, 2020[16]).

Sector coverage and free allocation

Approximately 430 Dutch companies participate in the EU ETS. A small proportion of installations contribute to the vast majority of Dutch emissions covered by the EU ETS. 81% of emissions came from 10% of the EU ETS installations in 2018. The main emitters are in the energy and chemical sector, refineries and manufacturing of primary metals (Rijskoverheid, 2020[17]).

In 2019, the EU ETS covers 45.2 million tonnes of Dutch industrial emissions (CO_2-equivalent)[12]. Emissions from electricity generation are also covered by the EU ETS. The industry sub-sectors contributing most to EU ETS emissions are chemicals, refineries and basic metals (Table 5.14). In 2019, these sectors received free allowances corresponding to respectively 96%, 73% and 85% of their verified emissions (CE Delft, 2021[7]).

Table 5.14. Verified emissions and free allocation, 2019

Industry sub-sector	Verified emissions (mln tonnes of CO_2-eq)	Freely allocated allowances (mln tonnes of CO_2-eq)	Proportion of free allocation
Chemicals	17.9	17.2	96%
Food	2.0	1.4	70%
Basic metals	11.6	9.9	85%
Refineries	11.0	10.3	73%
Other industry	2.7	2.0	94%
Total industry	**45.2**	**39.3**	**87%**

Source: CE Delft (2021[7]).

Box 5.1. Free allocation and decarbonisation incentives

Theory suggests that the EU ETS price provides an incentive for emissions abatement independently from how allowances are allocated. Because an emissions allowance could always be sold on the market, owning an allowance has an opportunity cost for forgoing emissions abatement, equal to the ETS price. The opportunity to sell allowances exists whether the allowance has been freely allocated or was bought on the market or during an auction. As such, the marginal abatement incentive remains intact independently of the allocation mechanism. This would incentivise all EU ETS participants to engage in emission reduction at the margin, for example, via efficiency improvements if no additional distortions exist.

However, preparing the shift towards a low- or zero-carbon economy requires thinking beyond abatement incentives at the margin towards deep decarbonisation and a technological switch. In such a setting, there is a need to re-evaluate the free allocation of emissions allowances. Investing in clean technologies as opposed to carbon-intensive technologies involves an investor's discrete choice that is driven by economic rents. Freely allocating emission allowances based on product-specific benchmarks that often differs across carbon-intensive and low-carbon substitutes will affect economic rents and can make carbon-intensive investments more attractive (Flues and Van Dender, 2017[18]). Depending on the allocation rules, free allocation can weaken incentives for firms to invest in break-through low-carbon technologies and undermines the trading system's effectiveness to drive decarbonisation.

For example, a traditional steel producer within the EU ETS, who receives a free allocation on all emissions, has an incentive to reduce emissions at the margin and sell the unused allowances on the market. The producer could do so by burning fossil fuels more efficiently for instance, which would be profitable as long as the expected price of the allowance sale outweighs the cost of the emissions abatement. However, if the same free allocation is not made available for clean producers, there may be no incentive to switch technologies towards existing (e.g. electric arc to melt iron) or entirely new and clean production processes (e.g. direct reduced iron using green hydrogen). For example, if the new technology is linked to a process-specific product-benchmark where free allocation is lower or nil, adopting the new technology confers an allocation disadvantage.

Flues and Van Dender (2020[16]) discuss recent empirical findings that are consistent with the theoretical argument that free allocation of permits in the EU ETS weakens abatement incentives or innovation efforts (Brouwers, Schoubben and Van Hulle, 2017[19]; Martin, Muûls and Wagner, 2016[20]; Martin, Muûls and Wagner, 2016[20]).

Indirect cost compensation

With the introduction of the EU ETS, Members States have the right to implement a national mechanism to compensate electricity-intensive industry sectors for the potential increase of electricity cost due to the EU ETS. The national measures need to be in line with EU state aid rules. Aid can be granted only upon approval by the European Commission.

In the Netherlands, a national compensation for higher electricity costs has been in place since 2014 (Article 4.4.1-4.4.13 of Regulation No. WJZ/13125043). A company needs to meet two criteria to be eligible for the indirect cost compensation. It needs to participate in the multi-year energy efficiency agreements MJA3 or MEE and to operate in one of the 15 industry subsectors as defined by the European Commission[13] (Appendix 4.4.1 of WJZ/13125043). The compensation payment is calculated based on: 1) the standardised product-specific electricity consumption profile per year; 2) a fixed CO_2 emission factor per MWh; 3) the average EU ETS future price in the previous year; and 4) a support intensity defined by the European Commission (set at 85% in 2014/2015, 80% in 2016/2017/2018 and 75% in 2019/2020). No compensation is granted for the first 1 000 MWh consumed.

Although the compensation mechanism aims to counteract a potential increase in electricity costs deriving from the EU ETS carbon price, the compensation payment in the Netherlands does not vary with the carbon content of the energy source used for electricity generation. This implies that facilities receive the same compensation per MWh whether they use electricity produced from carbon-intensive coal that pays the EU ETS price, or carbon-neutral renewable or nuclear energy that is not subject to the EU ETS.

Table 5.15 reports compensation payments for the Dutch industry sector over time. Payments vary between EUR 31.3 million in 2015 (compensation for 2014) and EUR 110.6 million in 2020 (compensation for 2019), which reflects changes in the EU ETS price and the support intensity. The largest recipients of compensation in recent years were the chemical sector and basic metal industry (non-ferrous metals, iron and steel), accounting for more than 56% and 32% of the total compensation respectively. Contrasting the compensation payments to the revenues generated from the auction of emissions allowances in the Netherlands shows that the indirect cost compensation paid in 2017-20 to industry represented 37.8%, 19.4%, 8.0%, 25.1% of auction revenues in 2016-19 respectively.

Table 5.15. Compensation payment for electricity input costs (in EUR million)

Industry sub-sector	2014	2015	2016	2017	2018	2019	2020
Chemicals				30.1	20.7	22.7	
Basic metals				17.1	12.0	12.9	
Other industry				6.4	4.2	4.7	
Industry total	52.7	31.3	45.0	53.5	36.9	40.3	110.6

Note: Payments reported in year *t* compensate for input costs incurred in year *t-1*. Sub-sectoral data available only for the years 2017-19.
Source: RVO (2020[21]).

Auction Revenues

In the Netherlands, revenues generated from auctioning EU ETS emissions allowances amounted to EUR 440 million in 2019, up from 25.6 million in 2012 (Table 5.16). Revenues are assigned to the overall budget. There is no legal earmarking of auction revenues (Marten and Van Dender, 2019[6]).

Table 5.16. Revenues generated from auctioning Dutch allowances per year

	2012	2013	2014	2015	2016	2017	2018	2019
Revenues (in EUR million)	25.61	134.24	125.63	183.57	141.59	189.63	500.84	440.13

Source: European Commission (2020[22]), European Environment Agency (2020[23]).

5.1.4. National carbon levy for industry

The Climate Agreement of 2020 announced a new carbon pricing instrument that takes effect in 2021. A legislative proposal “Wetsvoorstel Wet CO_2-heffing industrie” amends the Environmental Taxes Act and the Environmental Management Act to introduce a CO_2 levy for industry. The Lower House and the Senate adopted the proposal in November and December 2020, respectively. The national carbon levy for industry is framed explicitly as a supplement to the existing instruments (EU ETS, energy tax and energy surcharge) to achieve the carbon emission reduction target of 14.3 million tonnes in industry. It acts as a complement to the EU ETS and aims to set a domestic price floor per tonne of CO_2 for EU ETS emissions, following a pre-defined price trajectory until 2030.[14] 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.

The Dutch Emissions Authority (NEa) is the body responsible to implement the carbon levy. Installations need to report emissions and the calculation of their levy-free base to NEa. It carries out its service under the authority of the Minister of Finance.

A separate instrument puts a minimum carbon price on electricity production that takes part in the EU ETS. If the ETS price falls below the minimum price level, the Dutch national levy will apply.[15]

Rates

The carbon levy adds a floating contribution on top of the EU ETS allowance price to yield a fixed price per tonne of CO_2. The total levy (i.e. sum of the floating national part and the EU ETS price) will start at EUR 30 per tonne in 2021 and rise linearly to EUR 125 per tonne in 2030 with an annual increase of EUR 10.56 per tonne (Table 5.17).

Table 5.17. 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: The rates include the floating national part and the EU ETS price.
Source: OECD calculation based on legislative proposal “Wetsvoorstel Wet CO_2-heffing industrie”, Article 71p.

The levy rate has been calculated by estimating the rate required to reduce emissions by 14.3 million tonnes compared to a baseline scenario based on an abatement potential established ex-ante by PBL. The ex-ante analysis developed the price trajectory based on the marginal abatement costs of technologies that would need to be triggered to achieve the reduction target with some probability.[16]

A review of the rate trajectory is foreseen after five years in order to align with the planned update of EU ETS benchmarks and with the changes to the abatement cost curve through technology uptake. Another update of the rate was foreseen for 2020 to integrate the estimated impact on technology of the enlarged SDE++ scheme.

Committing now to a future path of gradual price increases can create strong incentives, particularly for investments in long-lived assets and infrastructure (Flues and Van Dender, 2020[16]). 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. One important success factor is a government’s ability to commit to rising price paths (Van Dender and Teusch, 2020[24]). Price trajectories are an essential feature to trigger clean-technology investments, particularly in situations where resources are scarce, such as in the wake of the COVID-19 pandemic (OECD, 2020[25]).

Sector coverage and other design features

The instrument covers emissions from installations that are part of the EU ETS as well as emissions from waste incineration plants and nitrous oxide installations. The Climate Agreement indicates that the instrument accounts “for roughly 82% of all industrial greenhouse gas emissions” and that the “levy will affect some 250 plants/businesses”.

The levy effectively acts as a baseline-and-credit system, where emissions above the baseline are taxed, and emissions below the baseline can be traded. In particular, installations have to pay the levy on their annual emissions that are not covered by a “dispensation right” (Article 71(l)1). Dispensation rights are the levy's analogue to free allocation and are attributed yearly following EU ETS benchmarks. Their amount will decrease by a specific annual reduction factor. In essence, dispensation rights are calculated as the product of the installation's output (ex-post), the EU ETS product-specific benchmark emission intensity and the annual reduction factor. Installations can trade their dispensation rights via bilateral contracts with other participants during a few months within a year. Dispensation rights cannot be carried forward (no banking), but can be carried back and used to claim back levy payments over a period of five years (Article 71q).

The number of dispensation rights (baseline) will decrease linearly every year based on a uniform, industry-wide reduction factor. The reduction factor starts at 1.2 in 2021 and will only drop below one in 2025 (Table 5.18). The gradual decrease of dispensation rights and high reduction factor in initial years aims to give businesses the flexibility to adapt to higher carbon prices in the future accounting for lead times of investments. In the context of the COVID-19 pandemic, the government recently announced an even more generous allocation of dispensation rights (Rijkskoverheid, 2020[26]). According to CE Delft, dispensation rights would cover a large part of the CO_2 emissions base across all industry subsectors in the early years, implying that only few industrial emissions would effectively be subject to paying the levy (Table 5.19). Although some relatively inefficient firms will be short of dispensation rights early in the process, they can most likely acquire those rights at negligible costs due to the large amount of excess dispensation rights in early years that are not bankable, thereby losing their value for future trading periods.

Table 5.18. Reduction factor to determine levy-free base

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Reduction factor	1.2	1.14	1.09	1.03	0.97	0.92	0.86	0.8	0.74	0.69

Note: The government recently announced an even more generous allocation of dispensation rights (Rijkskoverheid, 2020[26]).
Source: Calculation based on legislative proposal "Wetsvoorstel Wet CO_2-heffing industrie".

Table 5.19. Estimated proportion of emissions paying the levy in main 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 compared to 2021are assumed.
Source: CE Delft (2021[27]).

The design of the carbon levy boils down to a 'tax and trade' system with an ambitious carbon price trajectory and dispensation rights being freely allocated across all sectors. Installations pay the levy on emissions that are not covered by a dispensation right (tax component), which was either granted by the Dutch authorities or acquired via trading. They can trade dispensation rights (trade component) with other participating installations.

In theory, if trade occurs, the allocation of dispensation rights determines an effective annual emissions cap, with the levy acting as a safety valve. If the effective cap is insufficiently tight to trigger the safety valve, dispensation rights would be expected to trade at a lower price than the levy. More precisely, the floating component of the carbon levy would theoretically settle in a range between the rate set out through the price trajectory in a given year and a rate of EUR 0 per tonne. The former reflects the upper bound of the opportunity costs of holding a dispensation right. Given the generous allocation of dispensation rights in the early years of the levy, combined with the lack of banking option for future compliance, there likely will be no effective carbon price incentive deriving from the levy in the early stages and little trade in dispensation rights.

Revenues

The primary objective of the levy is to encourage CO_2 emission reductions, not to raise additional revenue. Revenues from the carbon levy will result from the difference between the levy rate and the EU ETS price per tonne of CO_2 multiplied by the emissions base that is not covered by a dispensation right outlined in Table 5.19. Given the generous allocation of dispensation rights, not much revenue can be expected in the early years of the levy. In later years, industry is expected to shift towards zero-carbon technologies or put other mitigation measures in place, which reduces the revenue collected through the levy further. This aligns with the ideas set out in the Climate Agreement that sees the carbon levy as part of a carrot-and-stick program with the carrot being the SDE++ and other investment support instruments and the stick being the levy that emitters must pay if they do not engage in low-carbon technology investment. Revenue is expected to be channelled back to industry for decarbonisation purposes.

> *"The carbon levy is actually expected to generate little revenue, given that businesses will be able to put measures in place on time and given the comprehensive policy approach on strengthening the region, adequate labour market policy and innovation and SDE+ subsidies, as well as due to the exchange option provided within the levy charging methodology. Any revenue generated by the carbon levy will be channelled back into making industry greener. This will be achieved through a generic subsidy scheme, which will be linked to an already existing subsidy scheme." (Page 109, National Climate Agreement)."*

5.2. Voluntary Agreements

This section describes and evaluates the most important voluntary agreements, namely those on energy efficiency (MJA-3 and MEE), those included in the Top sector policies and finally, the ones related to research networks.

5.2.1. Energy efficiency – MJA-3 and MEE (ended in 2020)

The government has made two agreements with the private sector on long-term energy efficiency. MEE is the multi-year agreement to ensure that participating ETS companies make a significant contribution to improving energy efficiency by taking all possible cost-efficient measures. In 2019, there were 111 participants in the MEE agreement, covering roughly 570 PJ of energy. Energy use covered by the covenant can be attributed 52% to the chemical industry, 27.2% to refineries and 11.6% to the metallurgical sector. Other industries covered by MEE include paper, glass, beer, cement and textile production (RVO, 2020).[17]

MJA-3 is the multi-year energy efficiency agreement committing to 30% energy efficiency improvement between 2005-20. MEE and MJA-3 are not mutually exclusive, but MEE is for the larger ETS companies. It is not clear yet if there will be a follow-up of MJA-3 after 2020, as the voluntary commitments become somewhat redundant in the presence of the ambitious Climate Agreement.

Participation in these agreements is not mandatory; however, participants in MJA-3 and MEE can receive money back via the refund scheme of the energy tax, which is described in more detail in the section above on carbon pricing and other fuel and electricity taxes. Other eligibility conditions for this refund scheme are that the energy is supplied from a single connection to the electricity grid and that energy usage exceeds 10 million kWh per year. Apart from this refund scheme, no other government funding exists for these non-binding agreements.

Part of these agreements is that industry organisations set up a roadmap with long-term opportunities and the government (through RVO) helps the participating organisations to draft energy efficiency plans, support the introduction of energy management and monitors the agreements.

Firms need to submit a monitoring report every year about the realisation of the intended measures. For MEE, this concerns measures in chain efficiency and process, for MJA-3 it also concerns the generation and/or purchase of sustainable energy. If a planned measure is not realised, another measure with a comparable savings effect needs to be taken, or an explanation needs to be provided. If a firm does not submit the progress statement, it is excluded from the use of the Energy Tax Refund Scheme. If the firm does not submit the monitoring report twice then their participation in the agreement will be reconsidered, which would imply that it would be no longer eligible for the refund scheme. Also, RVO visit around 100 firms every year to check their monitoring data.

RVO monitors the progress made in process efficiency, chain efficiency, sustainable energy and systematic energy management, and aggregates this progress into a sector report. Regional authorities take participation in these agreements into account when they enforce the Environmental Management Act (Wet milieubeheer).

