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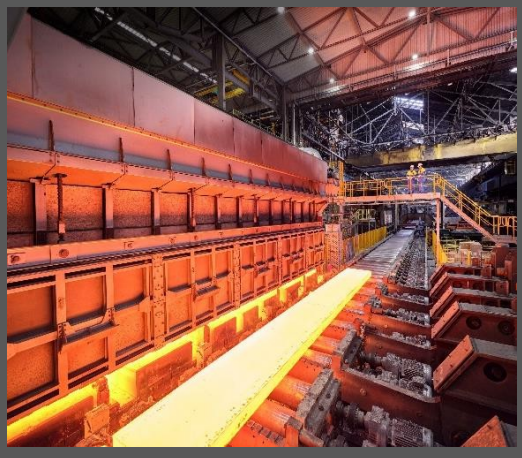
The Socioeconomic Impact of 6 Sectors within Basic Industry.



. 17, 2025

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VEMW
Attn: Hans Grünfeld
Houttuinlaan 12
3447 GM Woerden

Dear Mr. Grünfeld,

Before you is our report on the socioeconomic impact of 6 sectors within the basic industry. This report was prepared in accordance with our agreements recorded in the engagement letter dated January 10, 2025.

We accept no liability (including negligence) toward any party other than you or for any use of this report other than its intended use.

Do you have any further questions? If so, please feel free to me.

Kind regards,
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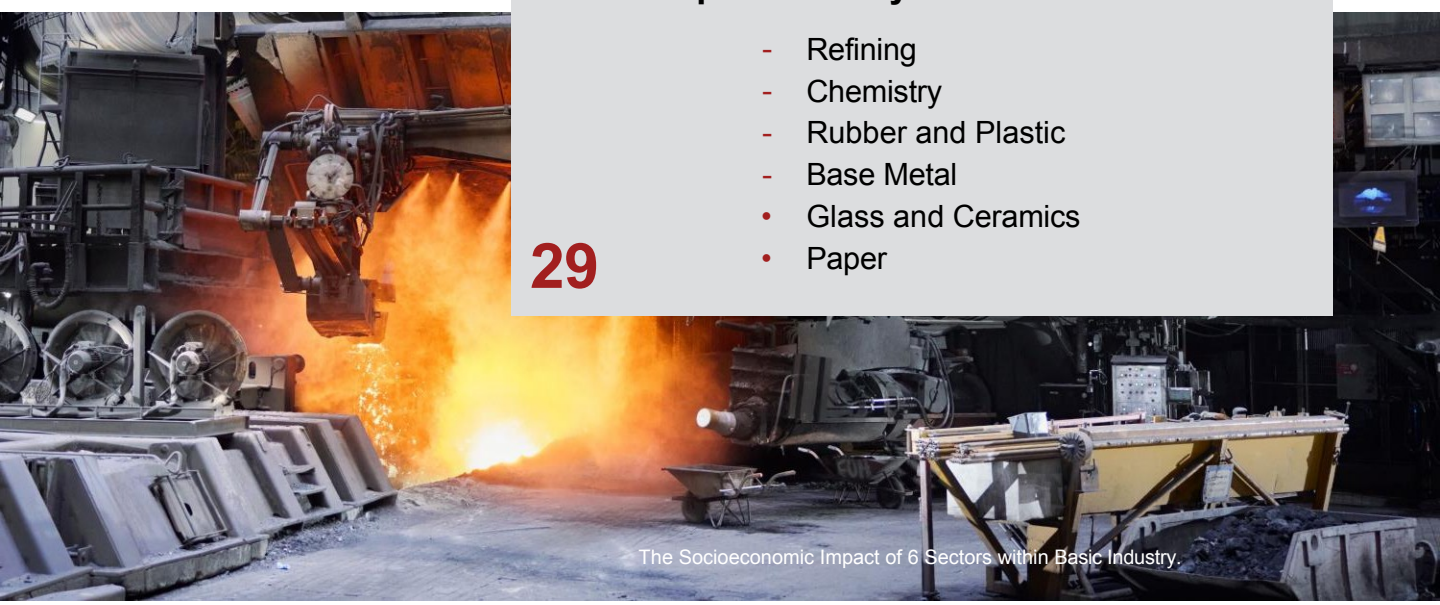


ADDRESS

The competitiveness of basic industry in Europe is under . Rising energy prices in Europe since the war in Ukraine has confronted the basic industry with significant cost increases. In addition to high energy costs its there concerns that the CO_2 pricing could lead to competitive disadvantages in Europe, as there are significant question marks over the effectiveness of the Carbon Border Adjustment Mechanism (CBAM), which is supposed to a level playing field with non-European countries. This is due in part to the lack of protection for export products and certain (sub-)sectors such as cement, iron and steel, aluminum, refining and fertilizers.

Dutch basic industry also experiences an uneven playing field within Europe, which the competitiveness and further weakens the investment climate in the Netherlands. While all European companies experience competitive pressure from outside Europe, Dutch basic industry also increasing inequality within Europe[1]. This is due to unilateral Dutch policy initiatives, such as additional CO_2 costs on top of European prices and relatively high grid tariffs relative to surrounding countries. It is unlikely that mitigation measures in the Netherlands, such as subsidies through SDE++ or customized agreements, will fully compensate for these disadvantages. The sharply declining production and closures of production sites in the Netherlands underscore the pressure for continuity and urgency.

While the competitiveness of European and Dutch industry is under pressure and dependence on imports is increasing, geopolitical developments are putting pressure on the open trade flows, production chains and climate objectives. For example, the vulnerabilities of production chains and their negative economic consequences became evident during the corona crisis. Furthermore, peaceful trade flows based on comparative advantages are not a given in a "slow-balancing" global economy with looming trade wars. The faltering international commitment to climate, reinforced by recent developments in the U.S., which, among other things, drew a line under government support for decarbonization plans U.S. industry, also shows that the hypothesis that we can serve future European demand with green imports from third countries does not simply hold true.

1) PwC Strategy& (2024), Playing field test

ADDRESS

The Draghi Report[1] and the subsequent Competitiveness Compass of the EU[2] underline the particular vulnerability of the energy-intensive industries, but also highlight the security, economic and environmental opportunities. The Draghi report makes it clear that Europe's competitiveness and earning power are declining and dependence on other countries is increasing. At the same time, the Draghi report recognizes the unique opportunities that preserving and making energy-intensive energy sustainable within Europe can provide. It sees these opportunities primarily in the areas of future earning power, the environment and economic resilience. The Compass announces several measures to realize this, including measures to reduce energy costs and a tightening of CBAM.

Within Netherlands is currently a discussion going on about the future of the Dutch industry. As a result of the competitive position being under pressure, the Dutch level playing field needs more attention than ever. For example, in early February, the Port of Rotterdam, together with the City of Rotterdam and the Province of South Holland, wrote a fire letter to the cabinet about the port's continued shrinkage, and InvestNL and Energie Nederland made a call for green demand stimulation towards Europe and the Dutch cabinet.

The purpose of this study is to provide a factual description of the socioeconomic impact of 6 sectors within basic industry on the Netherlands, which can contribute to the current discussion on the future of Dutch industry. Royal VEMW, in cooperation with FME, VEMOBIN, VNCI, VGN, VNO-NCW and several industrial companies, asked PwC to investigate the socio-economic impact of 6 CBS sectors (namely Refining, Chemicals, Rubber & Plastics, Base Metals, Paper and Glass & Ceramics). This report evaluates the 6 sectors along the axes of economic impact, environmental and strategic relevance, relying as much as possible on publicly available quantitative data. The report summarizes the results of the analyses at the level of the 6 sectors by pillar (economic impact, environment and strategic relevance). Sector-specific analyses are available in the appendix.

1) Draghi report: 'The future of European competitiveness'; 2) EU report: 'A Competitiveness Compass: Strategy for Economic Renewal'

1. ECONOMIC IMPACT

Basic industry is needed to make products we need now, and in the future

The refining sector processes crude oil into high-value products for transportation and the chemical sector. For example, fuels are made for means of transportation such as cars and trucks, as well as for airports and the defense sector. In addition, the provides inputs for many industries, making it a first link in industrial production chains. For example, bitumen is used to make asphalt and naphtha serves as a raw material for the chemical sector.

The chemical sector is a further important link in various production chains, providing essential building blocks for everyday products and the energy transition. For example, in the Netherlands we extract salt of high purity, from which chlorine is made that 75% of all pharmaceuticals (medicines) depend on. Dutch chemicals are also produced and used to make plastics, aluminum, detergent, shampoo, chips for computers and smartphones and paper, as well as products for the energy transition such as wind turbine blades, (hybrid) batteries, insulation materials and solar panels. The sector also supplies much of the raw materials for the rubber and plastics sector.

The rubber and plastics sector manufactures products that we use every day. For example, the rubber sector manufactures automobile tires, as well as "high-purity" rubber products that are widely used in the medical sector for such things as tubing, mouthpieces and respirators. Plastics have a very wide variety of applications. Examples include packaging for food and consumer goods, parts for displays, interior design, cords for electronics.

Base metals are critical to the energy transition. Electric cars, batteries, solar panels, wind turbines and hydrogen infrastructure are all technologies that require more metals than their conventional alternatives. Furthermore, we manufacture steel for such things as wall panels in buildings, machinery and various means of transportation.

Glass and ceramics sector[1] manufactures products such as ceramics and natural stone used in the construction of homes, schools and other buildings, while glass is particularly important to the food industry, as a supplier of glass packaging.

The paper industry supplies paper and paperboard for packaging of both consumer goods and food. Paperboard is expected to continue to play a major role due to continued demand for package shipments.

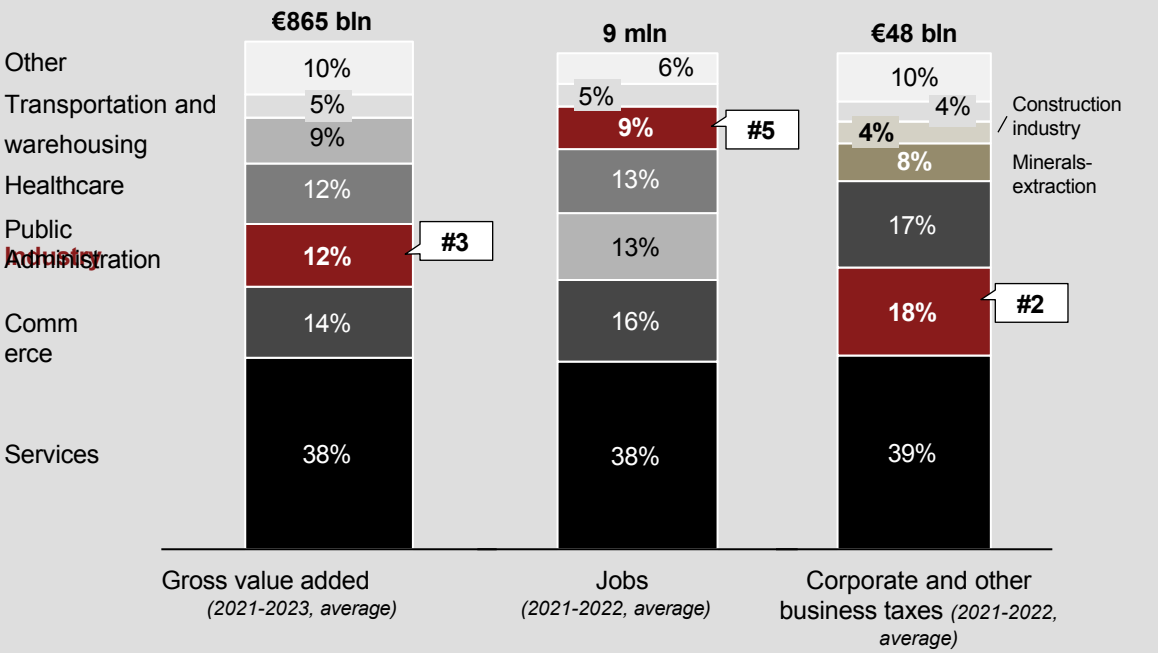
The 6 sectors will remain relevant in the future, as demand for products from these industries is expected to continue, to continue making products we use every day. For other basic industry products, demand will increase, for example for applications in the energy transition.[2]

1) CBS Construction Materials sector; 2) See the sector depth chapters in the appendix for a More detailed account of end products and future demand by sector;
Source: Ministry of Defense; Nobian: "Salt Study"; AVK Ravestijn; KU Leuven: "Metals for Clean Energy"; KIDV; Allianz: 'Paper sector risk report', Interviews with companies from the 6 sectors

1. ECONOMIC IMPACT

Industry[1] accounts for 12% of NL GDP, 9% of employment and 18% of corporate and other business tax revenues[2,3]

Delivered value of Dutch industry in VAT, jobs and corporate and other business taxes



Source: CBS

The gross value added of the Netherlands between 2021 and 2023 was €865 bln per , expressed in basic prices. Industry's gross value added was €107 bln per year between 2021 and 2023, accounting for 12% of the Netherlands' GDP (14% of GDP excluding public administration). This makes it the second highest contributor to the gross value added of the Netherlands after 2 sectors.

