

## 2. Dutch industry's structure and emissions

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This chapter presents a brief overview of the role of the industrial sector in the Netherlands' economy and CO<sub>2</sub> emissions, with a focus on four sectors which account for more than 90% of industry's direct GHG emissions: chemicals, refineries, metals and food processing.

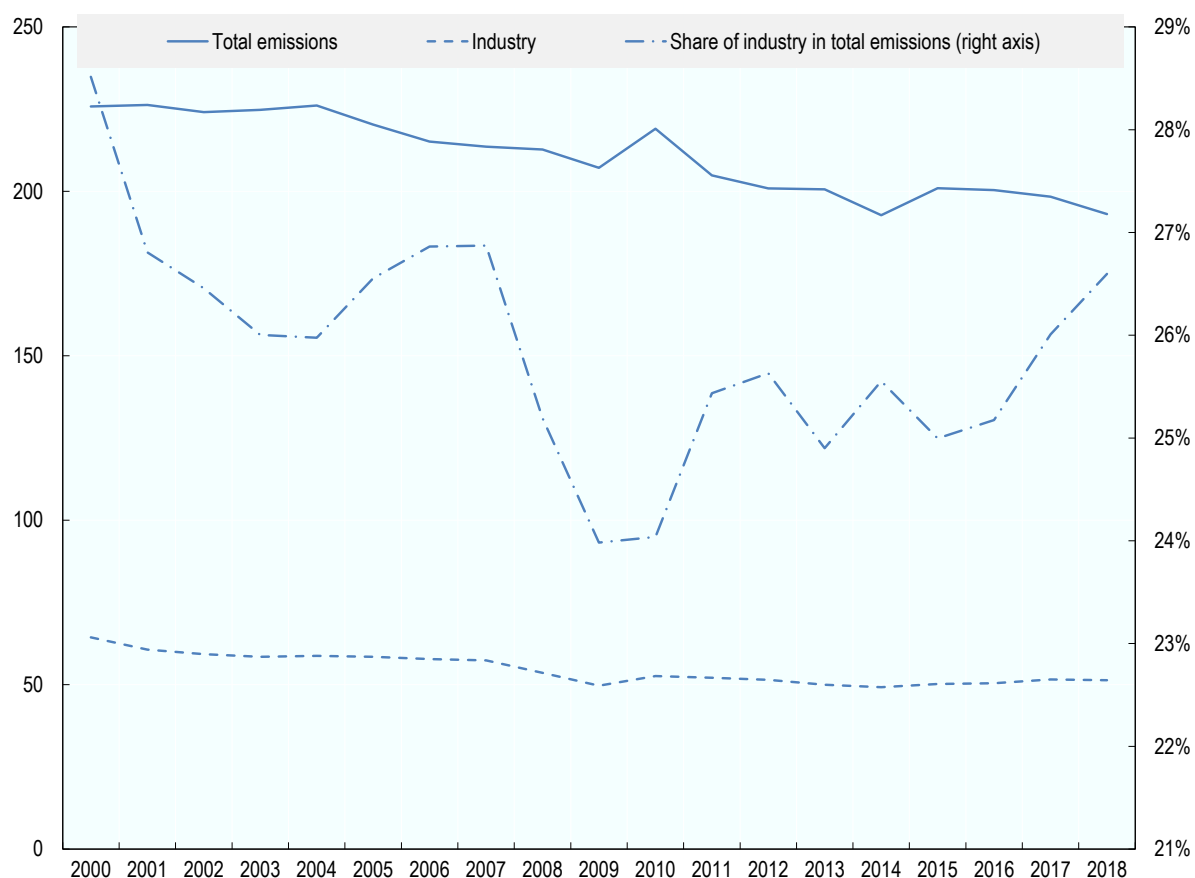
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## 2.1. Industry's emissions in the Netherlands

Greenhouse gas (GHG) emissions in the Netherlands have been decreasing at a constant pace since 2000 at the economy-level (as shown by the solid blue line in Figure 2.1). Industry has contributed to this, slightly more than other sectors as their share in emissions is 26.6% in 2018, compared to 28.5% in 2000. However, the downward trajectory in industry's emissions has stopped since the Great Financial Crisis, and their share in the total emissions has been rising since.

**Figure 2.1. Emissions of GHG are decreasing in the Netherlands, and industry is contributing to this reduction**

Emissions of GHG (Total and Industry) in the Netherlands in Mt CO<sub>2</sub>-eq, and share of emissions from the industry



Note: Industry emissions include emissions from industrial processes and fuel combustion in refineries, manufacturing and construction.