The MJA-3 and MEE agreements on energy efficiency were evaluated in 2013 by Ecorys and KPMG, respectively (Ecorys, 2013[28]; KPMG, 2013[29]). They concluded that the targets on energy savings are achieved and that the MJA-3 sectors achieved energy savings of 2.1% a year over the period 2005-11. However, the absence of a clear counterfactual makes it hard to evaluate the exact contribution of the agreements, and comparing its effect with the effects of other policy instruments is desirable. An important recommendation from the evaluations by Ecorys and KPMG is that more customisation in the level of ambition across sectors is desirable in order to take better account of heterogeneity across sectors.

5.2.2. Top Sector policies - TKI

The Top Sectors programme was created in 2011 as a response to the Global Financial Crisis, and aims to strengthen co-operation between firms, universities and the government in sectors where the Dutch economy has a global competitive advantage.

The top sectors are Agri-food; Chemistry NL; Creative industry; Energy; Life sciences and health; Logistics, High tech; Horticulture and propagation materials; Water and maritime and the Dutch digital delta. The three Top Sectors that are most relevant for the industry’s decarbonisation are Agriculture & Food, Chemistry and Energy.

Within each top sector, corporations and research institutes have joined together in Top Consortia for Knowledge and Innovation (TKI). The TKIs have drawn up a research agenda and objectives for the coming years, share knowledge, risks and investments and receive extra research funding in return. TKIs can benefit from a Public Private Partnership (PPP) allowance, which is explained in more detail in the Section 3.3 on R&D.

Businesses within the top sectors can take advantages of various financial and non-financial arrangements, such as tax instruments, financing and guarantees, and advisory services. In 2019, all top sectors created a KIA (Knowledge and Innovation Agenda).

The Top sector policies were evaluated by Dialogic in 2017, who found that the programmes are suitable for the exchange of information between corporations, knowledge institutions and governments, but that the responsibilities of the different stakeholders are not always clear.

5.3. Research, Development and Demonstration

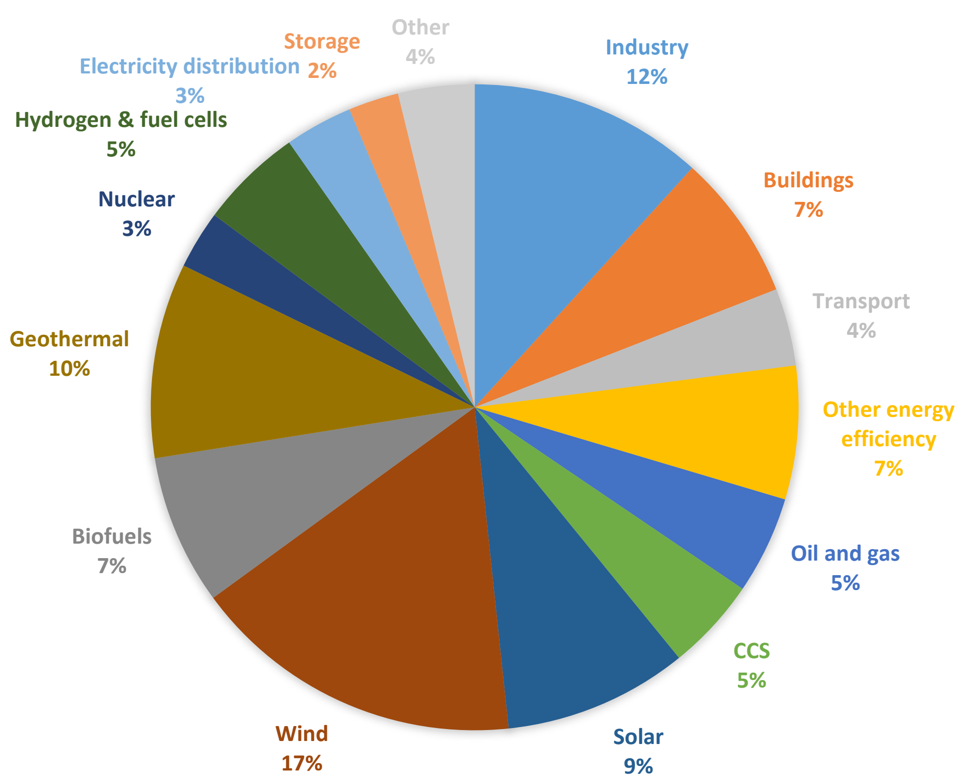
This section covers policy instruments related to research, development and demonstration of technologies relevant for the decarbonisation of the Dutch industry.

5.3.1. Public RD&D funding in the Netherlands

Before delving into the details of specific policy instruments, we provide an overview of public RD&D funding in the Netherlands relevant for the decarbonisation of the industry sector, as reported by the International Energy Agency's Energy RD&D Budget database. In 2018, the total public RD&D budget (by government and provincial authorities, but not municipalities) for energy amounted to EUR 225 million across all sectors and technologies. The breakdown by sector and technology is shown in Figure 5.1. EUR 26 million (11.6% of the total) went to energy efficiency measures in the industry sector. Other key enablers for the decarbonisation of the industry include CCS (EUR 10 million, or 4.6% of the total), hydrogen and fuel cells (EUR 11.5 million, 5% of the total) and renewable energy (EUR 96.7 million, 43% of the total).

The Netherlands' research and innovation strategy for the low-carbon transition, including its public funding dimension, is designed in collaboration with other European Union Member countries in the framework of the European Strategic Energy Technology Plan. Box 5.2 presents additional details on this co-ordination mechanism.

Figure 5.1. Public RD&D budget in energy technology in the Netherlands, 2018 (percentage of total)



Source: IEA Energy RD&D Budget database, 2020.

The rest of this section provides details on specific policy instruments. These are organised according to the various stages of research (fundamental research, applied research and development, and demonstration).

Box 5.2. The Energy Union SET plan

The European Strategic Energy Technology Plan (SET Plan) defines the new European research and innovation (R&I) energy-related agenda for the energy system as a whole. Its objective is to boost the transition towards a climate neutral energy system through the development of low-carbon technologies in a fast and cost-competitive way. The SET Plan sets R&I targets in each of its ten priorities (including energy efficiency for industry, renewable fuels such as hydrogen, and carbon capture, utilisation and storage [CCUS]), through a collaborative process that includes national governments, industry and research actors. The SET Plan does not have its own budget; instead, it is a co-ordination mechanism. Funding for the ongoing 1203 projects within the SET Plan, mobilising a total of EUR 13.2 billion, comes mostly from national authorities (58%) and EU funds (20%). Other transnational funds and regional funds make up for the rest. The budget of these projects account for 37% of the estimated R&I needs for the execution of all implementation plans.

The SET Plan consists of the SET Plan Steering Group, the European Technology and Innovation Platforms (ETIPs), the European Energy Research Alliance (EERA), and the SET Plan Information System (SETIS).

The SET Plan Steering Group consists of representatives from all EU countries, as well as Iceland, Norway, Switzerland, and Turkey. Its role is to ensure better alignment between the different research and innovation programmes at EU and national level, as well as the SET Plan priorities. It also encourages co-operation between national programmes to avoid duplication and to heighten the impact of public investment.

The European Technology and Innovation Platforms (ETIPs) were created to support the implementation of the SET Plan by bringing together EU countries, industry, and researchers in key areas. They promote the market uptake of key energy technologies by pooling funding, skills, and research facilities. Of particular relevance for the industry sector are the ETIP on Renewable Heating and Cooling and the CCS Platform.

The EERA aims to accelerate new energy technology development by co-operation on pan-European programmes. It brings together more than 175 research organisations from 27 countries, involved in 17 joint programmes. It plays an important role in promoting co-ordination among energy researchers along the SET Plan objectives and in the technology transfer to the industry. Several Dutch universities and research centres are part of the EERA: TUDelft, Wageningen UR, Utrecht University and TNO.

The EU's SET Plan Information System (SETIS) monitors the implementation of the SET Plan across Europe. For example, the latest review of the SET Plan documents the existence of 65 projects addressing energy efficiency in the industry, totalling EUR 324 million. Importantly, however, is the massive gap reported between the funds currently mobilised and the estimated R&I needs for this plan (EUR 3.3 billion). CCUS is also largely underfunded (EUR 645 million against 2.5 billion needed).

In addition, the SETIS provides information on the state of low-carbon technologies. It also assesses the impact of energy technology policies, reviews the costs and benefits of various technological options, and estimates implementation costs. This information is useful for European industrial initiatives, private companies, trade associations, the European Energy Research Alliance, international organisations, and financial institutions.

The Netherlands actively participates in the implementation of identified actions of the various working groups of the Energy Union SET plan, such as wind at sea and CCUS. The Netherlands participates in all SET programs, with the exception of concentrated solar power, ocean energy and batteries and e-mobility. The Netherlands also participates in networks of the European Research Area Network (ERA-NET) to co-ordinate research programs in national member states and stimulate collaboration. An example is the ERA-NET for materials research and innovation, which aims to fund ambitious transnational Research and Technical Development (RTD) projects addressing materials research and innovation including materials for low carbon energy technologies and related production technologies.

5.3.2. Fundamental research funding

Basic (otherwise known as fundamental research) is defined as the experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view (OECD, 2015[30]).

At the European level, the main funding arm for fundamental research is the H2020 programme, whose budget is EUR 79 billion over seven years, and its replacement Horizon Europe. The Netherlands participates actively in H2020, with over 5 300 grant agreements signed (19% of EU total) and a 16% success rate (against 12% on average). The EU contribution to Dutch research through H2020 amounts to EUR 4.5 billion for the period 2014-20, including EUR 280 million for projects falling under the topic "secure, clean and efficient energy" (733 projects) and EUR 173 million for projects falling under the topic "climate action, environment, resource efficiency and raw materials" (491 projects).[18]

The EU also funds Dutch research & innovation (both at the research and development stages) toward the industry's decarbonisation through the ESIF, in particular the ERDF and, to a lesser extent (for the food industry), the European agricultural fund for rural development (EAFRD). The EU contribution amounts to EUR 372 million for the period 2014-20 (335 million for ERDF and 37 million for EAFRD). The European structural and investment funds explicitly mentions "research and innovation" and "supporting the low-carbon economy" as two of the main five focuses. For the most developed regions, 20% of ERDF resources must be channelled specifically towards low-carbon economy projects. The share is 15% and 12% in transition regions and less developed regions, respectively.

At the domestic level, research funding flows through the Dutch Research Council NWO. The National Science Agenda (NWA) sets the priorities for funding. It includes 25 'research routes', which take an interdisciplinary look at the main research priorities of the Netherlands going forward. The most important 'routes' for the industry's decarbonisation include "Energy transition" and "Circular economy and resource efficiency".

The financial contribution of NWO is laid down in the KIC 2020-23, in which knowledge institutions, the business community, governments and other public parties commit to jointly invest in innovation. The partners in the KIC have committed to invest EUR 4.9 billion annually for the period 2020-23, of which EUR 2.05 billion would come from private sources and EUR 2.85 billion from public funds. From these funds, EUR 907 million would go to "Climate and energy" (EUR 588 million private; EUR 319 million public), EUR 53 million to the "Circular economy" (EUR 41 million private; EUR 12 million public) and EUR 50 million to "future-proof mobility" (EUR 28 million private; EUR 22 million public), which together form the theme "Energy transition and sustainability". The KIC is informed by the Knowledge and Innovation Agenda (KIA) from the Top sectors, which describe the new knowledge and innovations developed to reach the missions of the different themes, from which "energy transition and sustainability" is the most important theme for this report. The KIC thus follows from the government's mission-driven top sector and innovation policy. In particular, each year, mission-driven thematic calls are developed in line with the NWA. In 2020, for example, key thematic calls related to industry decarbonisation include "Key technologies" and "Energy transition and sustainability", each with a budget of EUR 11 million.[19]

5.3.3. Research & Development instruments

This section focuses on financial support mechanisms for projects at the research and development (R&D) stage, which aim to turn new knowledge into prototypes and then products. This includes applied research, defined as "the original investigation undertaken in order to acquire new knowledge, directed primarily towards a specific practical aim or objective" and experimental development defined as "the systematic work, drawing on existing knowledge gained from research and/or practical experience, directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed" (OECD, 2015[30]).

Horizontal instruments

A first set of instruments support R&D by firms, without any specific targeting. They are described in turn below.

H2020, EU SME Instrument and European Innovation Council (EIC)

The H2020 programme does not only fund fundamental research but also applied research and can finance private for-profit companies.

In particular, the SME instrument, funded through H2020, helps small and medium-sized enterprises to develop new innovative products, services and business models that drive economic growth and bring these onto the market. The EIC Accelerator Pilot builds on the SME Instrument Phase II and provides grant-only support as well as support in the form of blended finance (combining grant and equity). The scheme supports high-risk, high-potential small and medium-sized innovative enterprises willing to develop and commercialise new products, services and business models that could drive economic growth and shape new markets or disrupt existing ones in Europe and worldwide. The EIC Accelerator pilot has a total budget of more than EUR 1.3 billion for 2019-20.

The EIC Pathfinder offers grants of up to EUR 4 million to promote collaborative, inter-disciplinary research and innovation on science-inspired and radically new future technologies. These grants are for consortia of at least three entities from three different Members States and associated countries. The EIC Pathfinder pilot has a total budget of around EUR 660 million for 2019-20.

Overall, the net EU contribution to Dutch SMEs through H2020, including via the SME instrument and the EIC programmes, has been EUR 846 million over the period 2014-20, including EUR 163 million for the SME instrument and EUR 231 million for EIC.

For the two topics "secure, clean and efficient energy" and "climate action, environment, resource efficiency and materials", the net EU contribution to Dutch SMEs through the H2020 programme is EUR 453 million over the period 2014-20, including EUR 5.9 million for the SME instrument (23 companies) and EUR 1.3 million for EIC (10 companies).[20] This corresponds to an annual funding for Dutch SMEs in these two topics of around 70 million per year, including around EUR 1.5 million per year for the SME instrument and the EIC combined (the EIC only exists since 2018).[21]

WBSO (tax credit for research and development)

The main R&D support instrument in the Netherlands is WBSO, which is the tax credit for research and development, with an annual budget of EUR 1.28 billion in 2020 and around 19 000 participating companies in 2019. The WBSO provides a tax credit for wage costs of employees directly involved in R&D but also for other costs of R&D projects. The WBSO R&D tax credit offers support for both development projects, covering the development of technically new physical products, physical production processes or software, and technical-scientific research, covering explanatory research of technical nature.

The tax credit rates applicable in 2021 have been increased in view of the COVID-19 crisis. They are presented in Table 5.20. The total budget has been increased to EUR 1.43 billion.

Table 5.20. WBSO rates for 2021

	Rate 2021	Rate 2020
First bracket (up to EUR 350 000 of eligible costs)	40%	32%
First brackets – innovation starters (companies less than 6 years old, and maximum 3 years of WBSO subsidy obtained)	50%	40%
Second bracket (above EUR 350 000)	16%	16%

Source: RVO

According to the WBSO evaluation conducted by Dialogic in 2019, 23% of WBSO users in 2017 were companies in the manufacturing sector. In this sector, 6.5% of firms use WBSO. We have not been able to find a breakdown of WBSO funding by sector and technology, so cannot measure the amount going to the top emitting sectors and, within those, to low-carbon technologies through WBSO.

Lokshin and Mohnen (2011[31]) perform a cost–benefit analysis of the WBSO R&D incentive programme and find evidence of additionality, which suggests that the level based programme of R&D incentives in the Netherlands is effective in stimulating firms' investment in R&D. This squares with results from the OECD microBeRD project, which provides a harmonised analysis of confidential business R&D and tax relief microdata in 20 OECD countries (OECD, 2020[32]).. Firm-level estimates of the effect of tax incentives are not provided for the Netherlands, but the cross-country micro-aggregated impact analysis shows that, on average, one extra unit of R&D tax support translates into 1.4 extra units of private business R&D.