The average number of jobs in the Netherlands between 2021 and 2022 was 9 mln[4]. The industry offered to 753 thousand people in this period, representing 9% of the total (10% of total jobs, excluding public administration). This makes manufacturing the second largest employer in the Netherlands after 4 sectors (incl. public administration).

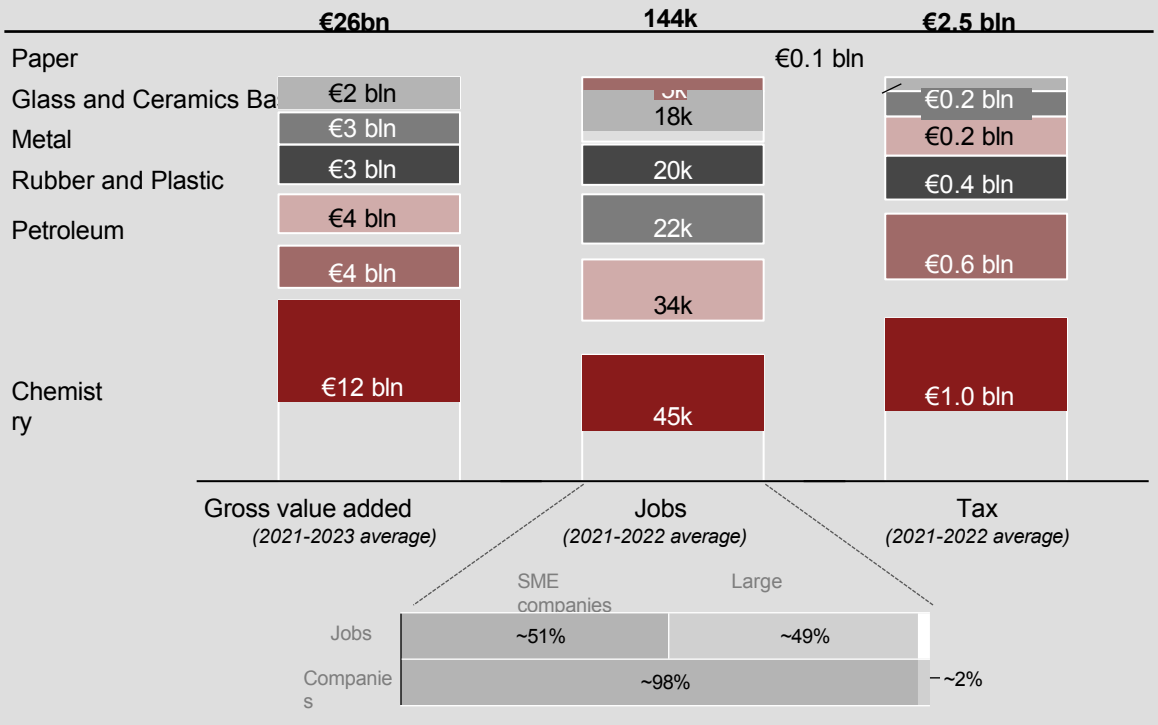
Finally, the Dutch government received €398 bln in tax revenue per year between 2021 and 2022. This comprised €48 bln (12%) of corporate and other business taxes[3]. Between 2021 and 2022, Dutch industry remitted €8.4 bln, which accounted for 18% of the total. This makes manufacturing the second largest sector in terms of tax contribution from corporate and other business taxes[3].

1) Industry is defined as the SBI code C, according to standard CBS classification; 2) Considered period concerns 2021 to 2023. However, for jobs and taxation, CBS data for 2023 is not yet available at the time of writing, the period 2021 to 2022 has been here; 3) Other business taxation concerns, for example, emission rights, sewer fees and water pollution charges; 4) Self-employed are not included in total jobs due to inconsistent data between different sectors; Source: CBS

1. ECONOMIC IMPACT

The 6 sectors are responsible for €26 bln GVA, 144k jobs and €2.5 bln corporate and other business taxes

Direct value of the 6 sectors in VAT, jobs and corporate and other business taxes



Source: CBS

Between 2021 and 2023, the average annual gross value added (VAT) of the 6 sectors was €26 billion, 24% of all industry and 3% of total Dutch VAT. Part of the VAT is realized through exports; for example, between 2021 and 2023, exports averaged €107 billion per year and the trade balance averaged +€35 billion. In particular, refining and chemicals export a lot; refining exported 79% of total production (€35 billion) and for chemicals it was 74% (€49 billion).

Between 2021 and 2022, an average of 144 thousand people worked in the 6 sectors, 19% of all jobs in the Dutch industry and 1.6% of jobs in the Netherlands. GVA relative to the number of jobs is relatively high for the 6 sectors compared to both industry and the Netherlands. The 6 sectors consist largely of SMEs. Between 2021 and 2023, the 6 sectors consisted on average of 5,500 companies, 98% of which are SMEs. Of the total number of jobs, 73 thousand (>50%) jobs can attributed to SMEs.

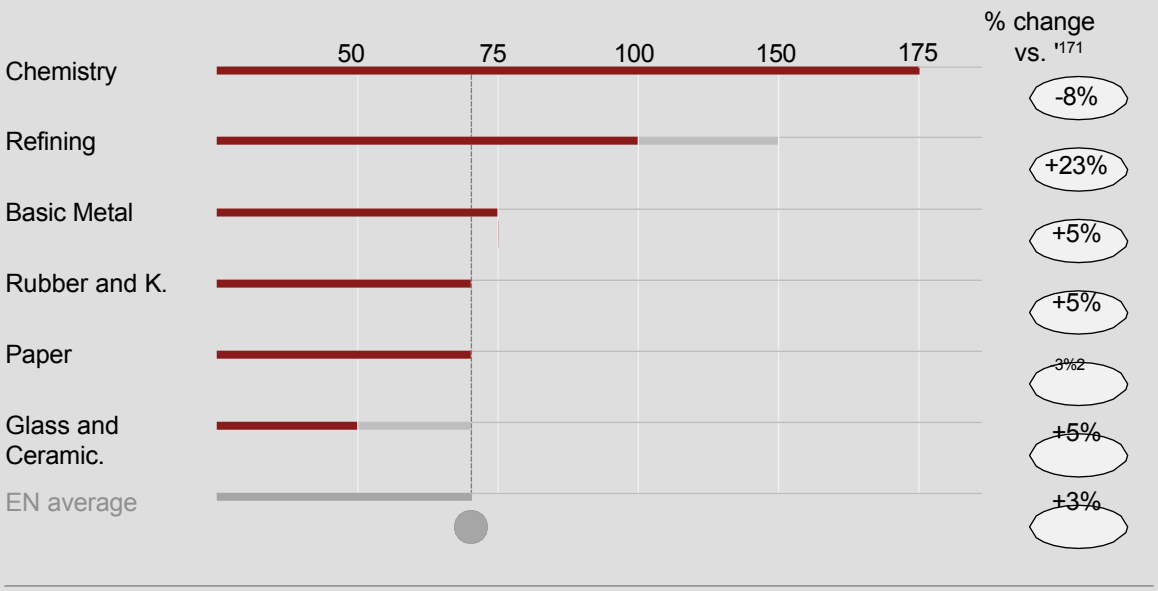
Finally, between 2021 and 2022 annual tax payments averaged €2.5 billion, accounting for 29% of total taxes paid by the industry and 5% of total taxes paid in the Netherlands during that period1

1) Other business tax for base metal is adjusted for EU ETS construction of Tata Steel with Vattenfall, see sector deepening basic metal for more information.
Source: CBS, interviews with businesses

1. ECONOMIC IMPACT

Average labor productivity of the 6 sectors is relatively high. Of the 6 sectors, productivity is highest in chemicals, refining and base metals

Average labor productivity in gross value added per hour worked, 2021 - 2023



Source: CBS

CPB indicates that since 1980 the capital intensification of industry has intensified. This is due to industrial processes that have been further automated or robotized, largely eliminating "dirty" and physically demanding work, and these processes require mainly specialized labor. Due to the high capital intensity of the 6 sectors, there is much room for high labor productivity and further growth, as CBS figures show.

The average labor productivity of the 6 sectors is higher than the NL average. Of the 6 sectors, productivity is highest in chemicals, refining and base metals. Labor productivity in the chemical sector is more than 2 times higher than the NL average. In addition, productivity of 4 sectors grew above average compared to 2017. Chemistry's productivity decline occurred in 2022 and 2023 and may be attributable to lower production, leading to, for example, diseconomies of scale, and margins under pressure. The refining sector saw very strong growth in recent years, partly to higher market prices due to the Ukraine war.

The capital intensification and increase in productivity are closely linked to the contribution to innovation of the 6 sectors. For example, they were responsible for 13% of Dutch patent applications and chemistry, base metal, glass and ceramics, and paper sector for [6%2] of total R&D spending in (2017 - 2022)[3]. An example is Chemistry, where average annual R&D expenditures are
~€576 mln in the same period, representing 5% of total R&D spending in the Netherlands.

1) Change 2017 vs. average 2021-2023; 2) Labor productivity trend is only available on the level of paper, wood and graphics; 2) CBS only reports R&D data for chemical, base metal sectors, construction materials and paper; 3) CBS only reports data on patent applications through 2021

1. ECONOMIC IMPACT

In addition to innovation in proprietary production processes, studies show that there are links between the presence of a number of sectors and innovation goals in the Netherlands, particularly around sustainability

The Netherlands invests in targeted innovation policy to maintain its strong international competitive position and, through Top Sectors, focuses on 5 central missions; a climate resistant, water-robust, sustainable, healthy and safe Netherlands.

In 2022, the Ministry of Economic Affairs, in cooperation with TNO, has formulated a number of specific innovation tasks, including the incorporation of renewable energy into the future energy system. This innovation task recognizes that technological and institutional innovations are needed to fit renewable energy sources into the energy system. This requires, for example, more efficient wind turbines, integration of solar cells in buildings and further developments of electrolyzers.