Source: Eurostat (greenhouse gas emissions by source sector), OECD calculations.

Industry accounts for the largest proportion of direct emissions (Scope 1, Box 2.1) in the Netherlands (Figure 2.3). Other important sectors include energy production, transport and agriculture.

The rest of this chapter will focus on four industrial sectors,<sup>1</sup> which accounted for more than 90% of industry's direct GHG emissions in 2018: chemicals, refineries, metals and food processing. The heaviest emitter is the chemical sector, representing 44% of industrial emissions (Figure 2.4). The three other sectors included are refineries, metals and food processing. These four sectors also account for a significant share of industry's Scope 2 emissions, as they represent 72% of the electricity use of the manufacturing sector.<sup>2</sup> Other emitting sectors include the "manufacture of other non-metallic mineral

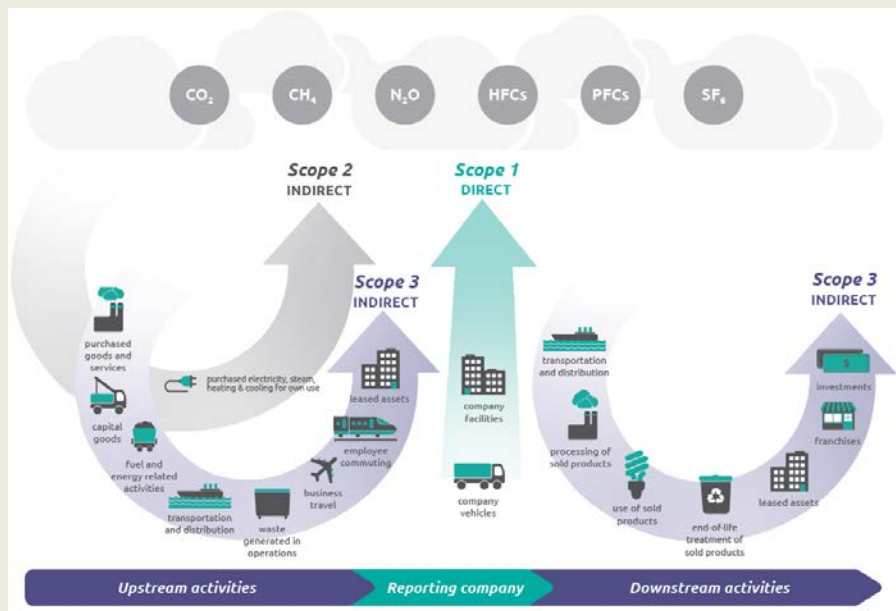
products” (4% of industrial emissions), the “manufacture of paper and paper products” (1%) and the “manufacture of fabricated metal products, except machinery and equipment” (1%).

### Box 2.1. Scope 1, Scope 2 and Scope 3 emissions

The GHG Protocol, a private sector initiative, defines emissions responsibility. IPCC summarises these definitions as follow: “*‘Scope 1’ indicates direct greenhouse gas (GHG) emissions that are from sources owned or controlled by the reporting entity. ‘Scope 2’ indicates indirect GHG emissions associated with the production of electricity, heat, or steam purchased by the reporting entity. ‘Scope 3’ indicates all other indirect emissions, i.e. emissions associated with the extraction and production of purchased materials, fuels, and services, including transport in vehicles not owned or controlled by the reporting entity, outsourced activities, waste disposal, etc.*”

Source: IPCC, [https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc\\_wg3\\_ar5\\_annex-i.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-i.pdf).

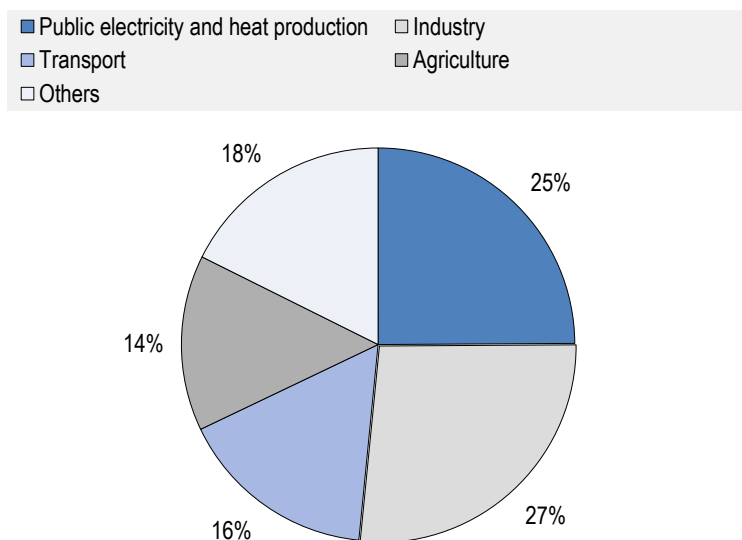
Figure 2.2. Overview of the definitions of scope for GHG emissions



Source: GHG protocol.