Innovation box

The 'Innovatiebox' (with a budgetary provision of EUR 1 554 million in 2017) is the other main scheme in the Netherlands for stimulating R&D in individual firms and improving the business climate for innovation activities. It offers companies a discount rate (7% instead of 25%) on the corporate tax on the profits resulting from their innovation. The innovation box policy instrument is essentially a patent box (and started as such until 2010), but without the formal requirement of a patent, making it all the more difficult to link profits to specific immaterial assets created out of innovation activity. To be eligible, a firm must have a patent, a plant breeder's right, or formally recognised (by the tax office) R&D activities. The firm must also generate the immaterial asset itself. (Mohnen, Vankan and Verspagen, 2017[33]) show that the innovation box effectively stimulates R&D, but that the so-called 'bang-for-the-buck' (which measures the effectiveness of the policy, and which can be seen as an indicator for the degree of additionality) is smaller than 1, i.e. the extra R&D is less than the forgone tax revenue.

Nationaal Groeifonds (National Growth Fund)

The National Growth Fund is a public investment fund set up to sustainably increase the earning capacity of the Netherlands (structural gross domestic product [GDP]). The National Growth Fund follows from the Growth Strategy published in 2019. In this growth strategy, the government announced that additional investments, of an incidental and irregular nature, were necessary to increase the earning capacity of the Netherlands.

For the period 2021-26, the National Growth Fund will provide EUR 20 billion for projects in the field of knowledge development; research and development and innovation; and infrastructure. The projects must have a minimum project size of EUR 30 million. Projects will be evaluated both against their impact on the growth of the Dutch economy but also on social benefits (with climate being explicitly mentioned). Namely, any cost-benefit analyses of the proposed projects will have to factor in a price for avoided CO_2 emissions. First applications are expected to be made in 2021.

InvestNL

The recently created Invest-NL agency (launched in January 2020) provides financing to companies, particularly start-up businesses, that contribute to making the Netherlands more sustainable and more innovative. With a capital of EUR 1.7 billion, Invest-NL focuses on the energy transition and on innovative, fast growing companies (scale-ups). It provides equity funding and loans, under the conditions that at least 50% of the total funding amount is provided by other financing parties and that the total funding amount (including funding by other parties) be greater than EUR 10 million.

NWO (Dutch Research Council) and TO2

The NWO funding instruments for the KIC provide funding not only for fundamental research but also for practice-oriented research in the framework of public-private partnerships (PPP). The funding can be used for mission-driven calls, partnerships, strategic co-operation and practical instruments. As explained above, "Climate and Energy" and "Circular economy" are two eligible fields. The rate of co-financing in the case of public-private partnerships is 30%.

The Dutch government also supports public-private partnerships by directly financing institutions that engage in applied research. In particular, organisations for applied research are united in the TO2 Federation. These include the major research centres Deltares, ECN, MARIN, NLR, TNO and Wageningen Research. These institutions partner with industrial actors to come up with practical solutions to concrete industrial issues, including the low-carbon transition.

Other horizontal support instruments

There are several other innovation support mechanisms, particularly targeting SMEs, such as the Small Business Innovation Research (SBIR), the SME Action Plan, the Innovation Vouchers, the Growth facility and the SME credit guarantee scheme (BMKB) for SME loans and the Fund-of-Funds, including the Dutch Venture Initiative (DVI) of the European Investment Fund and PPM Oost. The extent to which these instruments are being used for climate neutral investments in the industry is unknown.

Targeted instruments for low-carbon technologies

Integrated Knowledge & Innovation Agenda Climate (IKIA) and Multi-year Mission Driven Innovation Programmes (MMIPs)

As part of the Climate Agreement and the coalition agreement, the policy framework for low-carbon innovation has changed towards mission-oriented innovation programmes. In the IKIA, which was set in 2019, five missions are formulated that contribute to a deep emission reduction of greenhouse gases by 2050. The missions for 2050 are a CO_2-emission free electricity generation, buildings and transport, climate neutral industry and agriculture/nature. For 2030, intermediate targets are formulated for each mission.

The knowledge and innovation needs for attaining these targets are formulated in 13 mission-driven innovations programs (MMIPs) for various sectors, of which the following three specifically concern industry:

- Closure of industrial chains (MMIP 6)
- CO_2-free industrial heat system (MMIP 7)
- Electrification and radically new processes (MMIP 8)

The MMIP 6 (closure of industrial chains) focuses on innovations in industrial chains that include residual flows. This includes the reuse of (raw) materials, waste and residual gases, the reuse of CO_2, the use of bio-based raw materials, and the use of products that facilitate circularity. The aim is to use 50% less primary raw materials by 2030 and to achieve at least 80% circular and sustainable value chains by 2050.

The MMIP 7 (a 100% CO_2-free industrial heating system) focuses on the design and (re)design of climate-neutral energy and heating systems for industrial clusters and companies and optimal process efficiency. The focus is on temperatures up to 300°C by 2030 and on higher temperature levels by 2050.

MMIP 8 (Electrification and radically new processes) focuses on cost-effective innovations for fully climate-neutral production processes by 2050, optimally electrified and fully integrated into the sustainable energy system. Green hydrogen has an important role to play in this process.

The IKIA and MMIPs are not a financial instrument. Instead, they describe the types of innovation needed to achieve cost-effective decarbonisation, which are eligible for subsidies under various programme, such as Top-Sector Energy, Demonstration Energy and Climate Innovation (DEI+), HER+ and the MOOI programme described next.

MOOI

Projects within the MOOI aim at a CO_2-free electricity system, CO_2-free built environment, climate-neutral raw materials, and circular products and processes.

Eligible projects must be carried out by a consortium of at least three companies: they should reflect an integrated, multidisciplinary approach, bringing together various stakeholders, including innovative SMEs. They can concern industrial research, experimental development or feasibility studies, but projects should lead to a first market application in one of the significant industrial sectors in the Netherlands by 2030 "or shortly thereafter". The minimum subsidy is EUR 25 000 per project participant, and the maximum amount is EUR 4 million per project. The minimum total project budget is EUR 2 million. The grant for a MOOI project is equal to 50% of eligible costs insofar as they relate to industrial research, 25% of eligible costs for experimental development, 80% of eligible costs (for "non-economic activities of research organisations consisting of industrial research and experimental development") and 50% of eligible costs for other project activities. These percentages are increased by 10 percentage points for medium-size companies and 20 percentage points for small companies.

The total budget for the MOOI scheme is EUR 95 million, including EUR 21 million specifically earmarked for renewable electricity and EUR 17 million for the industry.

In the industry, the eligible topics for 2020 were: circular plastics; carbon capture and utilisation (CCU); process efficiency for drying and dewatering; industrial heat systems; hydrogen production from electricity; electrochemical production of basic chemicals; and electrical process routes as an alternative to cracking stoves.

Top Sectors: TKI/PPP allowance (Bio-based economy, Chemistry, Energy)

The Top Consortia for Knowledge and Innovation (TKI) is a central instrument of the top sectors approach. They are responsible for developing and implementing roadmaps in line with the KIC. All Top Sectors have one or more TKIs, consisting of representatives from business, science and government. Thus, TKIs are at the centre of the co-operation between government, industry and knowledge institutions around the nine top sectors.

TKIs were set up in 2012 and 2013 to implement the research and innovation component of the Topsector approach. Each Topsector has one (or more) TKI in which representatives of the business sector (including SMEs), science community and government draw up proposals for research and innovation roadmaps to be included in the KIC. Following KIC approval, the TKIs implement the roadmaps, building networks and consortia, using all funds available. These funds include thematic funding by Ministries, NWO-calls and in-kind contributions by companies, public research organisations and higher education institutions.

Cash contributions from the private sector are topped-up by the Private-public partnerships (PPP) supplement (TKI allowance). For every euro of private R&D expenditure spent by TKIs, the Ministry of Economic Affairs and Climate adds EUR 0.30 as a "PPP bonus" to the TKI's budget. In the case of an R&D partnership, the PPP bonus reaches 40% on the first EUR 20 000 of private contributions. This PPP allowance can be used by the TKI for new collaboration projects that may consist of non-economic activities, fundamental research, industrial research and experimental development. The allowance can be used to fund 100% of the extra research if it is fundamental research, but only 50% of the additional research if it is used for industrial research and only 25% if the PPP allowance is used for experimental research.

The total amount of funds for PPP projects across all Top Sectors was EUR 1 228 million in 2019, of which EUR 581 million was invested by private companies and EUR 647 million by the government.

MIT-Scheme (SME Innovation Stimulation Region and Top Sectors)

The MIT SME Innovation Stimulation Region and Top Sectors aims to stimulate innovation in small and medium-sized enterprises across regional boundaries. The scheme can support various projects: feasibility projects; knowledge vouchers; R&D collaboration projects; innovation brokers; and network activities. MIT SME encourages SME projects to better match the innovation agendas of the top sectors, but not only firms in Top Sectors are eligible. The TKIs propose which sub-instrument of the MIT SME Innovation Support Top Sectors scheme to include in MIT-calls by RVO.

Many of these projects focus on research collaboration between SMEs and other stakeholders: for example, knowledge vouchers focus on co-operation between a "knowledge institution" and an SME on a product or process innovation; R&D collaboration projects focus on collaboration between SMEs and larger firms (with only the costs incurred by the SME being eligible).

Overall, these are small projects in terms of funding. For example, for feasibility projects, the subsidy amount can represent up to 40% of the costs, with a maximum of EUR 20 000. The maximum subsidy amount for knowledge vouchers is EUR 3 750. For innovation brokers, the maximum subsidy per SME is EUR 10 000 per year. For network activities, the maximum costs per SME participant in the network activity is EUR 1 000.

An exception is R&D collaboration projects where the subsidy can be up to EUR 200 000 per project for "small" R&D collaboration and up to EUR 350 000 per project for "large" R&D collaboration.

Total budgets are also relatively modest: for example, the total budget for the innovation broker scheme is EUR 100 000.

The MIT SME scheme was evaluated by Technopolis in 2017[22]. The evaluation shows that MIT SME Innovation Stimulation Region and Top sectors is accessible to SMEs and supports innovative processes with most of its budget spent on R&D projects. MIT SME is mostly used in the Top sectors "Creative industry"; "High tech" and "Horticulture", perhaps because these are the Top Sectors with a higher share of SMEs. The evaluation report claims that the MIT SME scheme is efficient in stimulating public knowledge and its utilisation.

TSE Industry

TSE Industry (now closed) funds R&D projects that can cost-effectively reduce CO_2 emissions, in the themes of closure of industrial chains, CO_2-free industrial heating system, or electrification and radically new processes. These projects must have a first market application in a "meaningful" industrial sector in the Netherlands by 2030 at the latest. Companies can receive up to EUR 500 000 per project. The budget for 2020 was EUR 2.8 million.

KIEM GoChem scheme

The KIEM GOChem program, an initiative from the Top Sector Chemistry in which various partners are involved (NWO, the Ministry of Economic Affairs and Climate, the TKI's Chemistry and BioBased Economy, the trade associations NRK and VNCI and knowledge institutions), supports SMEs in chemistry and chemical processing industry with green innovation projects. The scheme supports co-operative projects between SMEs and knowledge institutions. The SME partners must contribute at least 25% of the grant amount. The maximum funding is EUR 40 000. The main funding themes are: sources and raw materials; processes and technology; molecules and materials; processing and application; chain and business models; and recycling and upcycling. The total budget is EUR 2.6 million for the years 2020 and 2021.

5.3.4. Demonstration

The last RD&D phase is the demonstration phase, which corresponds to the design, construction and operation of a prototype of a technology, at or near commercial scale, with the purpose of providing technical, economic and environmental information to industrialists, financiers, regulators and policy makers (Frascati Manual).

EU Innovation Fund

The revision for the fourth phase of the EU ETS, covering the period 2021-30, has led to the introduction of the Innovation Fund as a new funding mechanism for demonstration of innovative low-carbon technologies. The fund focuses on Innovative low-carbon technologies and processes in energy intensive industries, including products substituting carbon intensive ones; CCU; Construction and operation of CCS; Innovative renewable energy generation; and energy storage.

The Innovation Fund is the successor of the NER300, which focused mostly on renewable energy. Thirty nine projects were selected at the European level, but 20 of them have since been withdrawn. None of the 19 projects that are now completed, in operation or working towards entry into operation are located in the Netherlands. All projects related to ocean energy, PV and CCS were abandoned, and 10 out of 13 biofuel projects, generally because of regulatory, technical or financing issues.

The budget for the Innovation Fund for 2020-30 is projected to be around EUR 10 billion (or EUR 1 billion per year on average), but figures are uncertain as the resources come from the auctioning of EU ETS allowances whose price fluctuates on the market. The first call for large-scale projects (above EUR 7.5 million of total capital costs) was open until the end of October 2020, while the first call for small-scale projects (below EUR 7.5 million of total capital costs) was launched on 1 December 2020. The budget for small-scale projects is EUR 100 million for the first call.

Relevant costs eligible for subsidy are defined in the Innovation Fund as the difference between the best estimate of the total capital expenditure of the innovative technology plus the net present value of operational costs and benefits during ten years of the operation, compared to the results of the same calculation for a conventional production technology with the same output. The Innovation Fund will support up to 60% of the additional capital and operational costs of large-scale projects and up to 60% of the capital costs of small-scale projects, so funding appears more generous for large-scale projects.

In response to the first call for large-scale projects of the Innovation Fund, the European Commission received 311 applications for innovative clean tech projects, including 58 for renewable energy, 204 for energy-intensive industries (out of which 56 in hydrogen), 35 for energy storage and 14 for CCUS. Thirty nine of these projects are from entities based in the Netherlands (12%). However, the proposed projects have requested a total of EUR 21.7 billion, while only around EUR 1 billion is available. Therefore, it is reasonable to expect that only a couple of projects will ultimately be funded in the Netherlands for this round.

It is interesting to note that the proposed projects promise to reduce around 1.2 billion tonnes of CO_2 during their operating period within the Innovation Fund, implying that the subsidised cost per avoided tonne of CO_2 stands at only EUR 20 on average.

InnovFin EDP

In addition to the Innovation Fund, other EU programmes support CO_2-reduction technologies at the demonstration stage. For example, the InnovFin Energy Demonstration Projects (InnovFin EDP), administered by the European Investment Bank (EIB), provides loans, loan guarantees or equity-type financing typically between EUR 7.5 million and EUR 75 million to innovative demonstration projects in the fields of energy system transformation, including (but not limited to) renewable energy technologies, smart energy systems, energy storage, and CCUS, helping them to bridge the gap from demonstration to commercialisation. EIB financing is limited to 50% of the total eligible costs of the project, which include all the costs necessary for the successful demonstration of the technology, service, manufacturing or business process. Given the high risk involved, these EIB loans are guaranteed by the European Commission in the event of default. The total budget of the scheme was EUR 30 million in 2018 and EUR 35 million in 2019 (from the H2020 programme), but it can now benefit from unused funds from the NER300.

Top Sector Energy Studies Industry

Top Sector Energy Studies (including CCUS) aims to help the industry to investigate the feasibility of an innovative pilot or demonstration project that can cost-effectively reduce CO_2 emissions, such as closure of industrial chains, CO_2-free industrial heating system, electrification, CCUS and other CO_2-reducing measures. These possibilities must have a first market application in a "meaningful" industrial sector in the Netherlands by 2030 at the latest. It is therefore similar to the TSE Industry programme, but focused specifically on pilot and demonstration projects. Companies can receive up to 50% of the total project cost as a subsidy, the maximum grant amount being EUR 500 000 per project. The budget for 2020-21 was EUR 8 million.

Demonstration Energy and Climate Innovation 2020

The DEI+ 2020 scheme focuses on: 1) pilot projects to test and improve newly developed technologies; and on 2) demonstration projects to build a new production installation that realises an environmental benefit through the duration of the project, and will remain in use after the project has ended. The duration of a project is a maximum of four years (except circular economy projects below EUR 3 million, for which the duration is one year).

The relevant themes for the industry include energy efficiency; renewable energy (including the flexibility of the electricity system, such as hydrogen and spatial integration); CCUS; and other CO_2-reducing measures in the industry or electricity sector.

The annual budget is EUR 86.1 million of grants and is allocated on a first come, first served basis (provided the project is eligible).

In addition to DEI+ 2020, the DEI+ Circular Economy (DEI+ CE) focuses on reuse, recycling and bio-based raw materials, and has a budget of EUR 44 million.

Data from RVO suggests that DEI+ has been vastly oversubscribed (EUR 159 million of grants requested) while DEI+ CE was undersubscribed (EUR 25 million requested). No breakdown of allocated grants and requests by type of project is yet available.