TNO concludes that the Netherlands is relatively well positioned for this innovation task because it can build on a strong position in industries, knowledge fields and technologies. Among the mentioned for the strong position in industries are refining, chemicals, rubber and plastics and basic metals, which contribute greatly to the opportunities for the Netherlands to fulfill this innovation task.

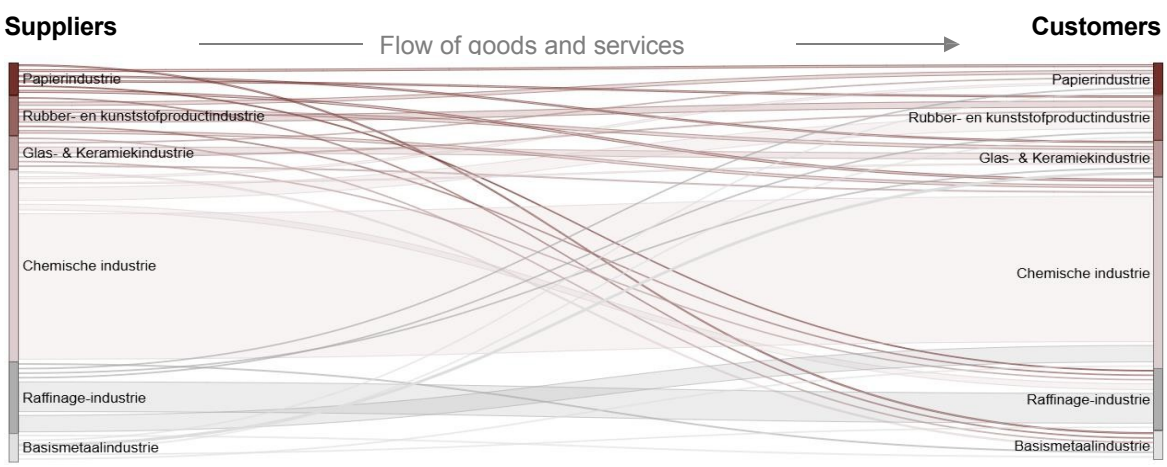
There are also plenty of examples of this. Many of these initiatives consist of collaborations between industry, Dutch universities and other knowledge institutions. For example, Nyrstar is one of the founders of Metalot, where industry, universities and governments work together to research and test metal fuel technology and hydrogen, among other things. Furthermore, Tata Steel is exploring the possibilities for wind turbines that require less steel, allowing them to be produced lighter and cheaper, and chemical and refinery companies are actively involved in research, testing and development of sustainable and synthetic fuels, plastic recycling and electrolysis.

Source: RFO; central government; TNO; Metalot

1. ECONOMIC IMPACT

Within and between the 6 sectors, there is strong chain dependence

Connectedness within the 6 sectors, flow of goods between the 6 , average between 2021 - 2023



Source: CBS

The figure shows the average flow of goods between the 6 sectors from 2021 to 2023 in the Netherlands, and shows strong chain dependencies within and between these sectors. For example, chemical companies purchase €14 bln worth of products from each other (the highest mutual flow of goods of all Dutch sectors) and €29 bln worth of base metal products flow between companies in the base metal industry. The refining sector supplied an average of €1.5 bln to the chemical industry, which in turn supplied €1.4 bln to the rubber and plastics industry. The glass and ceramics, and paper industries also supplied and received from all other sectors. For example, the chemical industry supplied €264 bln to the paper industry and the rubber and plastics industry supplied €244 bln to the glass & ceramics industry. This connection applies both nationally and regionally.

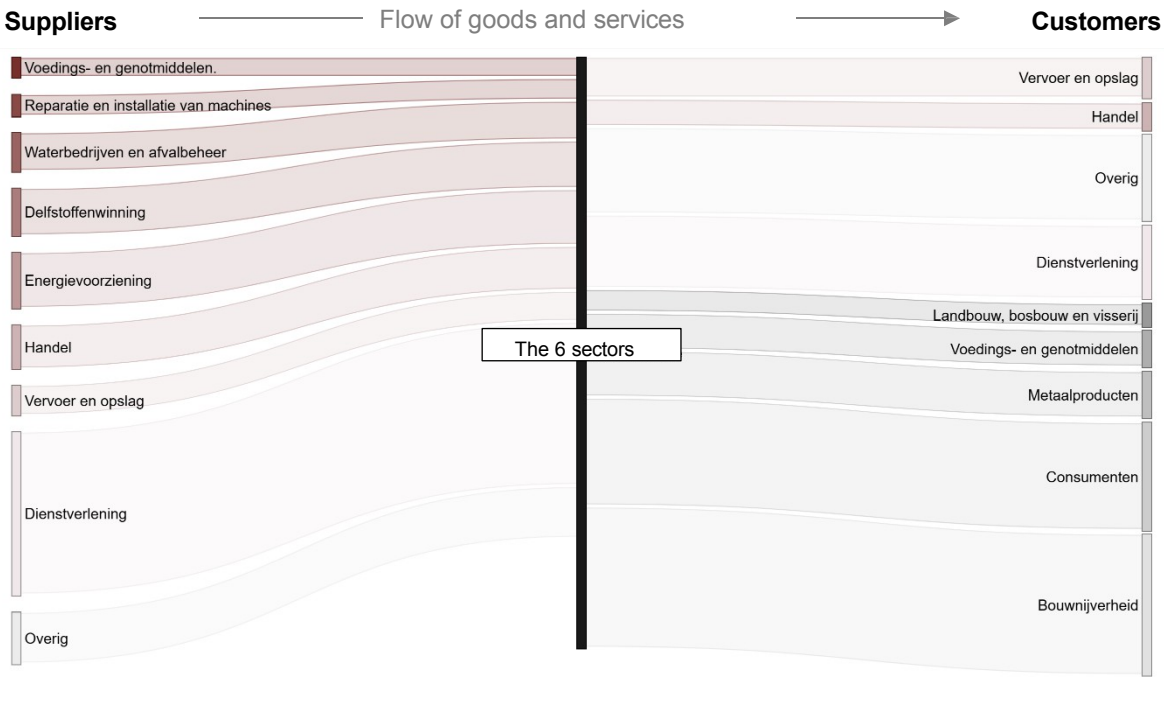
An example of an (inter)national chain is the connection between the refining, chemicals and rubber and plastics industries, with pipeline connections for transporting naphtha, propylene and ethylene between industrial clusters such as Moerdijk, Chemelot, Antwerp and the Ruhr area. Another example of a national chain is the production of galvanized steel: Nyrstar produces zinc ingots in Budel, are melted in Moerdijk by Wupperman and then applied to coils of steel from Tata Steel. SMEs such as MCB, then cut and slit these coils into sheet material, after which the product finds its way into numerous applications. Regional examples include the Chlor-Alkali cluster in Moerdijk and the Chemelot chemical cluster in Geleen, where production processes of different companies are strongly interconnected.

These chains and collaborations lead to economies of scale, synergy and knowledge, which contribute to the competitiveness of these companies.

1. ECONOMIC IMPACT

In addition, the 6 sectors are strongly linked to other industries

Connectivity of the 6 sectors with other industries and sectors, flow of goods between the 6 sectors and the other industries in the Netherlands, average 2021 - [20231]



Source: CBS

The 6 sectors are closely related to other industries and sectors in the Netherlands. They purchase goods and services from other sectors and their products form the basis for other industries. In particular, the 6 sectors purchase products from services (€8.3 bln), energy supply (€2.7 bln), mineral extraction (€2.3 bln), trade (€2.1 bln), water companies & waste management (€1.8 bln) and transport & storage (€1.4 bln).

Services one of the largest suppliers to all 6 sectors, e.g., staffing, employment and consulting firms and banks. The sectors together take €2.7 billion from the energy sector. Mineral extraction supplies raw materials, particularly for refining and chemicals. In addition, for metal production, both supplies by trade and water companies & waste management are important. Transportation & storage services are particularly important to the refining sector for the transportation and storage of gasoline, kerosene, naphtha and chemical products, among others. In addition, the food and beverage industry supplies ~€0.8 bln to the chemical and paper industries, among others. For example, Cosun supplies sugar beet pulp to Crown van Gelder for paper production and Avebe supplies special potato starch to the chemical and paper industries.

1) The 6 sectors themselves and imports and exports are excluded because the focus is on dependencies with other sectors within the Netherlands. The size of the bars indicates the relative size of the flows;
Source: CBS, interviews with ~20 companies from the 6 sectors

1. ECONOMIC IMPACT

Continued

The products produced by the 6 sectors are in turn used by other sectors in the Netherlands. The construction industry is the largest consumer with €7.1 bln, followed by consumers (€5.4 bln),. services (€3.6 bln), metal products (€2.2 bln), transport & storage (€1.9 bln) and the food industry (€1.7 bln).

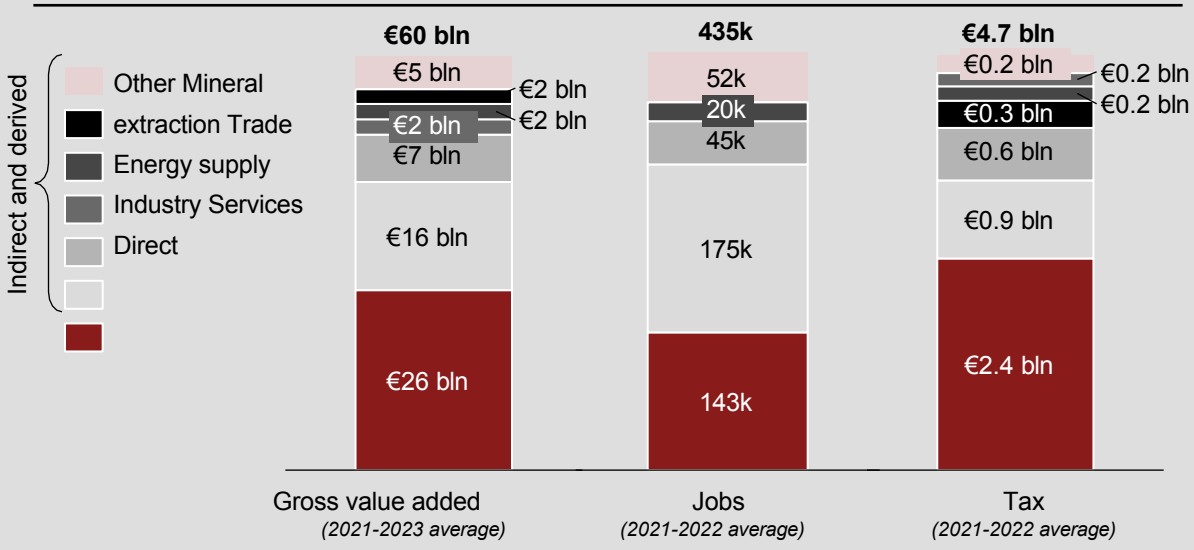
The construction industry buys products from the glass and ceramics industry, such as bricks and insulation materials, but also e.g. window frames from the rubber and plastics sector, construction materials from the base metal sector and additives for concrete from the chemical industry. Consumers mainly purchase products such as gasoline from the refining sector (€3.9 bln). The base metal sector supplies €1.9 bln to the metal products sector, where steel and aluminum are processed into tools and auto and machine parts, among other things. Paper, rubber, Glass and Ceramics (especially glass) and chemicals supply packaging and additives for taste and shelf life to the food industry. In addition, the Dutch chemical sector produces fertilizers and pesticides which find their way into agriculture.