Table 2.1 shows the economic importance of each industrial sector for the total economy, measured by gross output, value added, export and the number of employees. The manufacturing sector as a whole represents 12% of the total economy value-added and employs 10% of the workers in the Netherlands. However, unsurprisingly, the manufacturing sector is much more important in terms of export, with almost 45% of exports related to the industrial sector in terms of gross output and 36% in terms of domestic value-added content. When focusing on the four sectors responsible for most of the industrial emissions, they account for around a third of manufacturing value-added or employment, but half of exports (in gross output or value-added).

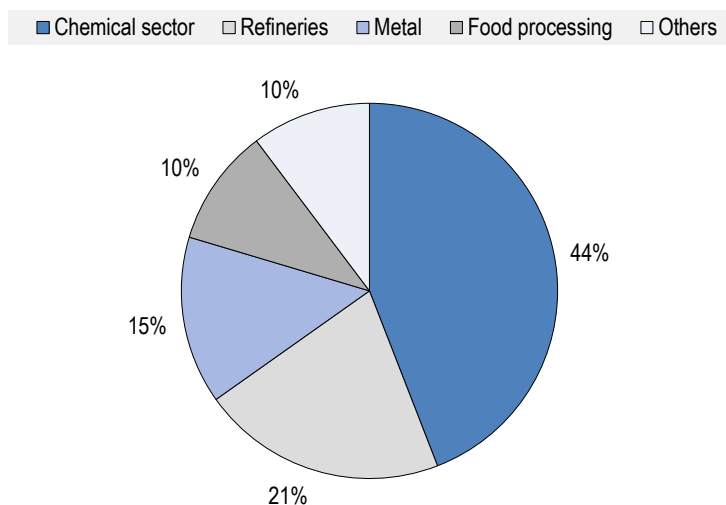
Figure 2.3. GHG emissions by sector, 2018



*Note:* Industry emissions include emissions from industrial processes and fuel combustion in refineries, manufacturing and construction. Agriculture emissions include emissions from agricultural processes and fuel combustion in agriculture, forestry and fishing.

*Source:* Eurostat (greenhouse gas emissions by source sector), OECD calculations.

Figure 2.4. GHG emissions of the industry by sub-sector, 2018



*Note:* This graph only includes direct emissions (Scope 1).

*Source:* Eurostat (Air emissions accounts by NACE Rev. 2 activity), OECD calculations.

The Netherlands is specialised in products that are both highly traded and responsible for significant GHG emissions. The challenge is therefore to decarbonise these sectors while preserving competitiveness. A loss of competitiveness could not only affect economic prospects, but also, absent mechanisms to penalise carbon-intensive imports, lessen the efficiency of the green transition globally by shifting emissions abroad rather than reducing them (referred to as “carbon leakage”).

**Table 2.1. Economic performance in the four sectors**

	Gross output		Value added		Export GO		Export VA		Employees	
	Euro	Share	Euro	Share	Euro	Share	Euro	Share	Thsd	Share
Total Dutch economy	1 514	100.0%	693	100.0%	352	100.0%	254	100.0%	7 829	100.0%
Manufacturing (D10T33)	345	22.8%	86	12.4%	155	44.2%	92	36.4%	742	9.5%
Food, beverages and tobacco (D10T12)	72	4.8%	16	2.3%	32	9.1%	21	8.4%	127	1.6%
Coke and refined petroleum (D19)	30	2.0%	1	0.2%	11	3.2%	4	1.5%	5	0.1%
Chemicals and chemical prod. (D20)	53	3.5%	12	1.7%	31	8.8%	19	7.6%	45	0.6%
Basic metals (D24)	9	0.6%	2	0.4%	6	1.8%	4	1.5%	21	0.3%
Scope of this chapter (D10T12, D19, D20, D24)	165	10.9%	32	4.6%	80	22.9%	48	19.0%	198	2.5%

Note: Gross output and value added are measured in billion euros. Gross output, value added and the number of employees are presented for 2018 and the figures on export are presented for 2015. Estimates are based on the International Standard Industrial Classification of all economic activities, Revision 4 (ISIC Rev. 4). Export GO = export gross output (adjusted for re-exports); Export VA = Domestic value added content of gross exports. Export GO and Export VA are from the TiVA database and the latter excludes the foreign value added in exports. The figures for Export of chemicals is available at a less disaggregated level and include pharmaceutical products (D21).