For reasons that are not specified, the subsidy percentage depends on the type of project (Table 5.21). However, the maximum subsidy is EUR 15 million per project. Importantly, the costs that are eligible for the subsidy are the "extra costs compared to a less environmentally friendly investment that would have been credibly made without the aid", similar in essence to the Innovation Fund.

It is important to note that there is some discretion in the evaluation of the projects' eligibility. Rejection can, for example happen if it is "unlikely that the project will be completed within the maximum allowed term", "insufficient confidence that those involved have the capabilities to complete the project", "insufficient confidence in the technical or economic feasibility" or that "the chance of success of innovation in the Dutch market and society is insufficient".

Table 5.21. DEI subsidy percentage per type of project

Type of project	Subsidy percentage
Pilot project or experimental development	25% for businesses 80% for research organisations (non-economic activities)
Other CO_2-reducing measures in the industry or electricity sector (demo)	40%
Circular economy (demo)	35%
Local infrastructure (demo)	50%
Energy-efficiency (all)	30%
Renewable energy (demo)	45% if the investments can be made as a separate investment or the investment is offset against the reference costs 30% for small installations where no comparable traditional system exists
All projects	+10 percentage points for medium-sized businesses +20 percentage points for small businesses

Source: RVO.

Hernieuwbare Energie Regeling (HER+)

The HER+ is the successor of the HER programme, which focused on renewable energy technology support. As of September 2020, the HER+ grant has been expanded to cover CO_2 reduction technologies more generally, and now includes CCS, hydrogen or residual heat utilisation. Its objective is to achieve the Netherlands' climate targets at a lower cost through innovative projects, and in particular to save on future public subsidies from the SDE++ scheme.

In practice, the objective of HER+ is to build demonstration projects that will reduce the costs of the technologies eligible to SDE++, therefore leading to savings on future subsidies under the SDE++. Project developers must demonstrate that the future savings from SDE++ (including after 2030) are greater than the grant allocated through HER+. Eligibility of a particular technology under SDE++ implies eligibility under HER+. Savings on future SDE ++ expenditure are not only related to cost savings by the project itself, but also through potential spin-off and repeated projects. The maximum CO_2 abatement cost eligible is EUR 300/tonne CO_2.

The HER+ has an annual budget for 2020 of EUR 30 million.

The HER has been assessed as an accessible instrument for SME businesses to achieve cost reduction in the transition to renewable energy and it contributes to knowledge and technology development. The evaluation report recommends to clarify the relationship between the scheme and the target groups of the HER in the Top sector energy to streamline the grant with other subsidies like SDE+

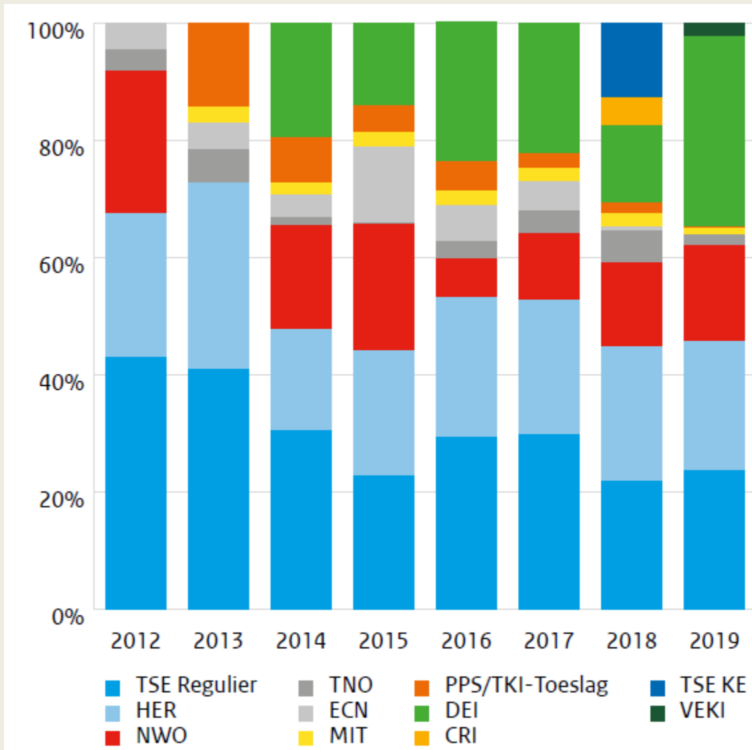
Box 5.3. Top Sector Energy : Review in figures 2012-19 (RVO, 2020)

In November 2020, RVO published a review of energy innovation projects financed with government resources within the Top Sector Energy for the period 2012 to 2019. It covers the following schemes: Top Sector Energy (TSE), Renewable Energy (HER), Demonstration Energy Innovation (DEI); Mission-driven Top Sectors and Innovation Policy; Accelerated Climate Investments for Industry (VEKI); Demonstration Energy and Climate Innovation (DEI+); MMIPs for the built environment; TNO (and predecessor ECN) financed by the Dutch Ministry of Economic Affairs and Climate Policy (EZK) and EU subsidies; NWO; Substantive assignments financed by EZK / RVO; PPP supplement; SME innovation stimulation Region and Top sectors (MIT) of the energy Top Consortia for Knowledge and Innovation (TKIs).

The analysis shows that from 2012 to 2019, more than 3 100 energy innovation projects were subsidised in the context of the Top Sector Energy (around 400 projects per year), amounting to around EUR 1.2 billion in total. The annual subsidy has grown over the years to EUR 211.9 million in 2019. These public subsidies represent around 60% of the total cost of the underlying projects across years.

Figure 5.2 shows the distribution of the annual subsidies by subsidy scheme and organisation. In percentage terms, most of the grants were awarded via the TSE, HER and DEI schemes. Together, these three schemes represent 78% of subsidies. NWO is another important source of funding (16% of total funding in 2019).

Figure 5.2. Distribution of the Top Sector Energy subsidies by scheme and organisation

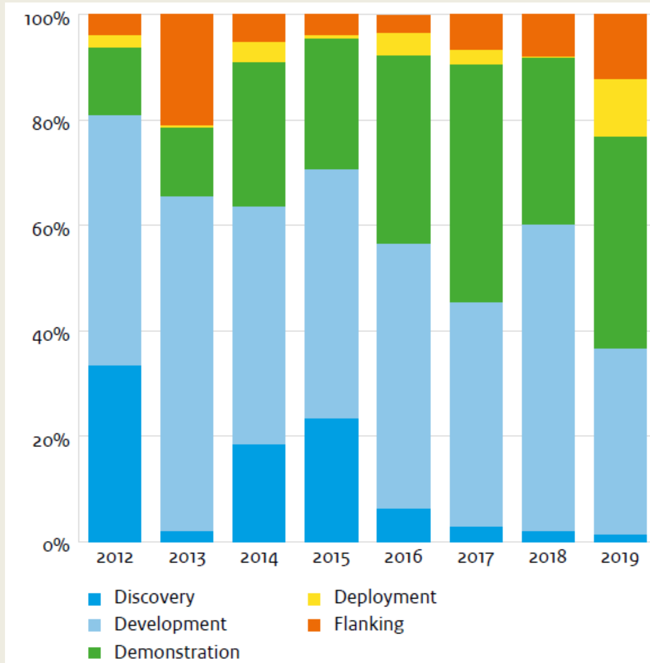


Notes: TSE KE shows the awarded subsidy for Top Sector Energy innovation financed from the Climate Envelope 2018/2019 resource.
Source: (RVO, 2020[34]).

Figure 5.3 shows the annual distribution of subsidies by innovation phase: discovery or basic research; development; demonstration; deployment and enabling ("Flanking"). The data shows an increase of the demonstration (40%) and deployment (10%) phases at the expense of development (around 35% in 2019, against more than 60% in 2013). Projects in the discovery phase are mainly subsidised via NWO and represent a tiny share of total funding. Funding for basic research is also strikingly fluctuating across years, with peaks in 2012 and 2015. The recent increase in flanking projects is attributed to the shift towards "mission-driven" innovation policy, with projects looking at the overall innovation system rather than just at particular innovations.

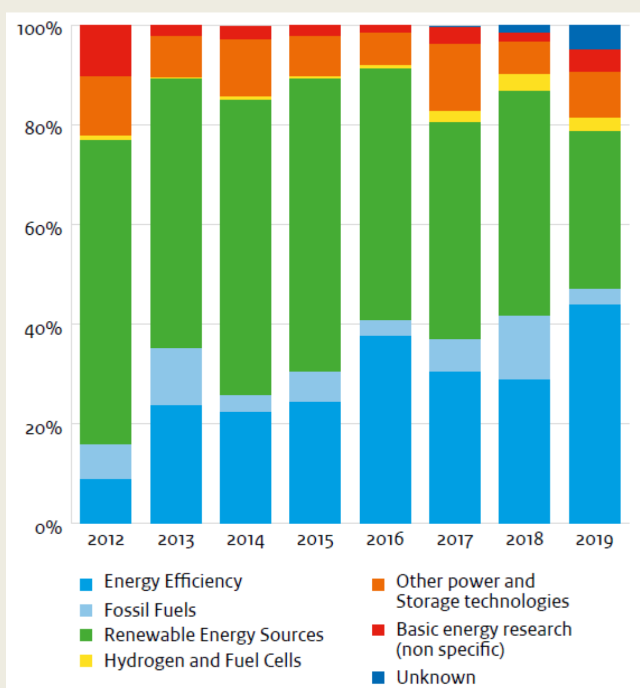
Figure 5.4 shows the distribution of subsidies by energy category following the International Energy Agency classification. There is a clear increase in funding for energy efficiency projects, in particular through DEI+, which now represent 40% of total funding. Subsidies toward renewable energy projects sources have been decreasing, from 60% of funding in 2012 to around 35% in 2019. Hydrogen and Fuels Cells have increased recently but remain extremely marginal, as are CCUS projects which represent most of the "Fossil fuels" category.

Figure 5.3. Distribution of the Top Sector Energy subsidies by innovation phase



Notes: "Flanking" projects are projects to which no TRL can be linked, because they are not aimed at technological innovation, but to changes in institutions (such as regulations), behaviour and/or social acceptance with regard to technological innovations.
Source: (RVO, 2020[34]).

Figure 5.4. Distribution of Top Sector Energy subsidies by IEA category



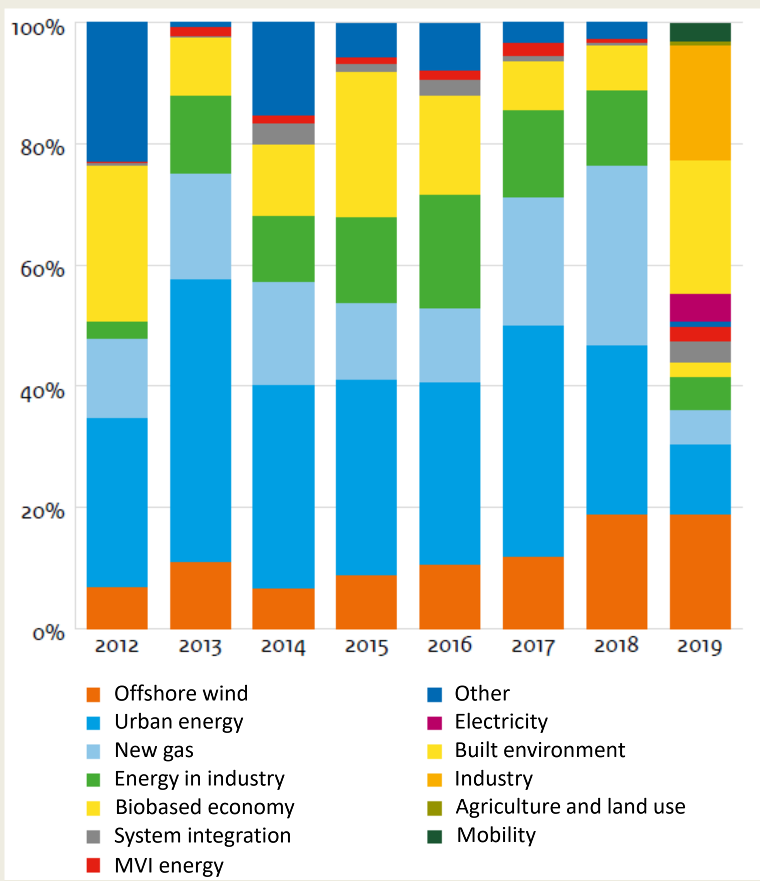
Source: (RVO, 2020[34]).

Finally, Figure 5.5 shows the Distribution of subsidies by Top Sector Energy themes and climate tables. The Top Sector Energy has five substantive themes around which the Top Consortia for Knowledge and Innovation (TKIs) has been set up. These include offshore wind, urban energy, socially responsible innovation energy (MVI energy) and system integration. Moreover, from the climate agreement, climate tables have been established: mobility, agriculture and land use, industry, built environment and electricity.

In the past eight years, 81% of subsidies have gone to projects that fit within the five TKI themes. Of these, 71% have gone to projects within the themes offshore wind, urban energy and new gas, which includes CCUS and hydrogen. The five climate tables accounted for 49% of the 2019 subsidy and 9% of the total grant from 2012 onwards.

Interestingly, around 25% of the subsidies in 2019 went to projects in the industry.

Figure 5.5. Distribution of subsidies by Top Sector Energy themes



Source: (RVO, 2020[34]).

5.4. Deployment

For the same reason that the existence of knowledge spillovers implies that private firms underinvest in R&D and justifies government support to innovation activities, externalities associated with the overall scale of technology adoption, such as learning-by-doing and network effects, can justify the government's intervention in support of technology deployment.

Deployment is defined as the selection and use of a commercially available technology-based product or service in normal operations by businesses, individuals or government agencies with the aim of accelerating the diffusion and adoption of technologies or practices (IEA, 2011[35]).

This section covers policy instruments related to deployment of technologies relevant for the decarbonisation of Dutch industry.

5.4.1. Specific/targeted instruments

SDE++ (Stimulering Duurzame Energieproductie en klimaattransitie: Stimulation of sustainable energy production and climate transition)

The SDE++ is a support scheme that promotes sustainable energy and Scope 1 carbon emission reduction by subsidising firms and non-profit institutions that invest in CO_2-reducing techniques and renewable energy production. It is being implemented as an update of the 2011 SDE+ scheme.

Qualifying projects as of 2020 concern the areas of renewable electricity, heat and gas, and low-carbon heat and production, including CCUS and hydrogen. The scope of support is expected to extend in 2021 to include bio-based production, electrification on offshore oil and gas production platforms, advanced renewable fuels for transport, and the recycling of plastics. Covered areas are relevant to industrial sectors, as well as agriculture, electricity, transport and the built environment. Applications may need to come with feasibility studies and installation permits.

The SDE++ is an abatement payment per unit of avoided CO_2 emissions that subsidises the revenue shortfall of CO_2-reducing techniques, that is, the operating cost difference between the low-carbon technique and the PBL-defined benchmark technique, factoring in the market value of the achieved CO_2 reductions in terms of EU ETS allowances (*but not in terms of avoided carbon levy payments*). While the cost parameter is technology-specific and fixed over the project's lifetime, the value of both CO_2 reductions (long-term ETS price) and energy products is updated annually, so that the subsidy depends on market conditions (including the market for green certificates). Firms apply for a subsidy amount per unit of avoided CO_2 emissions in a closed envelope auction, with a maximum of EUR 300/tCO_2. The total SDE++ subsidy amount tendered is allocated to project applicants in decreasing order of subsidy requirement per tonne of CO_2 reduction. While this makes the scheme cost-effective, the priority given to least-cost options makes it less relevant to support technologies that are at an earlier stage of development, such as hydrogen. Subsidy payments can be carried back or forward when planned production and actual production differ, with a limit of 25% of annual production.

Ex-ante evaluations of the SDE++ suggest that the newest technologies (in particular hydrogen, and CCSU to a lesser extent) fit less well in the SDE scheme because of their higher reliance on shared infrastructure, their benefits beyond CO_2 reduction, higher uncertainty regarding their cost, and their lower market readiness (Trinomics, 2019[36]; PBL, 2020[37]). Evaluations of the previous SDE+ show that firms value the de-risking nature of the scheme (CE Delft, 2016[38]).

Most SDE++ projects that are relevant for the industry are expected to operate in installations participating in the EU-ETS. The PBL is working on a correction factor to feed in the calculation of the revenue shortfall, so that nonparticipants are not put at a disadvantage. Investments in CO_2-reducing technologies of which the operation is subsidised under the SDE++ are ineligible for a tax deduction under the EIA scheme, nor for a grant under the ISDE scheme (see below).