Source: CBS, interviews with 20 companies from the 6 sectors

1. ECONOMIC IMPACT

Through this connectedness, every euro of direct contribution generates 1.3 euros of additional value, 2 additional jobs are created for every direct job, and 1.0 euros of additional tax is contributed for every euro of direct contribution

Direct, indirect and derived value of the 6 sectors in VAT, jobs and corporate and other business taxes



Source: CBS

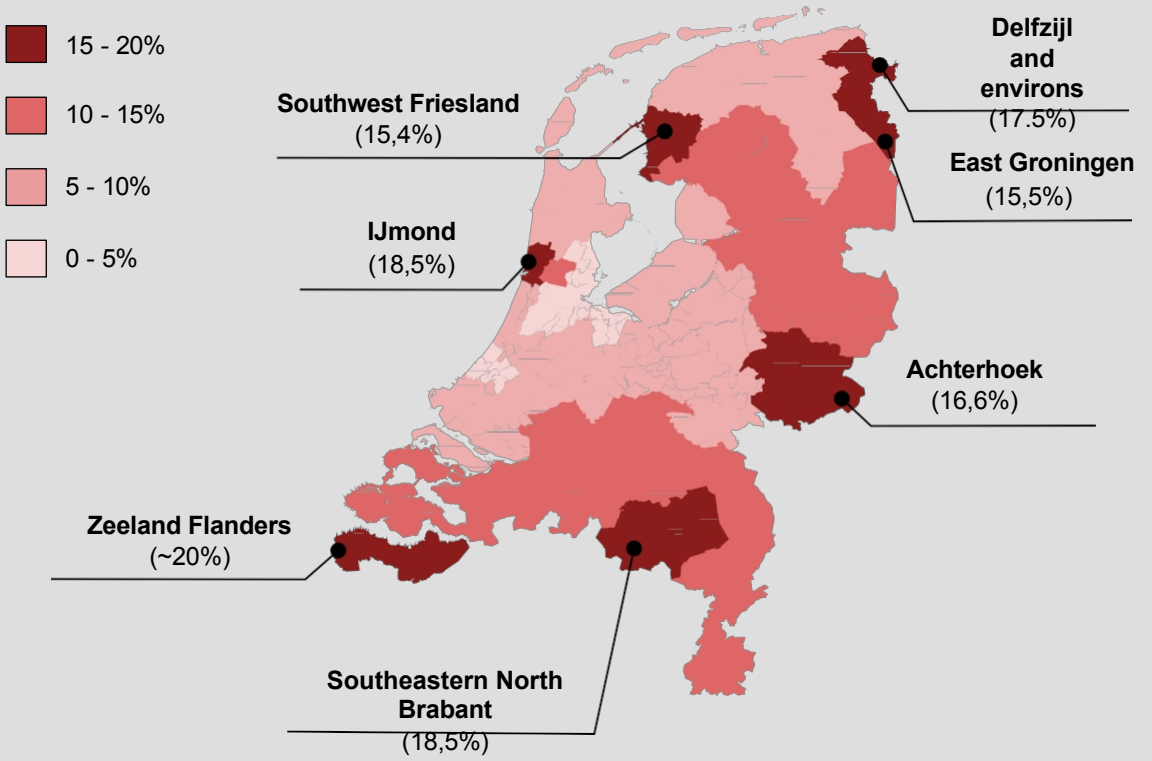
Due to the interconnectedness of the 6 sectors with other sectors in the Netherlands, each euro of direct contribution of the 6 sectors indirectly and inferredly generates 1.30 euros of additional gross value added (VAT), 3 jobs and 2.00 euros of additional taxes. These effects come partly because the 6 sectors purchase goods and services from other sectors in the Netherlands and partly because the employees of these 6 sectors spend their income on Dutch products.

Indirect value is particularly realized in the part of the Dutch economy where the 6 sectors purchase the most goods and services. Thus, the activities of the 6 sectors lead to €16 bln in added value, 175k jobs and €0.9 bln in corporate and other business taxes at the services sector. In addition to the service sector, the 6 sectors lead to indirect value in particular industry, energy supply, trade and mineral extraction.

1. ECONOMIC IMPACT

The economic effects of the industry are generated from regions spread throughout the Netherlands

Percentage of residents employed in industry, by COROP area, 2023



Note: COROP level data is only available at industry level and not at industry sector level, so data does not allow to the figure for the 6 sectors; Source: approximation based on CBS data

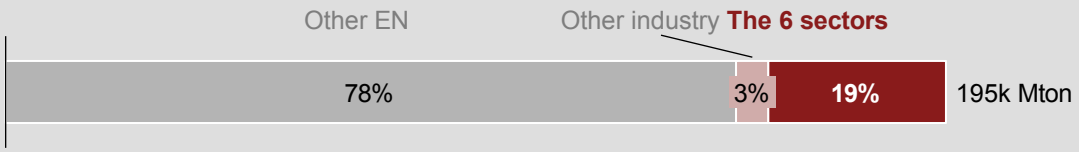
CBS divides the Netherlands into COROP areas, which together form a cluster of one or more adjacent municipalities in the same province. At the COROP level, it can be seen that industry, and thus its economic effects, are distributed throughout the Netherlands.

There are several COROP areas where more than 15% of the inhabitants work in , such as Southwest Friesland, IJmond, Zeeuws Vlaanderen, Southeast North Brabant, Delfzijl and its surroundings, East Groningen and the Achterhoek. There are also a large number of COROP areas where between 10 and 15% of the inhabitants work in industry, and these too are spread over a large part of the .

2. ENVIRONMENT

Industry was responsible for an average of 22% of NL CO_2-eq. emissions. The 6 sectors were responsible for 19% and achieved ~40% CO_2-eq. emission reductions compared to 1990

CO_2-eq. emissions, in Mton and % of total, average of 2021 - [20231]



Evolution of CO_2-eq. emissions from 6 sectors, in Mton

Source: CBS

Between 2021 and 2023, an average of 195k megatons of CO_2 equivalent was emitted annually in the Netherlands. Total industry was collectively responsible for 22% of the Dutch total. The 6 sectors were responsible for 19% of total Dutch CO_2-eq. emissions. Some emission reports use a broader definition of industry, where waste incineration, minerals and construction are also part of the industry sector. For consistency reasons, we use the same industry definition here as in the economic chapter.

The Netherlands has a target for industry to reduce CO_2-eq. emissions by 66% in 2030 compared to 1990. This should bring total industry to about 29.6 Mton CO_2-eq. emissions in 2030. For the 6 sectors, this would mean a target of ~27 Mton $CO_{(2)\text{-eq}}$. In 2023, emissions from the 6 sectors were ~34 Mton CO_2-eq, a reduction of ~40% (22 Mton) compared to 1990. Over the same period, production increased. When (highover) adjusted for sector-level production levels, CO_2-eq. emission reductions since 1990 are ~61%.

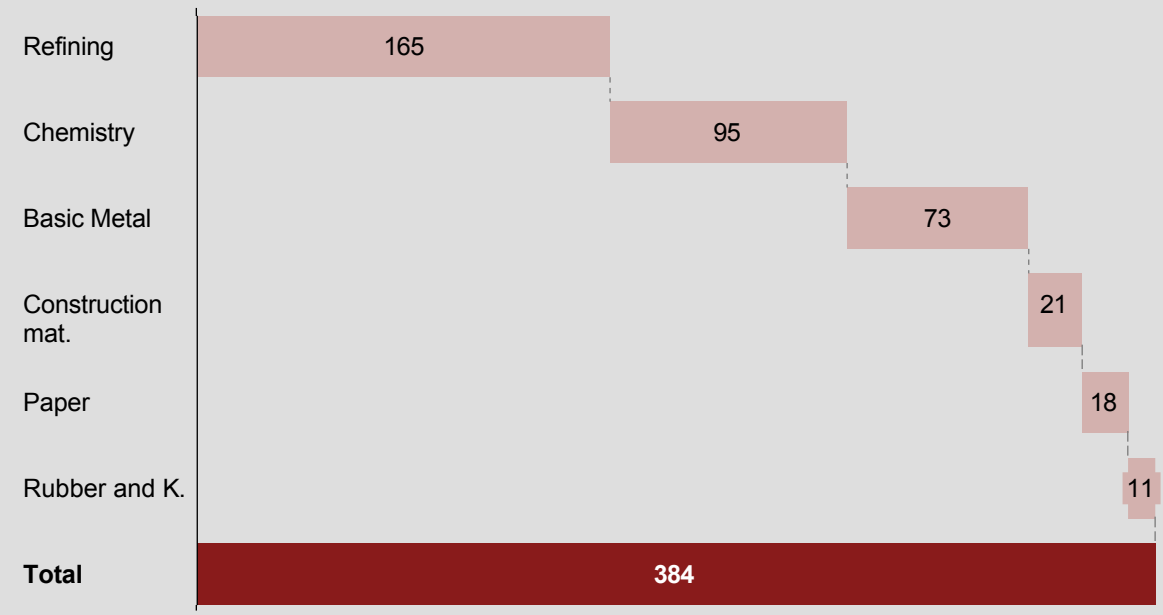
Major efforts that have led to CO_2-eq. emission reductions within the 6 sectors are reductions of nitrous and F-gases. In addition, process efficiency improvements and electrification (e.g., electric furnaces, industrial heat pumps) have led to a 26% reduction in CO_2 emissions.

1) Total Dutch emissions are the emissions of all persons and companies in the Netherlands, both products as households. Emissions from 6 sectors do not include emissions from Tata Steel which are given to Vattenfall imputed (see sector depth); Source: CBS; CLO

2. ENVIRONMENT

The 6 sectors paid an EU ETS contribution of ~€384 mln per year over the past 2 years (18% of NL total) on their CO_2-eq. emissions

Average annual ETS contribution, in€ mln, averaged over 2021 and [20221]



Source: RVO, PBL

With the introduction of the EU ETS system, industrial companies have been paying a price over CO_2-eq. emissions above an exempted limit since 2005. ETS allowances can be bought through auctions or from other companies that emit less than their exempted limit. The ETS proceeds acquired through auctions must be used to stimulate investments in renewable energy, energy efficiency improvements and low-carbon technologies that contribute to reducing CO_2 emissions and thus the EU ETS costs. The total ETS contribution for all Dutch companies between 2021 and 2022, was about €2.2 bln per year, of which ~€1.1 bln went to the Dutch government via auctions. The 6 sectors contributed an average of €384 bln annually between 2021 and 2022, 18% of the total.