Source: OECD STAN Industrial Analysis data (2020) and Trade in Value Added (TiVA) data (2018).

## 2.2. The five industrial clusters

Dutch industry is very concentrated with 12 firms<sup>3</sup> accounting for more than 60% of the industrial emissions,<sup>4</sup> and five regional clusters including most of the heavy emitters: “Rotterdam-Moerdijk”; “Smart Delta Resources” (Zeeland); “Chemelot” (South-Limburg); “Noord Nederland” (Eemshaven, Delfzijl and Emmen) and “Noordzeekanaalgebied” (Amsterdam-IJmuiden).

Table 2.2 shows which main sectors (chemical, refineries, metal and food) are represented in the different clusters (five geographical clusters plus the “Zesdecluster” for the rest of the country), which portrays the regional scattering of these industries. The chemical industry is represented in all six regional industry clusters, but in terms of size it is mostly concentrated in Rotterdam-Moerdijk, Chemelot and the Smart Delta Resources. Refineries are concentrated in Rotterdam-Moerdijk, with the exception of Zeeland refinery, which is located in the Smart Delta Resources. A vast majority of steel is produced by Tata Steel in IJmuiden, which is part of the Noordzeekanaalgebied cluster plan. Food processing is more spread over the geographical clusters taking place in the Smart Delta Resources, Noordzeekanaalgebied, Noord Nederland and in the sixth cluster (Zesdecluster).

**Table 2.2. Correspondence between clusters and sectors**

	Chemical	Refineries	Metal	Food
Rotterdam- Moerdijk	x	x		
Smart Delta Resources (Zeeland)	x	x	x	x
Chemelot (Limburg)	x			
Noordzeekanaalgebied (Amsterdam- IJmuiden)	x		x	x
Noord Nederland (Eemshaven, Delfzijl and Emmen)	x		x	x
Zesdecluster	x		x	x

Source: Based on the cluster plans (Box 2.2).

The six clusters have recently released plans for decarbonisation at the 2050 horizon, aiming for net-zero emissions in 2050. These plans are described in Box 2.2 and are consistent with the scenario presented in the following sections. Important to point out is the substantial heterogeneity in the size of the clusters,

with Rotterdam-Moerdijk, alone, being responsible for 70% of the targeted emission reductions for the industrial sector for 2030. Another relevant observation is that there is substantial overlap between the different cluster plans in reported opportunities, roadmaps and conditions.

### Box 2.2. Six industry cluster plans

This box describes the five geographical industry cluster plans, “Rotterdam-Moerdijk”; “Smart Delta Resources” (Zeeland); “Chemelot” (South-Limburg); “Noord Nederland” and “Noordzeekanaalgebied” (Amsterdam-IJmuiden), and a sixth cluster containing the rest of the manufacturing sector, spread over the Netherlands. Key conditions for the green transformation mentioned across plans are: sufficient supply of green electricity, infrastructure (e.g. for hydrogen and CO<sub>2</sub>) and facilitating legislation (e.g. to allow recycling resources).

#### Industry cluster plan Rotterdam- Moerdijk

The goal of the industry cluster plan Rotterdam-Moerdijk is to contribute 20-25% to the national GHG reduction targets, which is 70% of the target for the total industrial sector for 2030. The size of the industry cluster Rotterdam-Moerdijk, therefore, demands a more extensive description than the other industry clusters. The main activities in this cluster relate to the harbour, the processing of raw materials, refineries, the petrochemical industry and energy.

According to the industry plan, the cluster represents 400 000 jobs and a value-added of EUR 13 billion. The cluster is known for its energy-intensive industries, using 260 PJ annually, and this energy consumption alone is responsible for 18.6 Mt of CO<sub>2</sub> emissions (2016).