The Dutch government allocated a budget of EUR 5 billion to the SDE++ for the 2020 tender. The PBL estimates that about EUR 3 billion will go to the industry for CO_2 reduction over the period 2020-30, with the yearly expenditure expected to reach EUR 550 million in 2030.

Energy investment allowance

The energy investment allowance (EIA, *Energie-InvesteringsAftrek*) is a tax allowance available since 1997 to tax-paying firms in the Netherlands for qualifying energy-saving investment.

Qualifying investments must be in new (previously unused) assets, amount to at least EUR 2 500 and up to EUR 2.4 million per year, and be part of RVO's energy list (*Energielijst*). Assets on the list are particularly relevant for industrial processes and applications, but are also relevant for other sectors such as agriculture, electricity and retail. They cover commercial buildings, processes, means of transport, energy balancing, energy transition, energy advice and customised advice. The list is updated every year through legislation based on changes in technology availability. Renewable energy investments are excluded since 2014, as they can receive support under the SDE scheme (see above). Energy-saving asset producers can introduce requests to the RVO for inclusion of new assets on the list.

The EIA corresponds to a deduction amounting to 45% of the energy-saving investment cost from taxable income in 2020, in addition to the standard depreciation allowance. According to CE Delft's estimations, the effective EIA tax rebate lies between 10% and 15% of the investment, depending on the marginal corporate income tax rate of the firm, as well as on the EIA rate, which has varied between 41.5% and 55% over the past years (Table 5.22). Most beneficiaries are firms with an income of over EUR 200 000 (CE Delft, 2018[39]). Evaluations tend to suggest that the EIA is cost-efficient and that windfall profit is limited compared to similar instruments (PBL, 2020[40]; CE Delft, 2018[39]; Ecorys and Van Zutphen Economisch Advies, 2012[41]), even if the share of free-riders remains substantial at about 50% of users (Ruijs and Vollebergh, 2013[42]). The constantly updated technology list has also been commended in existing evaluations for reducing the information asymmetry between supply and demand for new energy-saving or sustainable technologies.

Table 5.22. EIA rate and effective tax rebate by marginal income tax rate

Year	EIA rate	Marginal income tax rate				Effective tax rebate (% of investment)				
		Corporate (firms)		Personal income tax (PIT)		Firms		Personal Income Tax payers		Weighted average
		EUR 0-200 thsd	> EUR 200 thsd	< EUR 60 thsd	> EUR 60 thsd	EUR 0-200 thsd	>EUR 200 thsd	<EUR 60 thsd	>EUR 60 thsd	
2015	41.5%	20.0%	25%	40%	50%	8.3%	10.4%	16.6%	20.8%	10.4%
2016	58.0%					11.6%	14.5%	23.2%	29.0%	14.5%
2017	55.0%					11.0%	13.8%	22.0%	27.5%	13.8%
2018	54.5%					10.9%	13.6%	21.8%	27.3%	
2019	45.0%	19.0%				8.6%	11.3%	18.0%	22.5%	
2020		16.5%				7.4%	11.3%	18.0%	22.5%	

Note: Rebates for PIT payers are approximations as PIT rates vary across years.
Source: CE Delft calculations.

Although EIA-eligible investments may also qualify for other support schemes, particularly when qualification depends on RVO's energy list, cumulating support is generally not authorised beyond standard depreciation. Specifically:

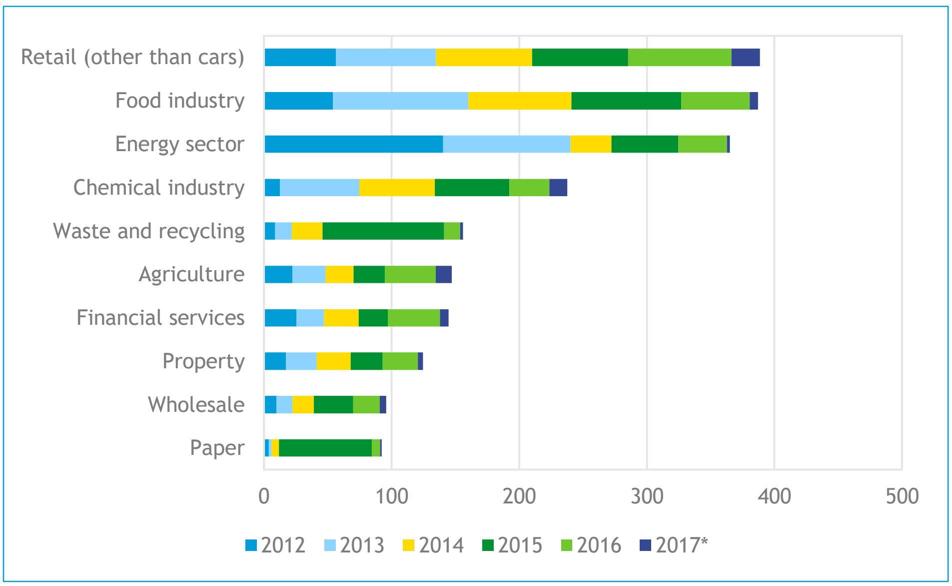
- Investment costs can be split across the EIA and the MIA (see below) schemes, but cannot be deducted under both; the effective EIA rebate is typically larger than the MIA rebate, which is discussed below;
- The EIA and the KIA deductions can be cumulated only under specific conditions (see below);

- The EIA deduction and the ISDE subsidy (*InvesteringsSubsidie Duurzame Energie* – see below) cannot be cumulated;
- Other investment subsidies, including VEKI (see below), must be subtracted from the investment costs for computing the deduction.

Note that the EIA is not compatible with the SDE++ by design (see above).

The Dutch government allocated a budget of EUR 147 million to the EIA for fiscal year 2020, in line with fiscal expenses in previous years.[23] Data on EIA take up over the period 2012-17 show a strong skew towards the retail, food, energy and chemical industries, and suggests that half of EIA investments concerns industry (CE Delft, 2018[39]) (Figure 5.6).

Figure 5.6. EIA investments by industry (EUR m.)



Note: 2017 as of 22 August.
Source: CE Delft (2018[43]). Beleidsevaluatie Energie-investeringsaftrek 2012-2017. CE Delft: Delft

VEKI

Since 2019, the VEKI grant (accelerated climate investment in industry, *Versnelde Klimaatinvesteringen Industrie*) supports tangible and intangible investments in the industry for the integration at a scale of commercially available carbon-reducing technologies. VEKI is a later-TRL complement to DEI+ with a similar working (Section 5.3.4).

VEKI is reserved for industrial firms. It supports the implementation of technologies that have been demonstrated at least three times in the Netherlands and of which the payback time is greater than five years. Qualifying projects must be in the area of energy efficiency, recycling and reuse of waste, local infrastructure or other CO_2-reducing measures. The main technologies are related to electrification, sustainable cold and heat demand, carbon capture, storage and utilisation, geothermal energy, and CO_2-free industrial heating according to CE Delft.

VEKI is an investment subsidy of minimum EUR 125 000 of which the rate depends on the underlying asset, with a premium of 10 points for medium-sized firms and of 20 points for small firms (Table 5.23).

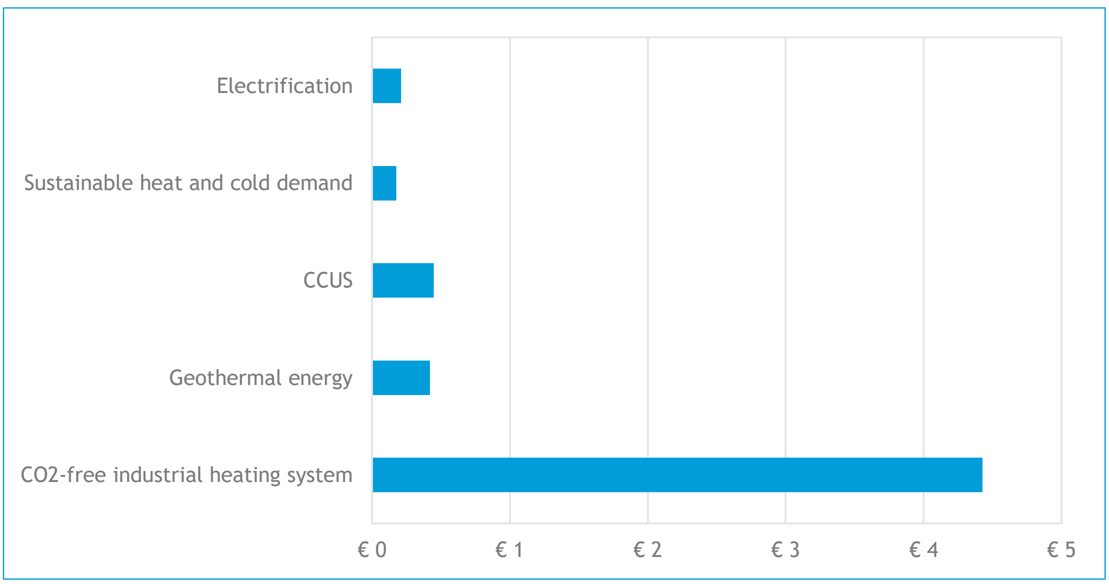
Table 5.23. VEKI subsidy rate by technology (%)

Type of project	Subsidy percentage
Other CO_2-reducing measures	40%
Recycling	35%
Local infrastructure	50%
Energy-efficiency	30%

Note: medium-sized firms: +10 percentage points; small firms: +20 percentage points.
Source: RVO.

The Dutch government allocated a budget of EUR 28 million for 2020. Data on take up suggests support is skewed towards CO_2-free industrial heating technologies according to CE Delft (Figure 5.7).

Figure 5.7. VEKI support by technology (EUR mln), January to July 2019



Note: Tenders open in August each year
Source: https://projecten.topsectorenergie.nl/projecten and CE Delft's calculations.

MIA and VAMIL

The MIA (environmental investment deduction, *Milieu-InvesteringsAftrek*) and the VAMIL (Arbitrary depreciation of environmental investments, *Willekeurige afschrijving milieu-investeringen*) are tax allowance schemes available to tax-paying firms in the Netherlands for eligible environment-friendly investments (excluding energy saving or renewable energy).

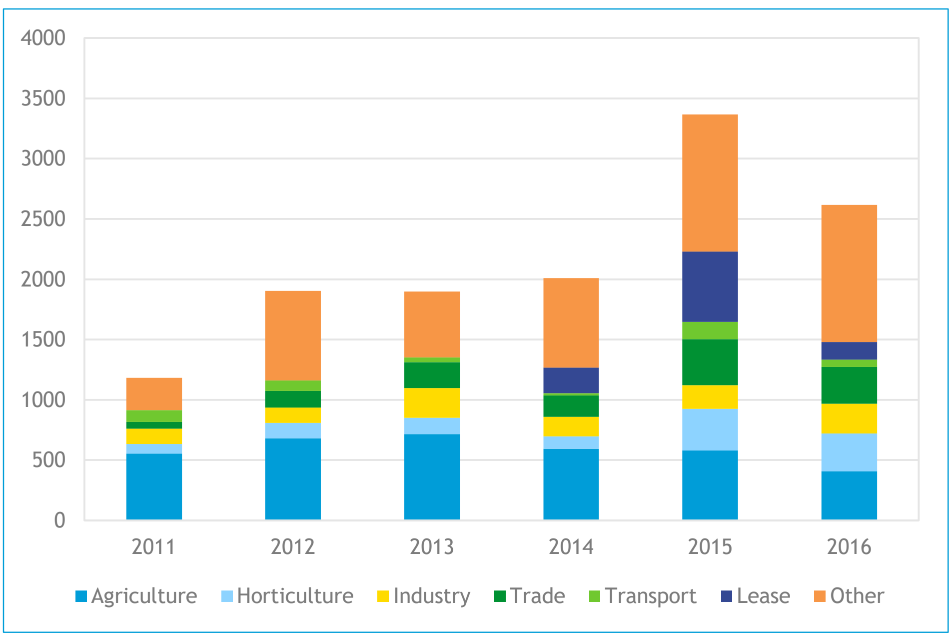
Qualifying investments must be in previously unused assets, amount to at least EUR 2,500 and up to EUR 25 m. per year, and be part of RVO's environment list (*Milieulijst*). Assets on the list include technologies that are relevant for industrial processes. They cover the areas of the circular economy and raw materials, carbon capture and utilisation, the bio-based economy, electrification, reduction of nitrogen and related emissions, and greenhouse gas emission reductions across all relevant sectors of the economy. The list is updated every year through legislation based on changes in technology availability. Renewable energy and energy-saving investments are excluded, as they can receive support under the SDE and EIA schemes, respectively (see above). Asset producers can introduce requests to the RVO for inclusion of new assets on the list.

MIA consists in the deduction of a fraction of the environment-friendly investment cost from taxable income in 2020, in addition to the standard depreciation allowance. Allowance rate are 13.5%, 27% or 36% depending on the type of asset. VAMIL consists in a one-off accelerated depreciation of 75% of the investment.

Firms typically combine the MIA and VAMIL schemes. Other investment subsidies must be subtracted before the MIA/VAMIL deduction is calculated. Investment costs can be split across the EIA and the MIA schemes, but cannot be deducted under both (see above). MIA/VAMIL investment may be eligible under the SDE++ scheme; in this case, the SDE++ subsidy will be adjusted to account for the MIA/VAMIL impact on the revenue shortfall parameter (see the description of SDE++ above).

The Dutch government allocated a budget of EUR 124 million for MIA and EUR 25 million for VAMIL in 2020. Data on take up over 2011-16 show that the industrial sector accounted for less than 10% of the total tax expense for MIA and VAMIL, of which virtually all went to SMEs, according to CE Delft (Figure 5.8). MIA/VAMIL investments in the area of nitrogen and greenhouse gas (GHG) emission reduction account for 2% of the total, according to CE Delft. According to an evaluation by CE Delft (2018[44]), the MIA and VAMIL schemes are cost efficient and generate relatively little windfall gains.

Figure 5.8. MIA/VAMIL investments by sector (EUR mln)



Source: CE Deflt (2018[44]). Beleidsevaluatie MIA\Vamil. CE Delft: Delft.

5.4.2. Generic and other less relevant instruments

Although not specifically targeted at the decarbonisation of the industry, other existing instruments may have a marginal impact on the deployment of low-carbon technologies.

Small-scale investment allowance

The small-scale tax allowance (KIA, *KleinschaligheidsInvesteringsAftrek*) is a generic investment tax allowance scheme available to small and medium enterprises, specifically those with yearly investment between EUR ~2 500 and EUR ~350 000, in addition to the standard depreciation allowance. The KIA deduction is available irrespective of the type of investment and may be cumulated with the EIA or the MIA under certain conditions. The budget allocation was EUR 379 million in 2019.[24]

Green project loan facility

The green project scheme (*Groenprojecten regeling*) is a subsidised bank loan facility for the financing of environment-friendly, circular economy and sustainable construction projects. The favourable tax treatment of capital gains from green funds enables participating financial institutions to charge below-market interest rates. As it only addresses the financing part of the investment, the scheme is in principle compatible with the instruments above. The tax expenditure was about EUR 62 m. in 2019.[25] In 2019, more than 50% of green project scheme investments were in construction and about 40% in energy saving and renewable energy.[26]

ISDE

The ISDE (*InvesteringsSubsidie Duurzame Energie*) is a subsidy available to firms and business owners for the purchase and installation of heat pumps or solar water heaters. The amount of the subsidy depends on the type of device to be installed. Even though ISDE-qualifying devices may be part of RVO's energy list, an EIA cannot be claimed for an ISDE-subsidised device. The Dutch government budgeted EUR 100 million for ISDE in 2020. Data on uptake shows that about 1-2% of subsidies went to the industry over the period 2016-17, mostly to small firms according to CE Delft.

LIFE

The LIFE programme is the EU's funding instrument for the environment and climate action. The aim is to support innovative projects that fit into European nature, environmental and climate policy. The LIFE programme is divided into two sub-programmes, one for environment (75% of budget) and one for climate action (25% of budget). Projects can receive co-funding of up to 60%. Any organisation in the EU can participate, from small and large firms to governments and NGOs. The current funding period 2014-20 has a budget of EUR 3.4 billion. Investments in LIFE projects in the Netherlands amount to EUR 720 million, of which EUR 223 million are from EU contributions. This budget is divided into environment and resource efficiency (EUR 466 million), nature and biodiversity (EUR 168 million), climate action (EUR 42.5 million), integrated (EUR 17.5 million) and others (EUR 26 million).