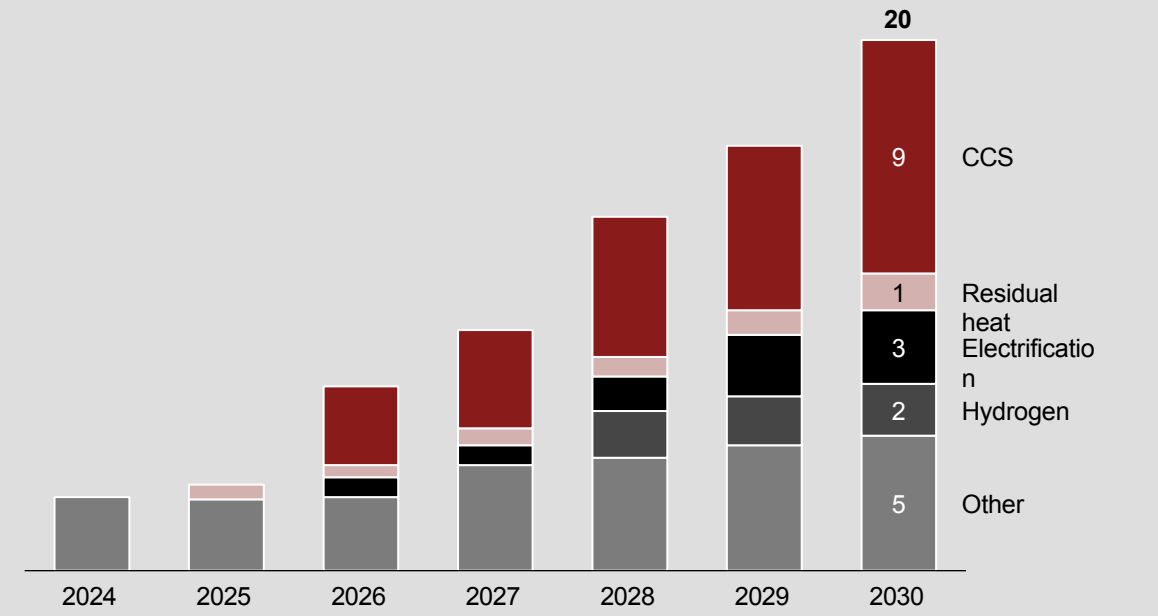
Between 2024 and 2030, the total number of available allowances entering the market will be reduced by ~4.3% annually. In addition, the allocation of free allowances will decrease by 50% towards 2030, and from 2034 free allowances are completely phased out for products covered by CBAM. At constant CO2-eq. emissions, ETS costs for sectors covered by CBAM are expected to increase in the coming years.

1) ETS allowances are allocated based on historical production, 2023 is not included due to significant production declines in 2023 that will most likely be corrected retrospectively
Source: Netherlands Emissions Authority; RVO; CBS; Rabobank; EC

2. ENVIRONMENT

The climate sector industry has plans for ~20 Mton CO2 reduction towards 2030. For most processes of the 6 sectors decarbonization techniques are available

CO_2 reduction plans by technique, in Mton



Source: RVO, PBL

RFO conducted an inventory of the CO_2(emissions) reduction plans of 54 companies within the climate sector industry in 2024, including the bottlenecks they face in realizing their plans. The climate sector industry is broader than the CBS industry sector used in the rest of this and also includes waste incineration, minerals and construction. The 54 companies spoken to include the 15 largest emitters (which are in the picture for customization at KGG), 10 WWTPs and 29 other ETS companies. These companies are collectively responsible for 79% of total industrial CO_2 emissions. RVO's 2024 inventory shows that the 54 companies interviewed have investment plans for ~20 Mton CO_2 emission reductions per year by 2030.

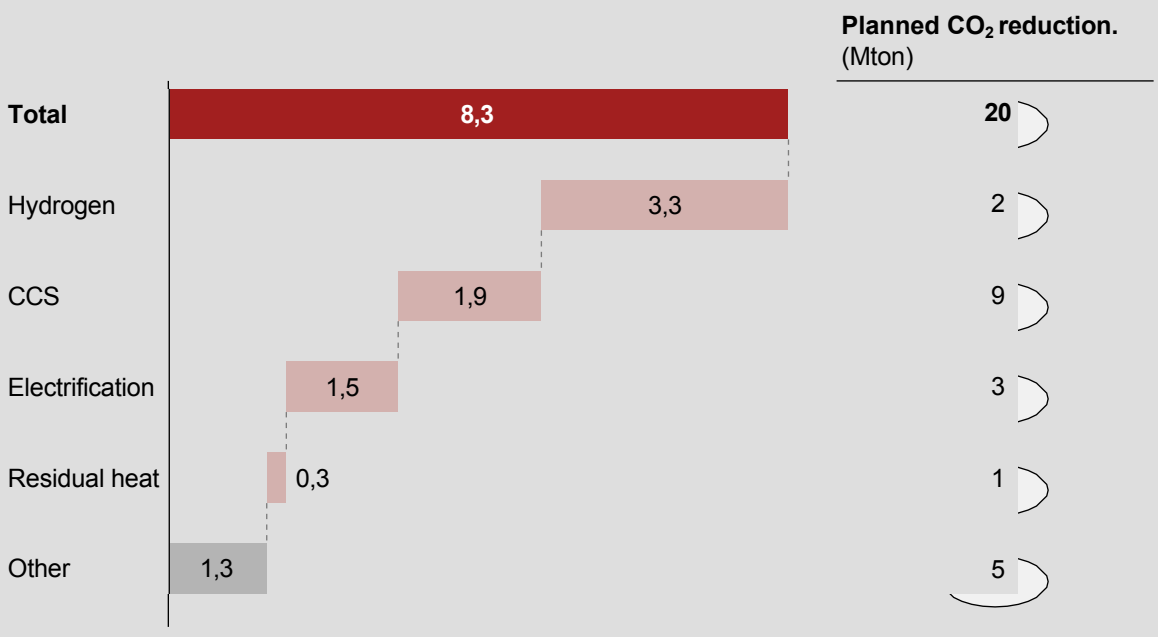
The companies interviewed are mostly companies from one of the 6 sectors. Other studies and the interviews with the various companies also confirm that concrete options are available for the 6 sectors to reduce CO_2 on a large scale. Electrification, CCS and hydrogen are the main routes here. For example, steel production can be greened using DRI technology in combination with hydrogen, with gas acting as an intermediate step, and electric arc furnaces.

Source: Netherlands Emissions Authority; RVO; CBS

2. ENVIRONMENT

Required investments for climate sector industry CO_2 reduction plans are estimated at at least €8.3 billion; across 100 projects, in 2025 or 2026 investment decision made

Required investment for 20 Mton emissions reduction in 2030, by technology and in€ bln



Note: Other consists of 1.5 Mton from closures of production facilities. Assumed to be mainly plans for solar energy and biomass combustion and gasification. Plans for 4.5 Mton have already been realized or are currently underway.
Source: RVO, PBL

Using key figures from PBL, an estimate was made of the investment amounts needed, for the planned decarbonization initiatives of the climate sector industry inventoried by RVO. According to the RVO, the plans will lead to 20 Mton of CO_2 reduction, of which 1.5 Mton comes from closures of production facilities.

The estimate shows that positive investment decisions could lead to investments in the Netherlands of at least ~€8.3 bln. This is most likely an underestimate, given that necessary adjustments for e.g. the incorporation of green hydrogen in production processes (e.g. Tata Steel's DRI) are not yet included. In addition, required investments in, for example, energy infrastructure are also not included in this amount.

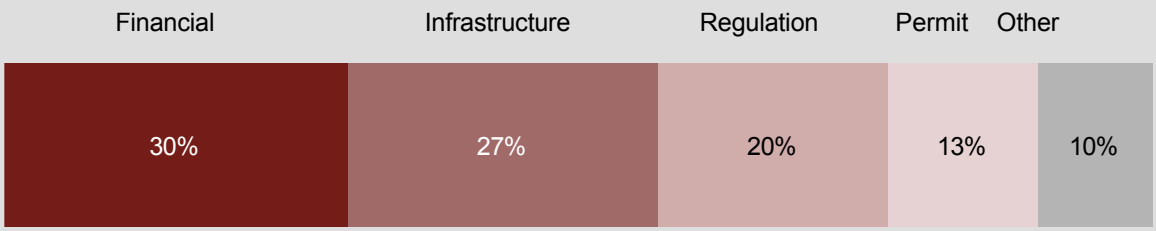
The RFO inventory also shows that investment decisions for 100 projects must take place in 2025 or 2026 and that there is limited room for further delay, due to the realization period of 3 to 4 years on average.

Source: RFO; PBL

2. ENVIRONMENT

The inventoried CO_2 reduction plans are not sufficient to meet the industrial climate target and plans are hampered by 4 bottlenecks

Perceived barriers, in % weighted by Mton CO_2 reduction



Source: RFO

RVO's inventory shows that with the known projects, the climate sector industry in 2030 will emit at least 1 Mton above the climate target industry 2030. These results are also in line with the most recent conclusions of the Climate and Energy Outlook 2024. In fact, the most recent KEV 2024 expects that based on the adopted and planned policy measures, greenhouse gas emissions in the climate sector industry are expected to decrease to 33.3-42.5 Mton CO2 eq. in 2030 (3.7-12.9 Mton above the climate target industry 2030).

It also appears that a number of obstacles stand in the way of a positive investment decision for the known plans. The biggest obstacle mentioned is financial; 74% of the projects have a financial bottleneck. In addition, for many projects, infrastructure, regulations and permits are bottlenecks.

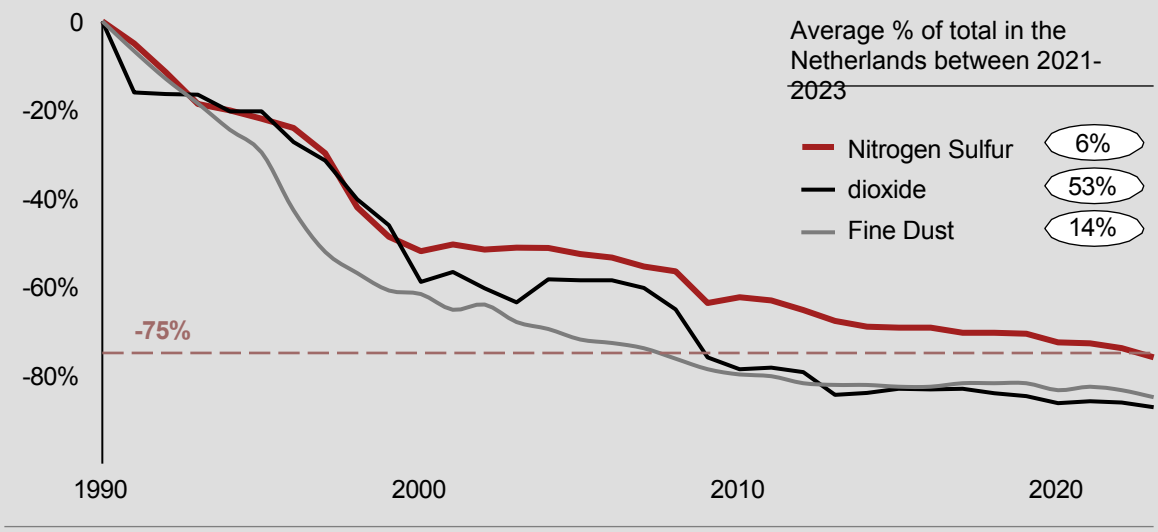
This is also evident from our interviews with ~20 parties from the 6 sectors. For example, people indicate that there is currently not enough stimulation of demand for green products and that the costs can only be partially passed on (unprofitable top), making the business case difficult complete. In addition, many companies indicate that congestion and the postponement of the Delta Rhine Corridor has led to the postponement of sustainability plans. Slow, complex and changing permitting processes are also often mentioned as bottlenecks. Finally, companies indicate that the proposed plastic tax leads to additional uncertainty.

Source: RFO, KEV

2. ENVIRONMENT

In addition to CO_2, the 6 sectors emitted nitrogen, sulfur dioxide and particulate matter, which reduced by >75% between 1990 and 2023. ZZS emissions from 6 sectors decreased for 15 substances and increased for 5 substances

Evolution of emissions of nitrogen, sulfur dioxide and particulate matter, normalized to 1990



Source: CBS

On average between 2021 and 2023, industry was responsible for 55% of total sulfur dioxide emissions. The 6 sectors were responsible for 53% and reduced this by 87% compared to 1990. As a result, the EU limit value for sulfur dioxide has not been exceeded anywhere in the Netherlands since 1998. If CO_2-emission reduction plans are realized, much of the remaining sulfur dioxide emissions will be eliminated. In addition, industry is responsible for ~22% of Dutch particulate matter emissions and ~8% of nitrogen emissions between 2021 and 2023. The 6 sectors were responsible for 14% and 6%, respectively.