#### Roadmap

Step 1 (2018-25): Efficiency measures and use of residual streams. Residual heat from industries can be used to heat houses, offices, and greenhouses and CO<sub>2</sub> can be captured and used in greenhouses or stored under the North Sea. The CO<sub>2</sub> reduction potential of step 1 is 4.9 Mt CO<sub>2</sub> in 2030.

Step 2 (2020 -30): Oil and gas used to heat in the production process will be replaced by renewable electricity and hydrogen (both produced and imported hydrogen, initially blue hydrogen and then green hydrogen, Box 1.2). The CO<sub>2</sub> reduction potential is 3.5-4 Mt CO<sub>2</sub> in 2030.

Step 3 (2030-50): Replace fossil fuels in the chemical sector and for transportation by biomass, recycling and re-using CO<sub>2</sub> in combination with hydrogen. The CO<sub>2</sub> reduction potential is 1 Mt CO<sub>2</sub> in 2030. To reach carbon-neutrality in 2050, most of these emission reductions occur between 2030 and 2050.

The industry cluster plan contains the following examples for a circular industry:

- a waste-to-chemicals factory in which plastic and mixed garbage is transferred into resources for industry
- pyrolyse scale-up projects to convert non-recyclable plastics to crackerfeed
- Biogate Europe to produce ethylene oxide and derivatives from biogenic resources
- CO<sub>2</sub> capture to deliver to greenhouses
- large-scale mono-manure fermentation or CO<sub>2</sub> fermentation factory
- extension of the bioliquefied natural gas station network
- scale-up to integrated factory/ bio refinery for cascading and
- valuation of sustainable biomass and oil in green chemistry and fuels.

According to the cluster plan, the necessary conditions for the green transformation are clear and stable multi-year legislation, financial conditions that make green investments economically rewarding, and

investments in infrastructure. Conditions related to hydrogen, electrification, use of residual heat and circular use of resources are: enough supply of sustainable energy (e.g. to produce green hydrogen); infrastructure for hydrogen, residual heat and CO<sub>2</sub> streams; increased electrolyse capacity and changes in legislation (e.g. to change the status of waste).

### Smart Delta Resources

The Smart Delta Resources (SDR) is located in Zeeland and Oost-Vlaanderen (Belgium) and includes the North Sea Port, which is a 60-kilometre-long cross-border port area that stretches from Vlissingen on the North Sea coast in the Netherlands to Ghent in Belgium. The industries in SDR claim to be responsible for an (in)direct employment of 100 000 people, and a value-added of EUR 14.5 billion, of which 33 000 jobs and EUR 5.6 billion value-added for Zeeland. The SDR region includes the production of chemicals, steel, energy and food. In addition, it is known for its current application of (grey) hydrogen (520 kt), which corresponds to 33% of total industrial consumption in the Netherlands, and has the potential to grow to more than 1 Mt annual (mostly green and blue) hydrogen production in 2050 (Box 1.2, on the processes to produce hydrogen). The Schelde-Deltaregion is the largest hydrogen producer and consumer in both the Netherlands and in Flanders with only Rotterdam having a similar scale. The presence of large-scale wind parks offer an opportunity for the production of green hydrogen.

The SDR region reduction target (Zeeland and Oost-Vlaanderen) is 11 Mt in 2030 and the provisional ambition for 2050 is to reduce emissions by 18 Mt CO<sub>2</sub> (which is not yet enough to reach climate neutrality). Most reduction will be achieved by replacing grey hydrogen with mostly blue hydrogen in 2030 and mostly green hydrogen in 2050, and by deploying carbon capture and storage (CCS), carbon capture and utilisation (CCU) and electrification. The GHG reduction plan consists of four main programs: Hydrogen Delta, Carbon Connect Delta, Spark Delta and Heat Delta. The SDR region is considered to be the motor of green wind-energy with Windpark Borsele 1, 2, 3 and 4.

Conditions mentioned in the industry plan to make the GHG reduction a success are regional hydrogen infrastructure, infrastructure for CCUS, enough sustainable energy and favourable regulations (e.g. issue necessary permits, and resolve obstacles caused by differences in regulations between the Netherlands and Belgium).

### Chemelot

Chemelot is a chemical business park consisting of leading chemical producers and a knowledge and innovation campus. It has approximately 8 000 employees.

Chemelot is responsible for 6 Mt CO<sub>2</sub> emissions per year. The target is to reduce GHG by 50% in 2030 (relative to the 1990 benchmark) and become climate neutral in 2050. To reduce GHG, the target is to produce 50 kt (blue) hydrogen in 2030 and 200 kt (blue and green) hydrogen in 2050. In addition, the Chemelot cluster has the ambition to be the first circular hub.