5.5. Command and control instruments

5.5.1. Environmental Management Act

The Environmental Management Act is the most important environmental act in the Netherlands and contains the general rules for environmental management. The Environmental Management Act is a framework, which means that the law mainly contains general principles, responsibilities and procedures and no detailed content. The main instruments of the Environmental Management Act are environmental plans and programs, quality requirements, permits, general rules and enforcements. The law also includes rules for financial instruments (levies, contributions and compensation). The Act also states the competent authorities for the different environmental permits and the enforcement of environmental regulation.

5.5.2. Obligation for investment in energy savings

The Environmental Management Activities Decree under the Environmental Management Act obliges companies and institutions to implement all energy-saving measures with a payback period of five years or less. This applies to companies and institutions (Environmental Management Act) that consume from 50 000 kWh or 25 000 m^3 of natural gas or an equivalent per year.

Once every four years, the company or institution reports to the competent authorities which energy-saving measures have been taken. In principle, this competent authority is the municipality in which the organisation is located, but the monitoring and enforcement tasks are sometimes delegated to an environmental agency. The authorities can start an inspection to find out if the company complied with this law, when it appears that the energy-saving measures with a payback period of five years or less are not taken. If the investigation shows that not all mandatory measures are taken, then the authorities can set a period within which the company must still comply with them. Enforcement measures may have financial consequences in the form of a non-compliance penalty.

The Environmental Management Act is enforced by the competent authority, who can decide on a penalty that needs to be high enough to prevent a rewarding violation. The penalty can vary from EUR 500 per week to 10% of the annual energy bill for each month of violation.

5.5.3. Standards

To our knowledge there are no product standards in place in the Netherlands, such as product carbon requirements.

5.6. Infrastructure programmes

At the European level, the Connecting Europe Facility (CEF) of the European Commission is planning to invest EUR 102 million in the coming years in the Porthos CO_2 transport network project, which is a project between the Netherlands and Belgium to build an open access CO_2 transport network between three of Europe's main ports (Rotterdam, Antwerp and North Sea Port). This network will lead to an offshore storage site in the North Sea. Similar to Porthos, the Athos consortium plans to use depleted offshore fields (oil, gas) or saline formations for the storage of CO_2 captured at industrial sources near the North Sea Canal, with the Tata steal plant as one of the first and largest suppliers.

Another project at the European level is the North Sea Wind Power hub which is a consortium that works on a Hub-and-Spoke system to facilitate Wind Power in the North Sea.

A third programme at the European level is the ERDF, one of the ESIF), which aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. It can be used for innovation, the digital agenda, SMEs support and the low carbon economy.

At the national level, the Taskforce Infrastructure Climate Agreement Industry (TIKI) advises on an effective, efficient and timely implementation of the infrastructure required for the green transition of the industrial sector as is stipulated in the Climate Agreement. In its report, TIKI first analyses the infrastructure that is already present in the Netherlands and the uncertainties and bottlenecks that exist, and then presents the infrastructure needed for the energy transition in the industrial sector, and how these networks for electricity, hydrogen and CO_2, for example, can be constructed.

The taskforce discussed the infrastructural needs with many stakeholders and came with four main recommendations: 1) An integrated main energy infrastructure should be established through agreements between industry, companies responsible for (energy) networks, and governments, in the Multi-year Program Infrastructure Energy and Climate (MIEK). MIEK gives the bottlenecks that have priority and determines how decisions to solve them are made. Examples include strengthening the electricity grid, hydrogen grid and a CO_2 pipeline network; 2) A system for the storage and re-use of CO_2 needs to be introduced, based on the projects that are already running in the Port of Rotterdam (Porthos) and Amsterdam (Athos); 3) Research on networks for hydrogen and CO_2 to Belgium and Germany should show how the Dutch economy could benefit from this; 4) Comply with a number of conditions, such as regulations, in order to be able to fully utilise the potential for CO_2 savings.

The agreements on energy infrastructure are important to get the necessary infrastructure in place for some of the most important green technologies, such as the production and processing of hydrogen, green electricity and CCS. No direct budget is linked to the TIKI and MIEK, but these reports are used as input for the infrastructure budget.

Finally, the National Program Regional Energy Strategy (RES) is a regional target which describes the strategy of the region to achieve regional energy goals. Regional choices are made on the generation of sustainable electricity, the heat transition in buildings and storage and the required storage and energy infrastructure. It is a co-operation between all regional parties, including governments and civil society organisations. The aim of the RES program is a regional strategy which describes the spatial integration of renewable energy generation, (residual) heat sources and associated infrastructure in the region. RES is related to TIKI and the Front Runner Program for the industrial sector (Box 2.2, cluster plans), which can be included in the RES. For the industrial sector, the RES can be important for delivering infrastructural aspects (e.g. heat transfers).

Box 5.4. Deployment of hydrogen technologies in the Netherlands as part of H-Vision

The Port Authority of Rotterdam and Gasunie plan to jointly construct and operate a hydrogen pipeline and will make a final decision on whether to pursue the project in the first half of 2021. This would then be connected to national hydrogen network developed by Gasunie.

Shell will construct its hydrogen plant at a dedicated site at Maasvlakte for electrolysers operated by various companies. Another project planned at this site is H_2-Fifty (the construction of a 250 MW electrolyser operated by BP and Nouryon). This facility is expected to become operational in 2025 on the coast of the North Sea. It will use offshore wind power to produce hydrogen, which will then be transported to users via a pipeline.

Source: https://www.portofrotterdam.com/en/news-and-press-releases/rotterdam-boosts-hydrogen-economy-with-new-infrastructure.

5.7. Green procurement programmes

The Dutch government has adopted a Sustainable Public Procurement system,[27] implying that the impact on the environment and social aspects should be taken into account in procurement programmes. The objective is to set the example and to boost the market for sustainable products. The government applies environmental criteria when purchasing products. Examples include computers that must be energy efficient and building materials which must be re-used for road construction projects.

The MVI (Maatschappelijk Verantwoord Inkopen) criteria tool for socially responsible public procurement gives criteria for socially responsible procurement. This tool can be used by governmental organisations, which can decide themselves how high their goals should be: basic, significant or ambitious.

The Netherlands program, which covers 45 product groups, monetises CO_2 reductions and other environmental impacts below the maximum standard. Bidders are required to use a software program called DuboCalc, which calculates the life-cycle environmental effects of materials and energy, from extraction to demolition and recycling. These effects are collapsed into an environmental cost indicator, permitting procurers to compare bids for their environmental costs. Procurers can set a maximum cut-off for this indicator, above which bidders become ineligible. Procurers can also subtract the monetised values below the standard (the environmental "benefits") from the bids in order to compare across bidders.

Green procurement is further considered in the CO_2 Performance Ladder, which is an instrument that helps public and private organisations to reduce their carbon emission through certification. The performance ladder has five rungs for procurement of construction works and materials, and monetises the appropriate rung of the latter for subtraction from the bid. A third party certifies the CO_2 performance of companies that volunteer. All this information is made available on a portal, TenderNED. Another institution, PIANOo, exists to provide advice to bidders. With a certificate on the Ladder, organisations can receive an award advantage for their registration on tenders. The instrument is used as both a CO_2 management system as well as a procurement tool.

5.8. Analysis of the policy package

This section summarises and analyses information on the policy package as described above. With regards to pricing instruments discussed in Section 5.1, two synthetic pricing indicators are presented and discussed. First, the effective carbon rate (ECR) summarising the different carbon pricing instruments and their application in a single measure. Second, an effective price signal on electricity use. The analysis of both indicators provides a synthetic view of how the Netherlands price electricity or carbon emissions from energy use in industry, with a focus on chemicals, metallurgical, food processing and refinery sectors. Finally, a summary measure on the amounts spent on technology support is presented.

5.8.1. The Dutch Effective Carbon Rate – a synthetic indicator of carbon pricing in the Netherlands

The effective carbon rate (ECR) combines prices with detailed information on the emissions base to which they apply (Box 5.5). The effective carbon rate allows for a precise appraisal of how much each tonne of CO_2 from energy used in the Netherlands pays in the context of multiple pricing policy instruments. The data builds on the OECD Taxing Energy Use (OECD, 2019[2]) and OECD Effective Carbon Rate (OECD, 2018[1]) databases and has been further refined in the context of this project.

Box 5.5. The ECR – a synthetic indicator of carbon pricing

The OECD's Effective Carbon Rate publications measures carbon pricing of CO_2-emissions from energy use in 42 OECD and G20 countries, covering 80% of world emissions. The ECR takes a comprehensive view of carbon prices, calculating the total price that applies to carbon emissions from fuel use as a result of market-based policy instruments:

- carbon taxes typically set a tax rate on energy use based on its carbon content
- specific taxes on fuel use (primarily excise taxes) typically set a tax rate per physical unit or unit of energy, but can be translated into effective carbon tax rates based on the carbon content of each form of energy
- trading systems, where the price of tradable emission permits represents the opportunity cost of emitting an extra unit of carbon regardless of the method to allocate pollution permits.

The extent to which countries choose to price carbon emissions through taxes and emissions trading systems varies substantially. Overall carbon price signals are far too weak to encourage citizens and businesses to take the climate costs of their actions into account. Recent evidence shows that taxes on polluting fuels are nowhere near the levels needed to encourage a shift towards clean energy. Adjusting taxes and subsidies and encouraging investment, will be unavoidable to curb carbon emissions.

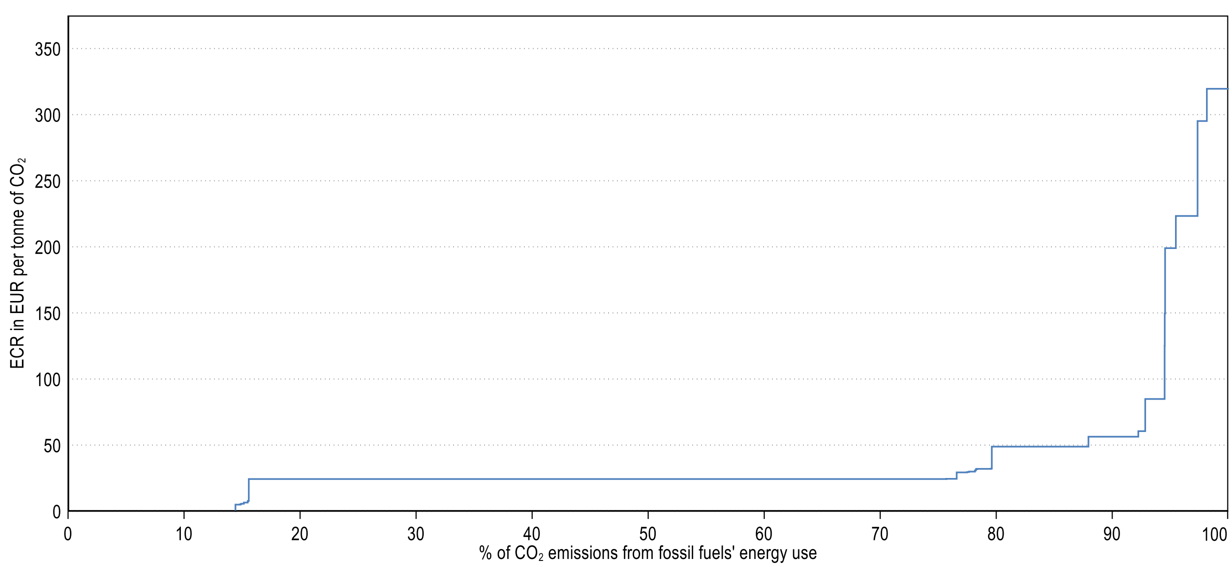
Source: OECD (2018[1]; 2019[2]).

The ECR in Dutch industry varies widely across energy products and users, as described in detail in Section 5.1. Figure 5.9 presents the full distribution of ECR levels across the emissions base of fossil fuel use in Dutch industry at the beginning of 2021, sorting emissions according to their price level and starting at zero.[28] The horizontal axis shows the proportion of CO_2 emissions, while the vertical axis shows the ECR in EUR per tonne of CO_2. The graph identifies the share of CO_2 emissions priced at any given ECR. For example, the intersection of the blue line and the bottom dashed grey line corresponds to an ECR of EUR 50 per tonne CO_2. The ECR summarises the price signal on CO_2 emissions from energy use related to fossil fuels, thereby excluding emissions from using fossil fuels as a feedstock.

Figure 5.9 shows vast heterogeneity in the ECR of Dutch industry. According to our estimations, 14%of CO_2 emissions from fossil fuel energy use are not priced at all and only 22%are priced at or above EUR 30 per tonne. A carbon price of EUR 30 per tonne in 2025 is consistent with the slow decarbonisation scenario by 2060 according to Kaufman et al. (2020[45]). It can also be seen as a historic low-end price benchmark of carbon costs[29] in the early and mid-2010s (Ecofys, 2014[46]).

The High-Level Commission on Carbon Prices (2017[47]) proposed a price corridor of USD 40-80 per tonne for 2020, if countries want to decarbonise in line with the Paris Agreement and assuming that necessary complementary policies to carbon pricing are in place. Currently, 20% of the emissions base from fossil fuel energy use in Dutch industry is covered at or above EUR 40 per tonne and 7% are priced at or above EUR 80. Following the carbon levy trajectory, the future carbon price is expected to increase strongly.

Figure 5.9. Effective carbon rate on CO_2 emissions from fossil fuel energy use in Dutch industry, 2021



Note: The ECR includes energy tax on natural gas and ODE rates on natural gas applicable on 1 January 2021. The ETS permit price is the average price in 2020. Following the opportunity cost argument, the EU ETS price is added on emissions covered by the system even if an EU ETS allowance was freely allocated. 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.[30] Fossil fuel energy use data is for 2018 and adapted from IEA (2020[48]), World Energy Statistics and Balances.

A more detailed ECR profile for the main sub-sectors in the Dutch economy (chemicals, refineries, basic metals and food processing) is displayed in Figure 5.10. The profiles partition the CO_2 emissions base from fossil fuel energy use by energy users and fuels (horizontal axis). The vertical axis shows the estimated ECR in EUR per tonne of CO_2, identifying its different components: the combined rate of energy tax on natural gas ("fuel excise") and ODE on natural gas is depicted in blue and the ETS permit price in green. Due to the large amount of excess dispensation rights in 2021 that are not bankable, and will therefore be useless for future trading periods, the national component of the carbon levy is set to zero.

As previously discussed, some of the largest emitters are fully exempt from taxation, in particular energy users in the basic metals and refineries sector, or are taxed at the lowest available tax rates, such as the majority of natural gas emissions in the chemicals sectors, as they fall into the fourth consumption band with the lowest tax rate. Substantial taxation arises only for small and medium sized consumers of energy in the food processing sector.

Beyond taxation, the EU ETS broadens the carbon pricing base across all sectors. Although, free allocation of emissions allowances maintain the price level at the margin, they can weaken incentives to invest in less carbon-intensive technologies and bulky investments (Box 5.1). The shift towards a low- or zero-carbon economy requires abatement incentives beyond the margin that favour deep decarbonisation and technological switch. Freely allocating emission allowances based on product-specific benchmarks that often differs across carbon-intensive and low-carbon substitutes will affect economic rents and can make carbon-intensive investments relatively more attractive (Flues and Van Dender, 2017[18]). Depending on the allocation rules, free allocation can therefore weaken incentives for firms to invest in break-through low-carbon technologies and undermines the trading system's effectiveness to drive decarbonisation.

The individual industry profiles displayed in Figure 5.10 allow a differentiation between an ECR net of free permit allocation, the effective average carbon rate (EACR), and the standard effective marginal carbon rate (EMCR). Partitioning the price signal deriving from the EU ETS (green area) provides an estimate of how much of the EU ETS emissions in a sector are covered by an auctioned (dark green) or freely allocated emissions allowance (light green). This is different from the marginal price approach taken in Figure 5.9, which does not consider free allocation, but assigns permit price to the respective emissions base independently on whether allowances are freely allocated. The latter approach is rooted in the idea that freely allocated allowances retain CO_2 abatement incentives at the margin due to the opportunity cost (the allowance price) that they entail.