There are several companies within the 6 sectors responsible for emissions of Substances of Very High Concern (PHS), such as PAHs, PFAS and heavy metals. Companies are licensed by the government for the amount of substances they are allowed to emit, including ZZS. For ZZS emissions, since Jan. 1, 2016, there is an obligation to prevent them as much as possible and, if that is not possible, to reduce them. Companies with an environmentally harmful activity must submit emission data of ZZS to the competent authority at least once every 5 years.

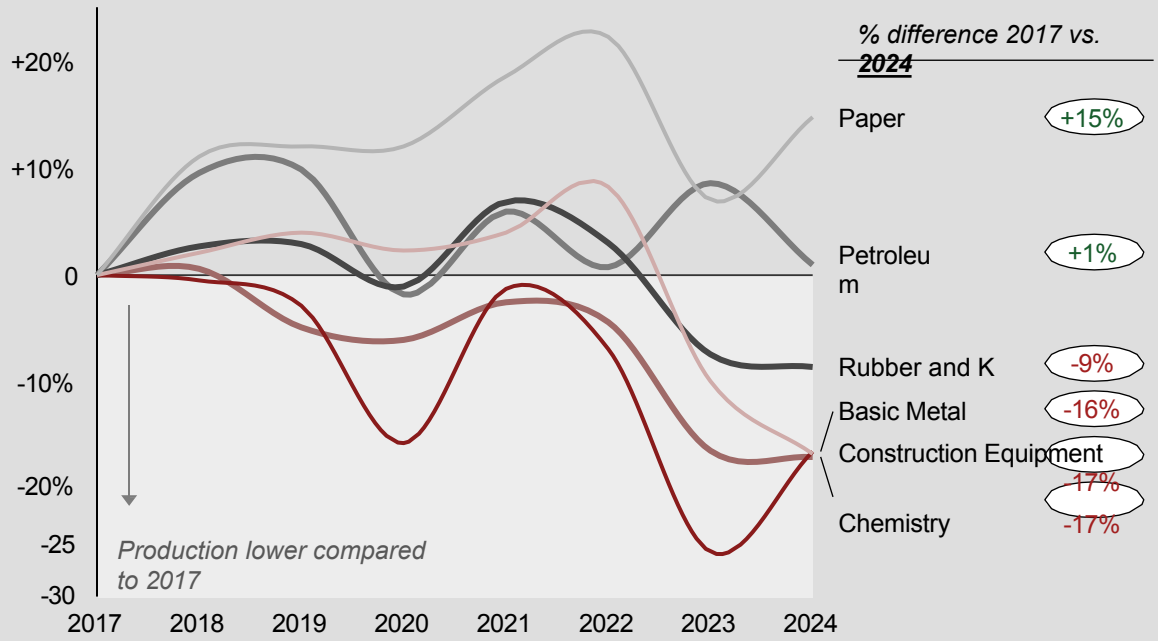
In the central government emission inventory, data on the amount of ZZS emissions to air is currently available for 91 ZZS substances. The central government's emission registration shows that of the 91 ZZS substances, industry will emit 24 different ZZS to air in 2023 and the 6 sectors
20. Between 2015 and 2023, ZZS emissions from the 6 sectors decreased for 15 ZZS and increased for 5 ZZS.

Source: Electronic Environmental Annual Report; RIVM; central government

3. STRATEGIC RELEVANCE

Production levels have declined at 4 of 6 sectors in recent years

Change in production by sector, in % compared to 2017



Source: CBS

For the base metal, glass & ceramics, chemicals and rubber & plastics sectors, a decline in production of 10% to 20% is visible. Factors explaining this decline include rising production costs due to high grid costs, European and Dutch CO_2 prices, global overcapacity and weakened demand for finished products. Specifically for base metal, in addition to the factors mentioned above, the large-scale maintenance of one of Tata Steel's blast furnaces plays a role. The decline in production can be seen from recent examples in the Netherlands; for example, Sabic closed its naphtha cracker in Geleen in May 2024, Dow announced in January 2025 that it was (temporarily) shutting down one of its crackers and postponing major maintenance, and Aldel went bankrupt in 2022. Production within refining and paper sector remained relatively stable.

Compared to the production developments, CBS data on investments of the 6 sectors show a relatively stable picture until 2023. Interviews show that the investments of the interviewed companies are mainly focused on maintenance and investments related to sustainability and growth are increasingly postponed.

3. STRATEGIC RELEVANCE

At the same time, import dependence has been steadily increasing since 2017 for all 6 sectors, in the Netherlands the increase is often stronger

Share of product demand filled through imports by sector, 2017 vs. 2022[1,2]

	EU27			EN		
	2017	2022	Δ	2017	2022	Δ
Refining	17%	18%	+22%%	15%	23%	+81%%
Chemistry	19%	20%	+2%	21%	22%	+13%
Rubber and Plastic	12%	13%	+1%	25%	26%	+15%
Basic Metal	16%	17%	+1%	23%	28%	+58%
Glass and Ceramics	8%	9%	+21%	18%	16%	-23%
Paper	8%	9%	+12%	26%	29%	+34%

Dependence gets higher *Dependency gets lower*

Source: Eurostat, CBS

Within the context of European and Dutch competitiveness being under pressure and increasing geopolitical tensions, the import dependencies for products from the 6 sectors were examined. Import dependencies are defined as the part of the EU or NL demand that is met by imports.

Based on Eurostat data, it becomes clear that the average EU import dependence for products made in the 6 sectors increased by 1-2 percentage points between 2017 and 2022. In addition, Eurostat data shows a decrease in the trade balance for each sector (with the exception of paper and chemicals). The trade balance of base metal increased by
€12.8 bln (-140% vs. 2017 trade balance) fell the most, changing from a trade surplus to a -deficit. In addition, the trade balance of glass and ceramics (-€5.4 bln, -50% vs. the trade balance), refining[3] (-€3.0 bln, -30% vs. 2017) and rubber and plastics (-
€1.8 bln, -28% compared to 2017) decreased. This decline occurred particularly between 2021 and 2022. The total EU trade balance decreased by ~€280 bln between 2021 and 2022; a decrease of 64% in 2022 compared to the trade balance in 2021.

For the Netherlands, import dependence has also increased, especially for products from refining, base metals and paper sector.

1) EU data available through 2022; 2) The percentage change in the share of EU product demand filled by imports is 2% in refining, chemicals and paper due to rounding differences; 3) In 2022,
trade balance increased positively after 4 years of contraction. This may have been driven by price effects due to the conflict in Ukraine.

3. STRATEGIC RELEVANCE

Gloomy expectations around competitiveness and future investment may signal that from 2022 the trend of increasing import dependence will continue and possibly accelerate

	Competitive position outside EU	Competitive position within EU	Expected investments next year
Refining	*Equally negative*	*Equally negative*	*Shrinkage instead of growth*
Chemistry	*Less positive*	*Less positive*	*Shrinkage instead of growth*
Rubber and Plastic	*More negative*	*Less positive*	*Shrinkage instead of growth*
Basic Metal	*Similar outcomes based on recent RAND study*		
Glass and Ceramics	*Equally negative*	*Less positive*	*Shrinkage instead of growth*
Paper	*More negative*	*More negative*	*Shrinkage instead of growth*

Balance weighted average is positive

Balance weighted average is negative

Source: CBS

The Eurostat data does not make it possible to evaluate import dependence beyond 2022, while interviews suggest that the competitive position is rapidly deteriorating and that this also has its impact on import dependence. This is difficult to objectify at the sector level, but several business cycle indicators from CBS' periodic COEN survey[1] confirm the 6 sectors' deteriorating sentiment about international competitiveness and expected investments in the next year.

Confidence in the Netherlands' competitive position outside the EU has decreased in almost all cases compared to 2022, and in some cases (rubber and plastics and paper), more negative than before. The competitive position within the EU shows a versed picture, where with the exception of refining, all sectors show a more negative picture than before. In addition, all entrepreneurs indicate that expected investments will decrease next year compared to the current year, entrepreneurs were also negative about this earlier, although to a lesser extent.

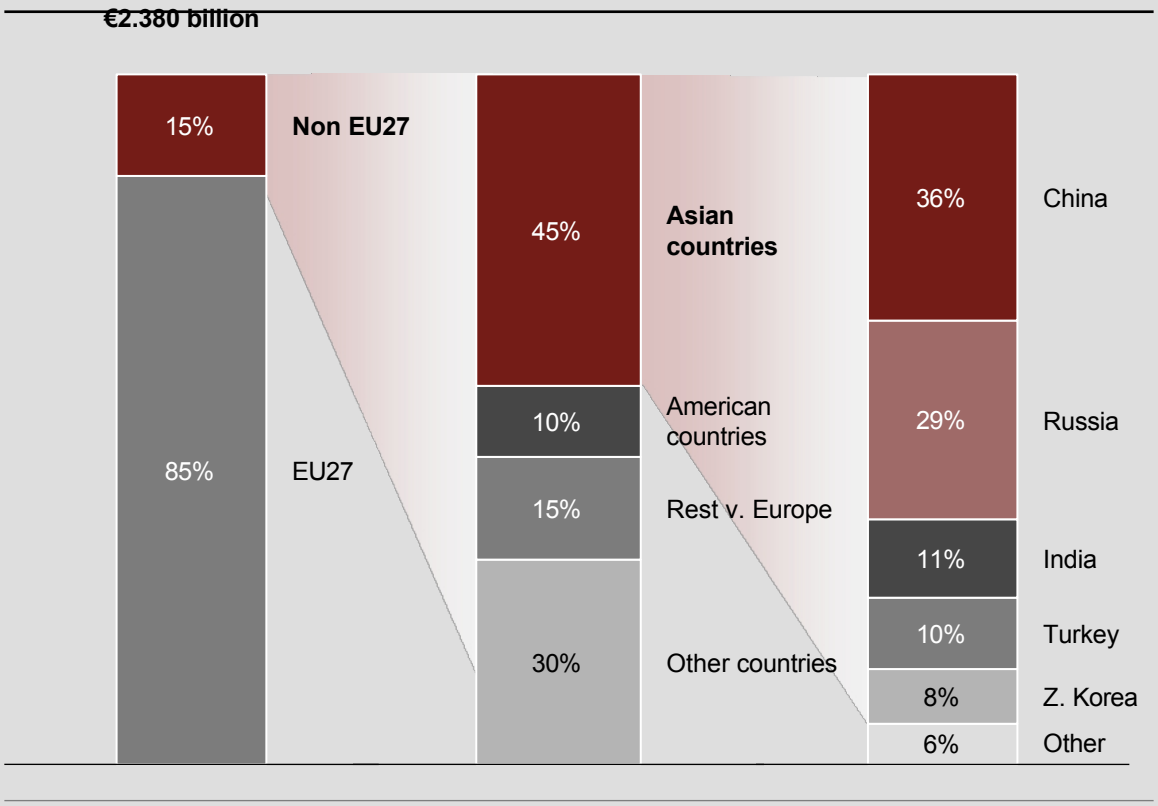
No CBS data is available for base metal. However, interviews with people employed in the sector and the recent RAND report "Forging the " also reveal a negative picture about the competitive position within and outside the EU. A survey by RAND shows that of 22 Dutch base metal companies interviewed, 45% are concerned about global competition until 2035, particularly because of major cost disadvantages.