The two strategies to reach these goals are the replacement of fossil-based resources by sustainable alternatives and the electrification of production processes using sustainable electricity. There are three underlying themes related to this: process innovations, circularity and hydrogen.

Two concrete solutions for 2030 are the reduction of nitrous oxide emissions and CCS. Nitrous oxide is not yet included in the Emission Trading System (ETS) system and therefore, some low-hanging fruits still exist to reduce the annual emissions of nitrous oxide by 0.9 Mt CO<sub>2</sub> (equivalent) by 2030. On the Chemelot site, a substantial quantity of almost pure CO<sub>2</sub> is available to capture. A challenge remains to find a solution to transport this carbon to the North Sea.

Infrastructure for hydrogen and CO<sub>2</sub> is a crucial condition to reach the GHG reduction goals along with strengthening the electricity network. Market-based solutions for this do not yet exist.

Other conditions mentioned in the plan are a level playing field, removing legislative hurdles and increasing subsidies for required investments that are not profitable.

### **Regioplan Noordzeekanaalgebied**

The regional industry cluster “Noordzeekanaalgebied” (Amsterdam, Zaanstreek, IJmuiden) represents almost thirty companies in the North Sea canal area. The industry plan claims that these industries generate approximately 78 000 jobs and a value added of EUR 9 billion. Important sectors are Steel (Tata Steel), food and energy (Vattenfall, AEB). GHG emissions in this area are 18.3 Mt per year (11% of CO<sub>2</sub>-emissions in Netherlands), of which 6.3 Mt by Tata Steel.

The GHG emission reduction target for this area agreed in the Climate Agreement is 4.2 Mt in 2030, but potential projects to reduce emissions exceed this amount.

Conditions mentioned in the industry plan to reach the GHG reduction targets are a smooth collaboration between the stakeholders, a decrease in uncertainty for investors (e.g. about future subsidies and the price of CO<sub>2</sub>), an increase in subsidies to allow for important non-profitable investments and finally improvements in the energy-infrastructure (e.g. hydrogen infrastructure).

### **Noord-Nederland**

The Noord-Nederland cluster is one of the smallest industry clusters, generating approximately 15 000 jobs and a value added of EUR 2 billion, according to the cluster plan. Industries related to this cluster are concentrated in Eemshaven, Delfzijl and Emmen and consist of the chemical industry, food, data centres, metal and biorefinery. The industry cluster Noord Nederland is responsible for 30% of Dutch electricity production.

GHG reductions in this industry cluster are reached by process innovation (30%), changing energy sources (25%) and energy-efficiency (17%).

### **Het Zesdecluster**

The sixth cluster is called “Zesdecluster” (literally meaning sixth cluster), which contains firms spread over the country and do not contain the twelve biggest emitters which are all represented in the five other clusters. The sixth cluster consists of the following nine sectors: food processing, paper, chemical, glass, ceramic, waste and recycling, Information and Communication Technologies (ICT), metallurgical, oil and gas.

The reduction target is 4.3 Mt CO<sub>2</sub> and the roadmap to reach this target consists of process efficiency, electrification, alternative resources, sustainable energy, geothermal heating, using warmth efficiently and innovative techniques.

Conditions mentioned in the cluster plan are the following: 1) access to infrastructure (strengthening of the electricity grid, infrastructure for hydrogen and networks for geothermal energy, heat supply and CCUS), 2) R&D support, 3) reliable and affordable energy, 4) facilitating legislation and 5) access to finance and subsidies.

To summarise, the main conditions for a successful transition of the different clusters are a sufficient supply of green electricity; infrastructure for hydrogen, CO<sub>2</sub> and (geothermal and residual) heating; steady multi-year subsidies to make investments in the green transition economically rewarding; innovation-friendly legislation (e.g. allowing the recycling of resources).

*Source:* This box is based on the information provided in the six (regional) industry cluster plans.



## Notes

<sup>1</sup> In the rest of this report, the industry corresponds to the manufacturing sectors (NACE Rev. 2 10-33).

<sup>2</sup> Source: Eurostat, energy supply and use by NACE Rev. 2 activity.

<sup>3</sup> Among which Tata Steel, Shell, BP, Zeeland Refinery, Chemelot Site Permit, Esso, Dow, Yara Sluiskil, Air Liquide, ExxonMobil.

<sup>4</sup> Source: Climate Agreement.





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