Accounting for free allocation significantly narrows the base of the ECR. More precisely, and as discussed in Section 5.1.3, the chemicals sector receives freely allocated allowances for 96%of emissions, the metallurgical sector 85% and refineries 73% (Table 5.14). This effectively drives a wedge between the marginal price emitters pay for an additional unit of emissions (EMCR) and the average price they pay for their entire emissions base (EACR).

The analysis of carbon pricing signals in 2021 allows drawing first policy recommendation (more details are provided in Section 9.1). The effective carbon rate is very heterogeneous both across and within sectors (Figure 5.10). For example, in the basic metals sector, a third of emissions are not priced at all and the rest priced at below EUR 30 per tonne. In the refinery sector, all emissions are priced below EUR 30 per tonne, whereas the food processing sector pays EUR 30 per tonne or more on 87% of its emissions. The chemicals sector stands in between and features important within-sector heterogeneity, with 63% of emissions priced below EUR 30 per tonne and 37% above EUR 30.

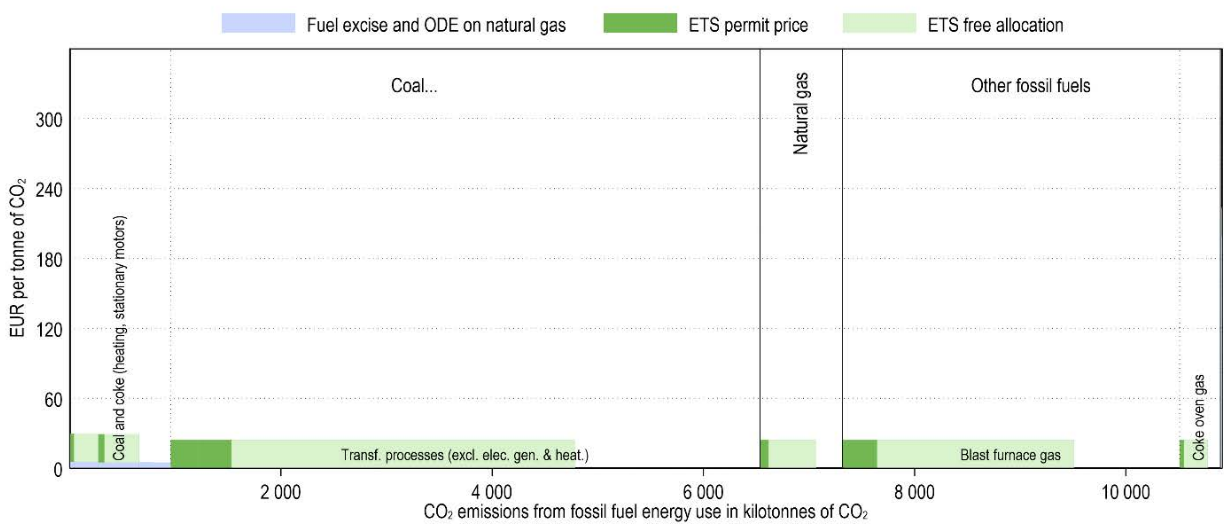
The carbon price also varies widely within sectors, yet for different reasons. In the basic metals and refinery sector, some emitters are simply fully exempt from taxation. In the chemicals sector, within-sector heterogeneity is driven by sector specific fuel use. Specifically, natural gas is subject to energy tax and ODE, while other fossil fuels are widely used too, but not taxed. In food processing, where natural gas constitutes the main fossil fuel consumed, variation arises from the size of energy users. The largest natural gas consumers pay the lowest available tax and ODE rates of the fourth consumption band. Substantial taxation arises only for small and medium sized consumers of energy.

A question arises on how these 2021 pictures may change with the phasing-in of the carbon levy base and the gradually increasing price. Future developments in industry structure, production processes and technology use and their effects on the CO_2 emissions in the Netherlands are challenging to predict.

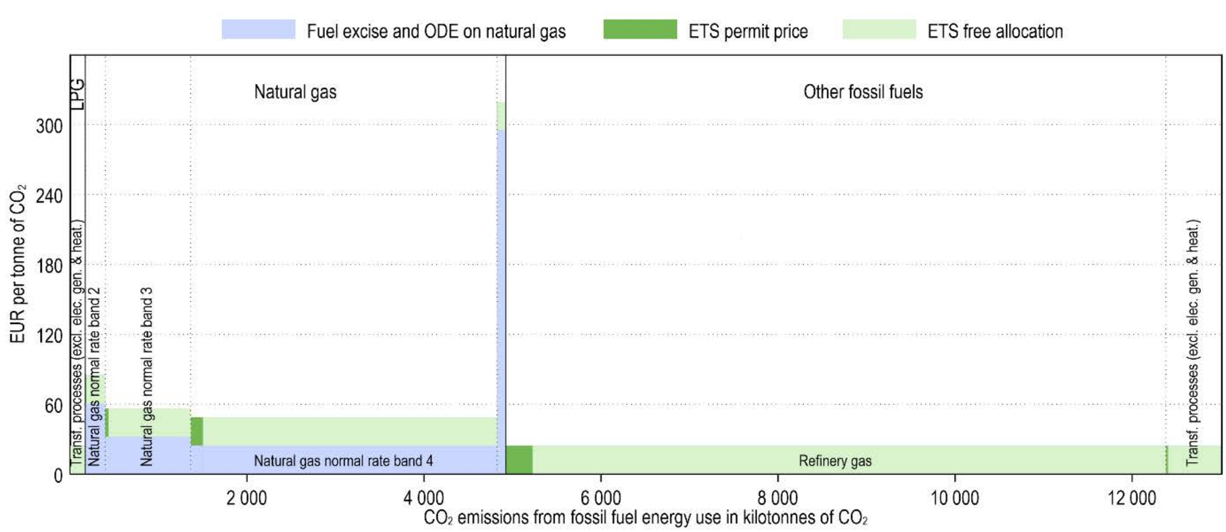
Table 5.24 seeks to provide a static picture on ECRs, if the EUR 125 carbon levy applied in the current situation, but without taking potential changes in the emissions base into account. The table contrasts three ECR estimates: first, the marginal ECR in 2021 (ECR 2021) considering the EU ETS price signal independently whether allowances were freely allocated or not; second, the average ECR in 2021 (EACR 2021), i.e. net of free allocation; third, the average ECR assuming the 2030 levy rate (EUR 125 per tonne) and levy base applied on the current emissions base. The latter estimate assumes no behavioural adjustments to the emissions base, i.e. it does not consider technological shifts or efficiency improvements that industry may undertake by 2030. It, therefore, does not integrate the key policy objective (carbon abatement) of the Dutch carbon levy.

Figure 5.10. Effective carbon rates on CO_2 emissions from fossil fuel energy use in Dutch main industry subsectors, 2021

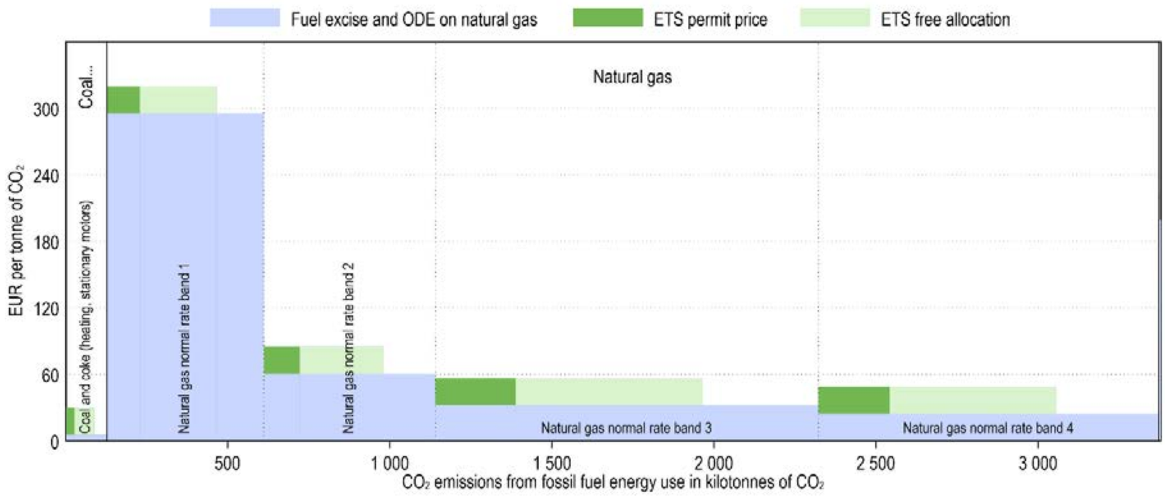
A. Basic Metals



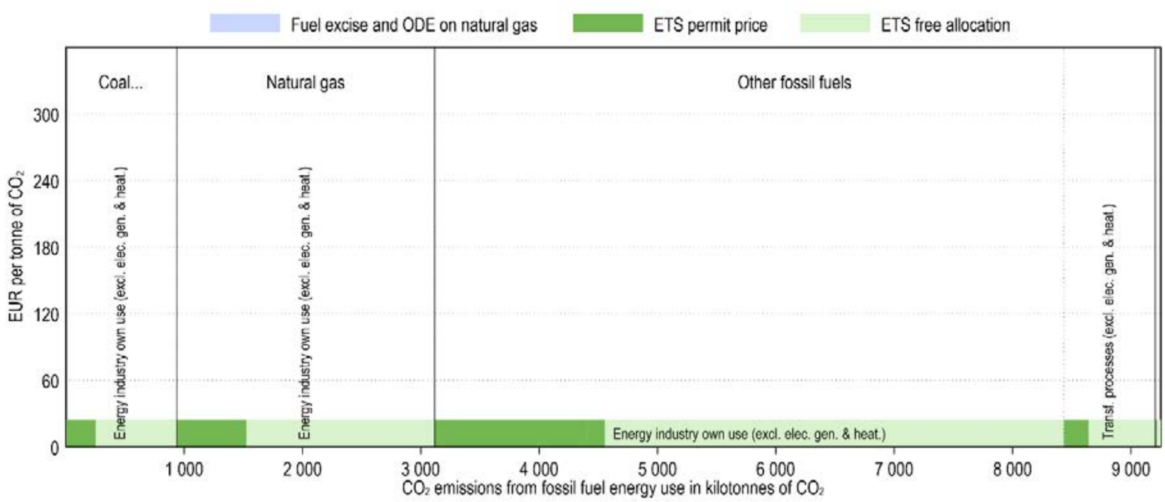
B. Chemicals



C. Food processing



D. Refineries



Note: The 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[49]). ETS data from the Dutch emissions registry is matched to fossil fuel energy use data from IEA (2020[48]), 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 estimates confirm the uneven carbon pricing signal across sectors in 2021 due to generous tax exemptions and the regressive energy tax rates (first column). Taking free allocation of emissions allowances in the EU ETS into consideration (column 2) reveals even larger differences. In 2021, the EACR is estimated at EUR 76 per tonne on average for the food processing sector, against an average rate of EUR 13 per tonne in chemicals, and only EUR 7 and EUR 3 per tonne in refineries and in basic metals, respectively. Applied on the current emissions base, the carbon levy of EUR 125 per tonne would not close this sectoral gap, with EACRs estimated between EUR 24 in basic metals and EUR 92 in the food industry under such a scenario.

Table 5.24. Weighted average effective carbon rates in key sectors for 2021 and estimates for 2030

	Weighted average ECR (in EUR per tonne of CO_2)		
	ECR 2021	EACR 2021 (net of free allocation)	EACR levy-2030 (no behavioural adjustments)
Basic metals	17.51	3.30	23.98
Chemicals	36.64	13.26	50.61
Food	88.19	76.29	91.59
Refineries	24.35	6.57	41.62

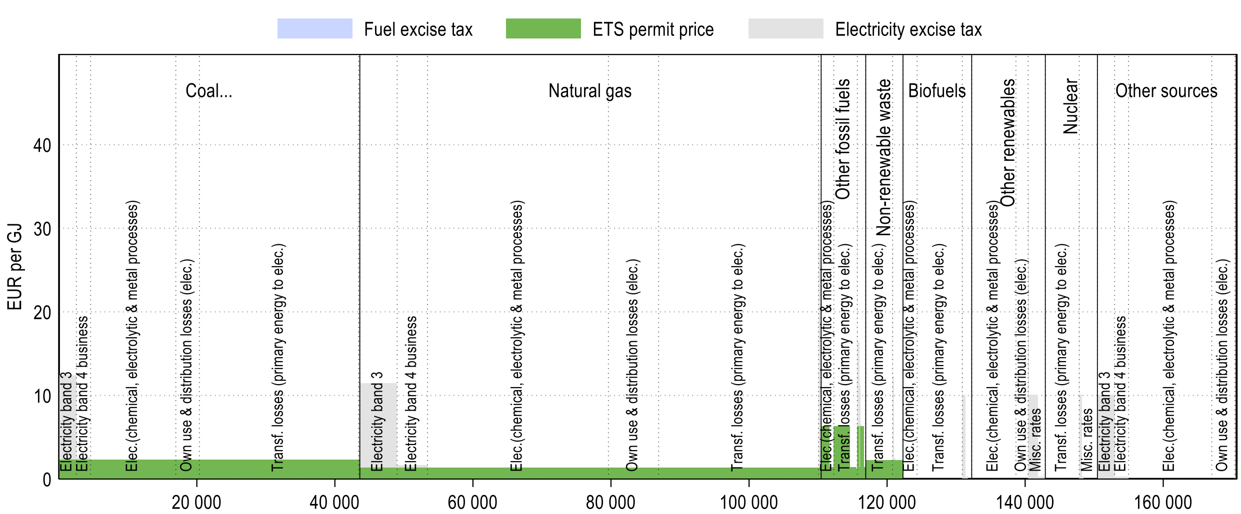
Note: The energy data that is used to calculate the weighted averages is for 2018 and adapted from IEA (2020[48]), World Energy Statistics and Balances. ECR 2021 provides a summary of the marginal ECR in 2021, i.e. considering the EU ETS price signal independently whether allowances were freely allocated or not. EACR 2021 provides a summary of the ECR net of free allocation. EACR 2030 includes the carbon levy of EUR 125 per tonne and an ETS price at EUR 80 per tonne following price forecasts by BNEF (2020[50]). Free allocation of EU ETS emissions permits and levy dispensation rights in 2030 follow estimates by CE Delft (2021[27]). The 2030 scenario assumes no behavioural adjustments in the emissions base, i.e. no technological shifts no energy efficiency improvements or rebound effects compared to 2021.

5.8.2. Effective price signal on electricity use

The design of electricity taxation is also important for decarbonisation. Electricity taxes apply to an energy output (electricity) and are typically not distinguished by energy source. In this case, 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 when electricity generation itself is decarbonised. Several instruments price electricity use in the Netherlands directly (e.g. electricity taxes, surcharge on electricity, indirect cost compensation). Carbon pricing instruments put a price on emissions of the input fuels used to generate electricity (e.g. EU ETS, carbon floor price for electricity). Fuels used as an input are typically exempt from energy tax and the surcharge.

As with energy taxes, the design of electricity pricing in the Netherlands raises equity concerns. Key industrial users of electricity do not pay the Dutch electricity tax and surcharge – or pay only little – either because electricity generation for own use is exempt or because large electricity consumers are subject to the lowest possible rate (Figure 5.11). This treatment favours concentrated, large electricity users at the expense of small industrial users as well as residential and commercial users.

Figure 5.11. Effective price signal on electricity use in main four industry sub-sectors, 2021



Note: Electricity tax includes the ODE on electricity use. Rates applicable on 1 January 2021. The ETS permit price is the average price in 2020. Fossil fuel energy use data is for 2018 and adapted from IEA (2020[48]), World Energy Statistics and Balances.

The current design of the Dutch electricity tax 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. In addition, another large part of the primary energy use associated with electricity generation is not subject to the electricity tax because it is lost in the conversion process – it never becomes electricity.

Electricity taxation still incentivises electricity savings in general. In liberalised power markets, fossil fuel-powered generators are frequently the marginal electricity producer. Energy savings induced by electricity taxes could thus indirectly decrease emissions.[31] Electricity taxes also have the advantage that they can be levied on electricity imported from abroad. (OECD, 2019[2])

Finally, electricity taxation may slow down electrification of industrial processes, which is often a good decarbonisation option provided electricity itself decarbonises. Contrasting the statutory energy tax rate for natural gas to the rate on electricity in GJ terms shows a bias in favour of using natural gas over electrifying industrial processes for all but the highest consumption band (Table 5.25). Everything else being equal, this favours the use of natural gas over electrification of industrial processes.