1) The COEN survey periodically captures the mood of business owners about developments in the past time and expectations for the coming period.
Source: CBS; RAND (2025): '*Forging the* '

3. STRATEGIC RELEVANCE

In 2022, 15% of finished products were imported from 6 sectors, 45% of which came from a number of Asian countries

EU27 imports of goods of the 6 sectors, in 2022 by region or country of origin[1]



Source: Eurostat

In 2022, total EU demand for finished products from the 6 sectors was €2,380 billion. 85% of this demand was met through local production and the remaining 15% was imported from non-EU countries. Imports accounted for 45% from Asia, 15% from the Rest of Europe, 10% from the Americas and 30% from other countries. The Asian countries from which most imports originated were China (36%) and Russia (29%).

If import dependence increases further in the coming years, it is likely that these imports will come from similar countries. This is especially true for China, as there is (structural) overcapacity. Imports from Russia are actually expected to have decreased since 2022, due to EU efforts to reduce dependence on Russian products.

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the . Source: Eurostat Input-output data (2022, actual prices)

3. STRATEGIC RELEVANCE

Empirical analysis shows that Dutch chemical and base metal sectors currently export 35 products to other European countries, which can be labeled as critical products according to the EC's methodology

In the context of current geopolitical risks, the European Commission monitors strategic dependencies. The European Commission's most recent monitor was in March 2023, and based on this analysis, 564 critical products were identified where the EU is highly dependent on a limited number of non-EU countries. Of these, 204 products were important for sensitive ecosystems, being security, health and the green and digital transition.

For this report, we replicated this analysis[1]. For each critical product we then determined the extent to which the Dutch 6 sectors currently export these critical products to other EU countries. If, due to current competitive disadvantages, Dutch production of these critical products were to disappear, this could potentially mean a greater dependence of the EU on non-EU countries.[2]

The empirical analysis shows that the list of critical products betenfa 87 chemical or base metal products. Of these 87 products, there are 30 chemical and 5 base metal products for which the Netherlands supplied more than 2% of total EU imports of this product in 2022.

The results were validated with several base metal and chemical companies, but given the short timelines of this project, it was not possible to fully validate the list. Nevertheless, a number of products were directly recognized by the companies we consulted during the study. An example is Dead Burned Magnesia which is produced by Nedmag in Veendam and is crucial for the production of, for example, refractory bricks needed for production of green cement and steel.

In addition, there are plans among several base metal companies to start producing critical products in the Netherlands. For example, Nedmag is in talks with a company that wants to produce magnesium metal based on Nedmag's magnesium chloride. Currently, the EU is ~97% dependent on China for this product. Also, Nyrstar plans to extract germanium from the zinc concentrates it currently purchases for zinc mining. Germanium is on the European Commission's critical raw materials list due to its high dependence on China and the importance of germanium for energy transition, security and high-tech applications. For example, germanium is used for semiconductors, infrared optical instruments and army night vision goggles. To this end, Nyrstar has submitted a proposal to the European Commission for funding of a demonstration plant.

In conclusion, based on an empirical analysis, in line with the methodology of the European Commission, it appears that there are 35 chemical and base metal products produced and exported in the Netherlands that can be considered critical according to the EU methodology. An initial qualitative interpretation of these results confirms that some of these products actually produced in the Netherlands. However, further depth on these products is needed to validate the full list. In addition, this follow-up study should take into account specialty products, for which the current HS6 product codes are currently too broadly defined (e.g. specialty steel from Tata Steel used for batteries).

1) The filtering from critical products to products for sensitive ecosystems was not done because the methodology for this was not described in the European Commission studies; 2) In doing so, we also stretched the criterion around extra-EU imports to take into account products that are not now, but could potentially become so with the removal of
Dutch exports. This did not lead to an expansion of the product list. Source: European Commission (2023), "*An enhanced 'methodology to monitor the EU's strategic dependencies and vulnerabilities';* Nedmag; interviews with companies from the 6 sectors

3. STRATEGIC RELEVANCE

Examples show that the 6 sectors can be relevant to broader strategic Dutch interests, such as defense and circularity

Within the short time available for this research, we were not able to conduct a full analysis of the relevance of the 6 sectors in relation to the public and strategic interests by the Dutch government. However, some examples show that the 6 sectors can contribute to safeguarding the Dutch strategic interests.

For example, activities of the refining and chemical industries are designated as vital processes by the Ministry of Justice and Security, NCTV Department. Vital processes are defined as a process or service in which disruption, failure or manipulation can have consequences so severe that they can damage national security. For example, by causing significant economic damage, long-term environmental consequences or seriously affecting other vital processes.

In addition, a number of Dutch refineries are currently connected to the CEPS system; a pipeline system whose main purpose is to supply military bases with fuel. Due to security reasons, the relative importance of Dutch refineries in ensuring security of supply for Dutch and NATO purposes is not known. Nonetheless, the Dutch refining sector appears to contribute to the security of supply of fuels in crisis situations. Further (internal) research could provide more certainty on the relative importance of the Dutch refineries.

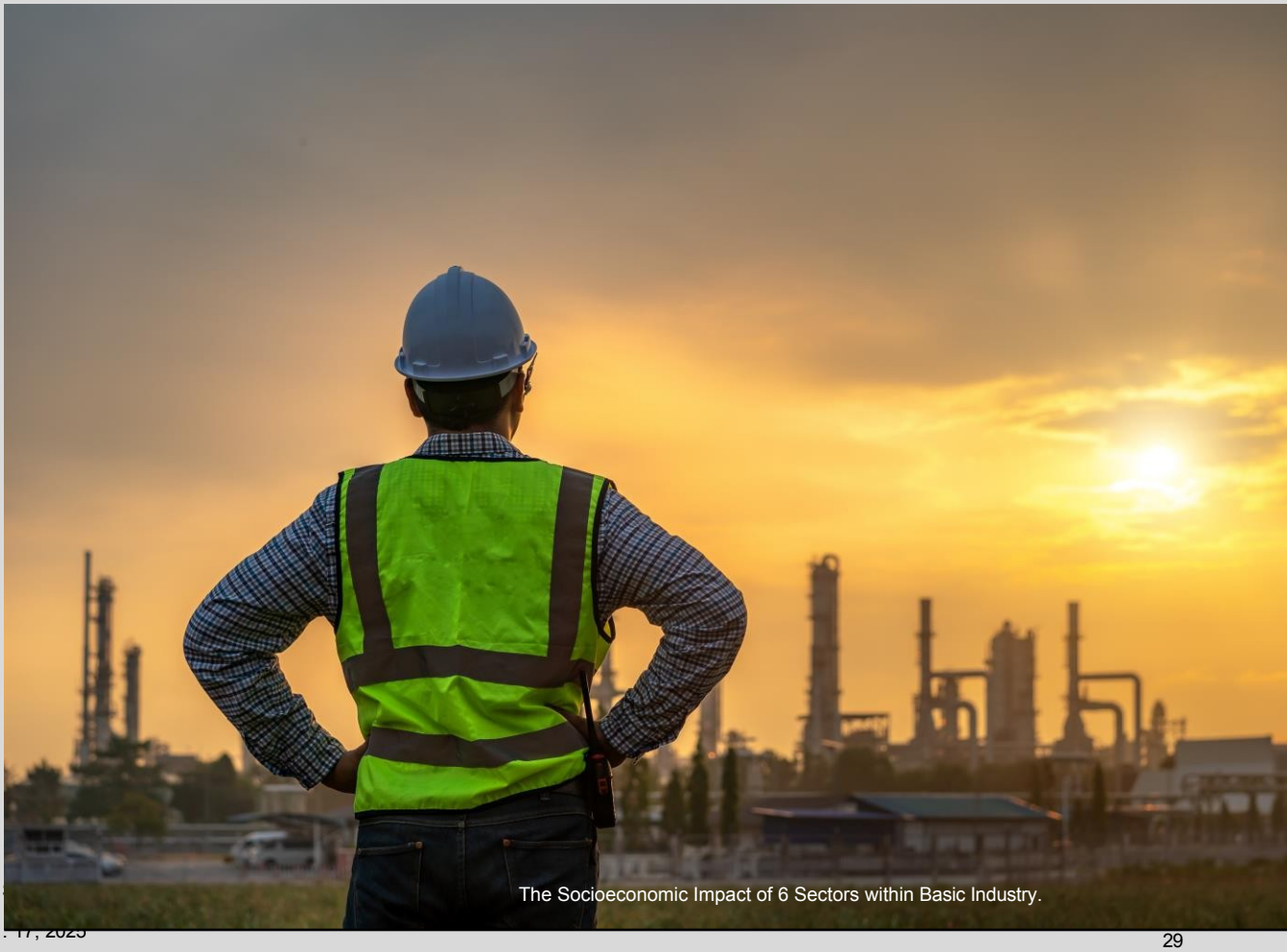
Finally, the Netherlands has a goal of having a circular economy by 2050, with a guiding goal of using 50% less abiotic raw materials (minerals, metals and fossil) by 2030. The paper, glass and ceramics and base metals sectors already play a role within the circularity chain today. For example, the Dutch paper industry already uses 89% recycled paper for packaging, Dutch packaging glass consists more than 65% recycled glass (cullet) and the recycling rate of Dutch steel is ~17%. The chemicals and rubber and plastics sectors can also contribute to the circularity goals in the future. Within the National Program, plastics have been identified as one of the priority products, for which specific policies are being developed. The chemical industry has the infrastructure and technologies that can facilitate mechanical and chemical recycling. Thereby, the 6 sectors seem to be able to contribute to the Dutch circularity goals. This study did not examine the extent to which local production is a precondition for our circularity goals.

Source: Defense; NATO, VNG, Tata Steel, NCTV; Paper Recycling Netherlands

Sector-specific analyses

1. Refining
2. Chemistry
3. Rubber and Plastic
4. Basic Metal
5. Glass and Ceramics
6. Paper

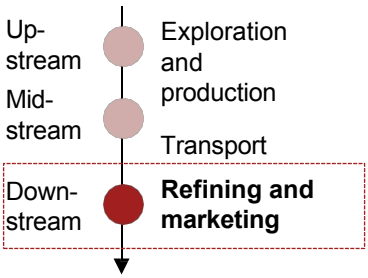
Sector-specific analyses
1. Refining



The Socioeconomic Impact of 6 Sectors within Basic Industry.

1. Refining

1.1 Introduction



Input for transportation and chemical sector, among others

Figure 1.1. Refinery value chain.

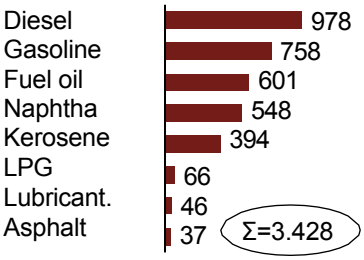


Figure 1.2. Production volume/product (2023) in PJ, in NL

6 refineries in the Netherlands

~5,000 people employed in the refining industry

Figure 1.3. Average employment 2021 - 2023

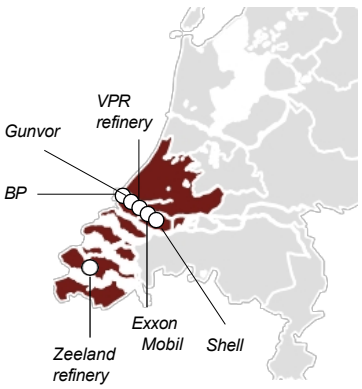


Figure 1.4. Geographic location of refineries.