The total price differential between electricity and natural gas use is even more pronounced taking pre-tax prices into account, because the unit price for electricity (excluding taxes) exceeds the unit price of natural gas by EUR 12.5 EUR per GJ (Table 5.26). 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.

However, it is not straightforward to compare the electricity and natural gas prices as reported in Table 5.26 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. Everything else being equal, 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. 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 5.25. 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 5.26. Pre-tax prices for natural gas and electricity in Dutch industry, Q2/2020

	Natural gas	Electricity
Unit price, excluding taxes [in EUR/GJ]	4.6944	17.222

Note: For natural gas, prices refer to the Eurostat consumption band I4 for industry (annual consumption: 100 000 – 1 000 000 GJ). For electricity, prices refer to the Eurostat consumption band ID for industry (annual consumption: 2-20 million kWh).
Source: Based on IEA *Energy Prices*.

5.8.3. Technology support

Figure 5.12 presents a back-of-the-envelope estimate of the amount of public funding available for the various stages. Where no specific budget exists (for example in the case of horizontal instruments), these estimates have to rely on specific assumptions on the share of funding channelled toward low-carbon technologies. These assumptions are detailed in Table 5.27.

First, within the RD&D phase, most of the policy instruments at the national level are focused on demonstration, rather than on research and development. In particular, the Netherlands strongly relies on European instruments to fund fundamental research. This allows benefiting from economies of scale by aligning research programs and co-operations at the European level and makes sense from an economic theory perspective (since knowledge externalities are larger at the EU level than at the domestic level). Nevertheless, it begs the question whether this strategy is sufficient to maintain technological leaders and sufficient absorptive capacity in the long term.

Moreover, within R&D, there is a clear financial focus on horizontal instruments, which cohabit with a myriad of targeted instruments with little individual funding. The advantage of horizontal instruments is their technological neutrality, but by construction, they benefit mostly technologies that are closest to the market. The ambitious 2050 objectives and the implied deployment of radically new technologies such as hydrogen might justify a stronger focus on targeted instruments for R&D.

The introduction of the SDE++ implies a novel focus on deployment compared with RD&D. This is generally a welcome development, in line with the overall objectives of the Climate Agreement, which rests on indicative public investment needs of EUR 500 million/year for RD&D and EUR 3 billion/year for deployment for the Netherlands as a whole (not only industry). However, within the deployment phase, there seems to be a focus on energy efficiency improvements through EIA (marginal approach) instead of technology shifts promoted through MIA/VAMIL, for example. Similarly, the set-up of the SDE++ scheme – which allocates subsidies to project applicants in decreasing order of subsidy requirement per tonne of CO_2 reduction, thus giving priority to least-cost options - makes the scheme less relevant to support technologies that are still at an earlier stage of development, such as hydrogen.

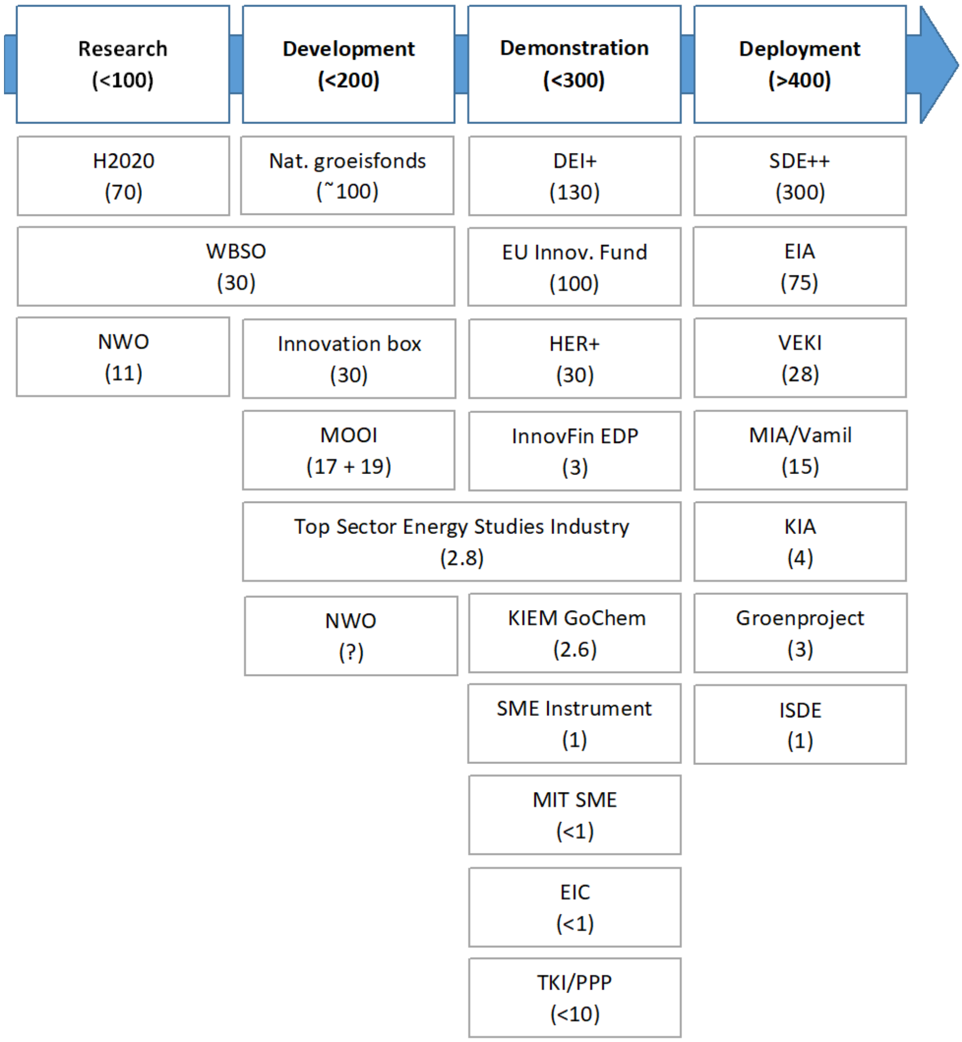
Deployment support is spread across many instruments, some of which have a very similar mechanism, e.g. the investment allowance schemes EIA, MIA and VAMIL. Streamlining could reduce fixed administrative costs, provide clarity and contribute to make it easier for industrial firms to price carbon emissions.

Finally, investments in infrastructure are a necessary condition to reach climate neutrality of industry in 2050. The use of sustainable energy and green techniques is highly dependent on the available infrastructure for electricity, hydrogen, CO_2 and heat networks. Important infrastructure is being constructed at the European level, such as the Porthos and Athos CO_2 transport networks and the North Sea Wind Power hub. At the national level, the Taskforce Infrastructure Climate Agreement Industry (TIKI) and the Multi-year Program Infrastructure Energy and Climate (MIEK) describe the infrastructure required for the energy transition and how bottlenecks can be solved. The six regional industry cluster plans also make infrastructure one of the most important conditions for accelerating the green transformation. As the construction of infrastructure takes time, more priority and speed 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) which goes in this direction, but the resources associated with this Programme are not known yet.

Table 5.27. Estimated amounts and types of annual funding available by instrument

Programme name	Generic / specific	Annual funding available or spent on industry decarbonisation	Type	Author and type of evaluation conducted (descriptive or econometric)
Fundamental research				
H2020	G	ca 70m/y for “energy” and “climate”	Grant	European Commission, (2017), descriptive
now	G	11m for “Energy transition and sustainability”	Grant	n.a.
Research & Development				
EIC Accelerator	G	<1m/y for “energy” and “climate”	Grants and equity	n.a.
WBSO	G	~30m (300m/y for industry, assume 10% is low-carbon)	Tax credit	(Dialogic, APE and UNUMERIT, 2019[51]), Econometric
Innovation box	G	~30m (assuming similar proportion as for WBSO)	Tax credit	(Mohnen, Vankan and Verspagen, 2017[33]), Econometric
Nationaal Groeifonds	G	~100m (total budget 3.3bn/yr; assume 1/3 to R&D and 2/3 to infrastructure, 1/3 to climate, and 1/3 of this to industry)	Grant and/or equity	New scheme
MOOI	S	17m (+19m for renewables)	Grant	n.a.
IKIA/MMIPs	S	n.a.	Grant	New scheme
TKI/PPP	S	<10m (from Top Sector Energy review)	Grant	(Dialogic, 2016[52]), descriptive
MIT SME	S	<1m	Grant	(Technopolis, 2017[53]),econometric
TSE Industry	S	2.8m	Grant	n.a.
KIEM GoChem	S	2.6m	Grant	n.a.
Demonstration				
EU Innovation Fund	G	~100m (assume 10% to NLD)	Grant	New scheme
InnovFin EDP	G	~3m (assume 10% to NLD)	Loans, guarantees, equity financing	n.a.
Top Sector Energy Studies Industry	S	8m	Grant	n.a.
DEI+	S	86.1m + 44m (CE)	Grant	(SEO and Dialogic, 2007[54])”, econometric
HER+	S	30m	Grant	(SEO and Dialogic, 2007[54]), econometric
Deployment				
SDE++	S	~300m (PBL: 3bn over 2020-30)	Grant	Evaluation SDE+: (CE Delft, 2016[38]), econometric
EIA	S	~75m (hyp: 1/2 x 147m budget 2020)	Tax credit	(CE Delft, 2018[39]), econometric
VEKI	S	28m	Grant	n.a.
MIA/VAMIL	S	~15m (hyp: 1/10 x [124+25] m budget 2020)	Tax credit	(CE Delft, 2018[44]), descriptive
KIA	G	~4m (hyp: 1/10 to industry x 1/10 to decarb x 379m budget 2019)	Tax credit	n.a.
Green project loan facility	S	~3m (hyp: 1/20 x 62m tax expense 2019)	Loan	n.a.
ISDE	S	~1m (hyp: 1/100 x 100m budget 2020)	Grant	(SEO, 2019[55]), econometric

Figure 5.12. Estimated amounts of annual funding available by stage (in EUR million)



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Notes

[1] As long as VAT applies equally to a wide range of goods and services in an economy, it does not change relative prices between energy sources and other factors of production. Specifically, VAT does not make fossil fuels more expensive than other energy sources as long as it is applied uniformly. Only a concessionary VAT rate that applies to specific energy products would affect relative prices and should be considered when describing effective energy tax rates (OECD, 2015[56]). Because no concessionary VAT rates apply in the Netherlands, VAT is not covered in detail in this report.

[2] Natural gas used to produce electricity is exempt from the energy tax.

[3] Other EU countries also provide preferential treatment for large industrial users. For example, German industrial users that consume electricity above a certain threshold benefit from a reduced tax rate to counter potential negative effects on competitiveness. Different from the Dutch regressive rate on energy use, the preferential treatment of electricity consumption is reported in the German tax expenditure report.

[4] Because the large producer uses more energy, the nominal amount of tax paid will also be higher for the large as opposed to the small producer.

[5] While this argument holds directly for the energy tax on natural gas, its applicability for electricity is indirect, only for a given generation mix.

[6] Earmarked revenues are legal prescriptions that commit all or part of tax revenue to one or several specific spending items or to a spending programme.

[7] Note that these numbers do not take into account the change in ODE rates in 2020 and 2021, which increase rates in the third and fourth consumption band more proportionally.

[8] Exceptions to this rule during Phase 3 are Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland and Romania. During Phase 4 (2021-30) only Bulgaria, Hungary and Romania still transition to free allocation.

Note by Turkey

The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.

Note by all the European Union Member States of the OECD and the European Union

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

[9] Included are the following NACE categories: Manufacture of food products (NACE 1041, 1062 and 1081); manufacture of coke and refined petroleum products (all NACE 19); manufacture of chemicals and chemical products (NACE 2011-17 and 2060); manufacture of basic metals (NACE 2410-2420, 2431, 2442-2446 and 2451)

[10] These figures are based on prices at *General EUA auctions* at the European level between 1 January and 31 of December 2020.

[11] Effectively the MSR adjusts the cap by decreasing the amount of allowances that are distributed through auctions. Whether an adjustment takes place depends on the number of unused emission allowances in circulation at the end of each year. If this surplus exceeds a threshold of 833 million, the system automatically places a certain share of allowances in reserve and takes them off the market. When the number of allowances falls below another threshold, the reserve releases permits to the market. As of 2023, allowances in the reserve will be invalidated as long as the amount held in the reserve exceeds the number of allowance auctioned in the previous year (European Commission, 2020[15]).

[12] Figure provided by CE Delft, who “have allocated excess CO_2 content of waste gases in the iron and steel industry (above the emissions from natural gas) to the industrial sector in a way that is being explained in CE Delft (2016).

[13] Aluminium production (2742); mining of minerals for the chemical and fertiliser industry (1430); manufacture of other inorganic basic chemical products (2413); lead, zinc and tin production (2743); manufacture of leather clothing (1810); manufacture of basic iron and steel and of ferro-alloys and seamless steel pipes (2710, 272210); manufacture of paper and cardboard (2112); manufacture of fertilisers and nitrogen compounds (2415); copper production (2744); manufacture of other basic organic chemical products (2414); spinning cotton or cotton-like fibres (1711); manufacture of synthetic and artificial fibres (2470); iron ore mining (1310); some subsectors within the industry manufacture of plastics in primary forms (2416XXXX); Mechanical Pulp (21111400).

[14] Electricity generators are not covered by the levy. A separate minimum price on carbon emissions from electricity generation is currently being proposed for the electricity sector.

[15] The levy will start at EUR 12.30 per tonne of CO_2 raising to EUR 31.90 in 2030.

[16] Two main assumptions are part of the calculation: first, the emission reduction target will be achieved with a 75% probability; second, the carbon-abatement potential will be achieved with an 80% probability (i.e. 20% of the technologies in the ex-ante abatement curves drop out) – National Climate Agreement (Government of the Netherlands, 2019[9]).

[17] https://www.rvo.nl/sites/default/files/2020/11/resultatenbrochure-meerjarenafspraken-energie-efficientie-2019.pdf.

[18] The complete database of H2020 projects is available at https://cordis.europa.eu/.

[19] https://www.nwo.nl/en/researchprogrammes/kennis-en-innovatieconvenant-kic/mission-driven-calls-kic-2020-2023

[20] Note that there are other topics, such as "Advanced materials", "Future and emerging technologies" and "Advanced manufacturing and processing", which might include relevant projects for the industry's decarbonisation.

[21] The full list of projects supported by the SME Instrument and the EIC are available at https://sme.easme-web.eu/.

[22] https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2017Z03803&did=2017D07791.

[23] https://www.rijksoverheid.nl/documenten/begrotingen/2019/09/17/bijlagen-miljoenennota-2020.

[24] https://www.rijksbegroting.nl/2019/kamerstukken,2018/9/18/kst248658_9.html.

[25] https://www.rvo.nl/sites/default/files/2020/08/Beleidsevaluatie Regeling groenprojecten 2010-2017.pdf.

[26] https://www.rvo.nl/sites/default/files/2020/07/Jaarcijfers Groen Beleggen 2019.pdf.

[27] https://www.pianoo.nl/en/public-procurement-in-the-netherlands/sustainable-public-procurement-spp

[28] Different from the usual practice in OECD Taxing Energy Use and Effective Carbon Rates publications (2018[1]; 2019[2]), the Dutch CO_2 emissions base used in the context of this project only covers emissions from the combustion of fossil fuels and excludes emissions from the combustion of non-renewable waste and biofuels. As usual, the indicator excludes emissions that are not related to energy use (such as process emissions) and carbon emissions embedded in fuels that are used as a feedstock.

[29] The carbon costs approach to carbon pricing estimates the damage to society that results from one tonne of CO_2 released into the atmosphere. Other approaches define benchmark carbon prices that are necessary to reach specific CO_2 emission reduction scenarios (e.g. Kaufman et al. (2020[45]) and High-Level Commission on Carbon Prices (2017[47])).

[30] Ultimately, depending on the allocation of dispensation rights, the national component of the carbon levy likely settles in a range between the rate set out through the price trajectory and a rate of EUR 0 per tonne. The former reflects the upper bound of the opportunity costs of holding a dispensation right. Generous allocation of dispensation rights will lower this rate. Indications are that it may yield an effective marginal price signal of zero in the early years of the levy.

[31] Note however that the Dutch power sector is additionally subject to the EU ETS, which may further decrease the effectiveness of electricity taxes when triggering net emission reductions.

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