The refining industry processes crude oil into fuels and chemical feedstocks

The refining industry includes the exploration, extraction, distribution and refining of crude oil. Within the value chain, oil exploration and extraction is referred to as "upstream," transportation to refineries as "midstream," and refining into high-value products such as fuels as "downstream. The Dutch refining sector is mainly active in downstream activities.

Between 2021-2023, the Netherlands produced on average ~€44 bln worth of refined products annually, of which 79% (€35 bln) was exported

During the same period, imports amounted to ~€15 bln.[1] This brings the NL trade balance for refinery products to +€20 bln.

In the refining sector, markets capture each other's shortages and surpluses, e.g., the EU exports fuels to the US when there are shortages there.

The sector consists of 6 refineries in the Netherlands and employs ~5,000 people

There are 6 refineries operating in the Netherlands, with a total of about 5,000 people are employed. Most of these refineries are large companies with an average of 800 employees. One refinery, Vitol's VPR Refinery, is smaller and belongs to the SME sector, with about 50 employees[2].

Most refineries are in Rotterdam (South Holland) and Zeeland Refinery is in Vlissingen. These locations offer advantages due to their proximity to a port and connection to Schiphol Airport, military airports, Belgium and Germany through an extensive pipeline network and rivers.

1) Adjusted for re-exports; 2) Firms with fewer than 250 employees are classified as SMEs, according to CBS standards; Source: CBS; IEA; Argus

1. Refining

1.1 Introduction

Figure 1.5. End products

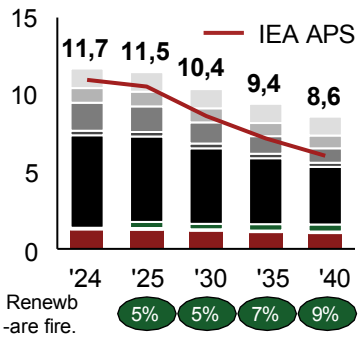


Figure 1.6. Future EU demand refinery products (mb/d)

Product	Growth p.y.
LPG	-0,2%
Naphtha	-0,8%
Gasoline	-3,6%
Kerosene	+1,7%
Diesel	-2,5%
Renew.	+1%
Fuel Oil	-1,8%
Other	-1,2%

Figure 1.7. Growth per year to 2040 of various products

Feb. 17, 2025
Strategy&

Source: CBS; IEA; Argus

Refined products are essential for transportation and consumer products

In the Netherlands, the refining sector focuses mainly on refining crude oil into products for transport, industry and the chemical sector. For road transport and (civil and military) aviation, fuels such as diesel, gasoline and kerosene are produced, which have a large share in daily use.

In addition to fuels, refined products play a crucial role in the chemical industry. In this industry, refined products, particularly naphtha, are used as base materials for consumer products such as plastics, medicines, paints, fertilizers and synthetic packaging. In addition, many products find their application in sectors such as construction and infrastructure, for example through bitumen (asphalt).

Fossil refinery products expected to remain needed until (after) 2040

Electrification of transportation and sustainability of the chemical sector will reduce demand for fossil refinery products by ~2% per year between 2024 and 2040. The lower demand will be particularly noticeable in gasoline and diesel, with annual declines of -3.6% and -2.5%, respectively, between 2024 and 2040. Nevertheless, despite all the measures announced, the IEA expects that ~8.6 mb/d of refinery products will still be needed in 2040.

Demand for renewable fuels will increase toward 2040, due to European regulations

Fuels made from renewable resources are expected to occupy a larger share of the energy mix. Between 2024 and 2040, the demand for biofuels will increase ~1% annually, increasing its share in the total fuel mix from 5% in 2025 to 9% in 2040.

1. Refining

1.1 Introduction

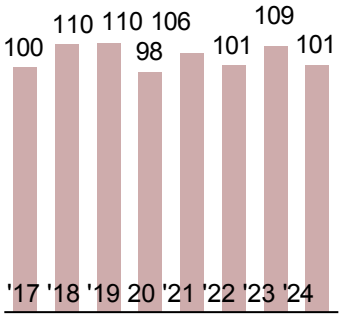


Figure 1.8. Historical production, normalized to 2017

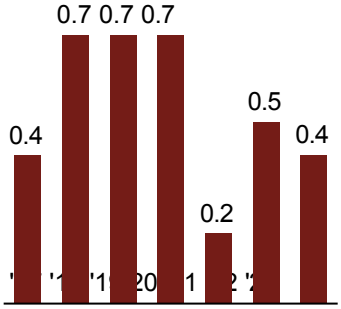


Figure 1.9. Historical investments (€ billion)[1]

Historical production was relatively stable, one refinery closed in December 2024

Refining production fluctuates from year to year but has remained relatively stable over a longer period (2017 to 2024). Refineries, unlike many other energy-intensive industries, are relatively less affected by rising gas and electricity prices because the energy for production is extracted mainly from crude oil. As a result, the share of gas and electricity costs in total energy costs is lower for the current production processes. For sustainable production techniques, such as electrification and green hydrogen, this does not apply. Production at the Gunvor refinery ceased in December 2024.

Investments focus primarily on maintenance and preservation

Refinery investments were lower between 2021 and 2023 than between 2018 and 2020. In recent years, most investments focused on the maintenance of existing infrastructure and some sustainability initiatives, such as Porthos and the Holland Hydrogen 1, for example. Refineries say they are postponing further investments in sustainability due to the uncertain business climate and high costs for sustainability projects.

1) Investment amount for 2019 is divided between 2018 and 2019, since amount for 2018 is not available
Source: CBS; IEA; Energeia

1. Refining

1.2 Economic impact

€ 3.5 billion
Gross value added *(2021-2023 average)*

5k
Jobs *(average 2021-2022)*[2]

€ 638 million
Corporate and other business taxes *(average 2021-2022)*[1, 2]

Direct value added by the refining sector averaged ~€3.5 billion per year between 2021 and 2023

The Dutch refining sector contributed on average ~€3.5 billion to Dutch GDP between 2021 and 2023 (0.4% of total) and there are ~5k people employed (0.1% of total).
The refining sector paid an average of ~€638 million in corporate and other business taxes between 2021 and 2022[1, 2].

Figure 1.10. Key economic impact figures.

Total gross value added including the direct, indirect and derived impact of the refining sector averages ~€6.8 billion between 2021 and 2023

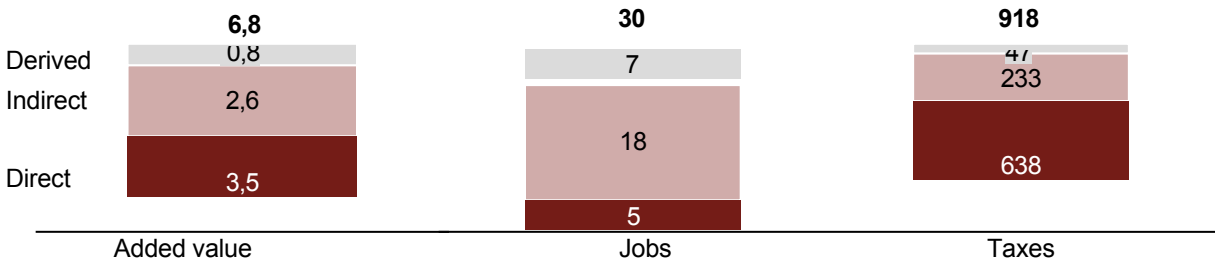


Figure 1.11. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

In addition to the direct economic impact, the refining sector also has indirect economic impact for the Netherlands as the sector purchases ~13% of its inputs within the Netherlands. As a result, the refining sector indirectly leads to ~€2.6 bln in added value, ~18k jobs and €233 mln in taxes.

Finally, the refining sector leads to derived economic impacts as workers within the Netherlands spend some of their income on Dutch producers. The derived impacts of the refining sector amount to ~€0.8 bln in value added, ~7k jobs and ~€47 mln in taxes.

As a result, the total value added is ~€6.8 bln, the sector leads to ~30k jobs and ~€918 mln in tax revenue[1]. This means that every euro of direct contribution generates €1 of additional value added, for every direct job ~4.9 additional jobs are created and for every euro of direct tax €0.4 additional tax is paid.

1) Other business taxes include emissions taxes, sewer fees and water pollution charges;
2) Taxes and jobs are shown for 2021-2022 because CBS data on corporate taxes and employment for 2023 is missing; 3) Multipliers for gross added, jobs and taxes are in line with the 2022 Oxford Economics study on Shell, where the derived multipliers were 1.8, 6.4 and 1.4 are; Source: CBS Input-output data (2021-2023, actual prices)

1. Refining

1.2 Economic impact

Labor productivity in the refining sector is above the NL average and increased by ~17% between 2017 and 2023

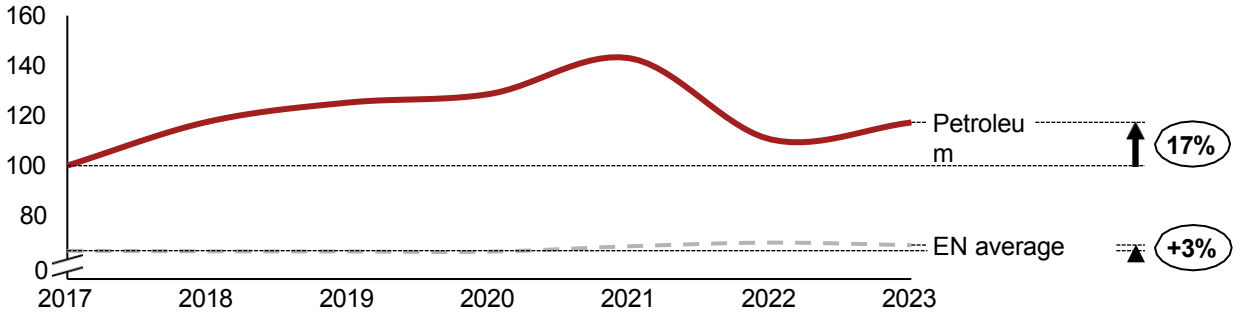


Figure 1.12. Labor productivity in NL refining sector and NL total commercial sector (2017-2023, € per hour worked)[1]

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and corporate profits, and also creates more room for higher wages. Labor productivity within the refining sector averaged ~€121 per hour worked between 2017 and 2023. This is ~75% higher than the Dutch average of ~€69 per hour worked[1].

In addition, between 2017 and 2021, labor productivity within the sector increased by ~41%. In 2022, there was a decline in labor productivity, most likely driven by lower production and increasing pressure on margins from this year (see section 1.1). Total labor productivity increased by ~17% between 2017 and 2023.

EPA patent applications fluctuated between 0 and 2% of the NL total between 2017 and 2021

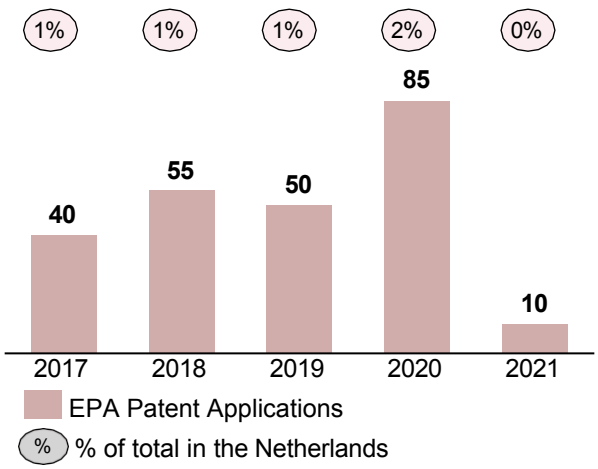


Figure 1.13. Number of EPO patent applications for NL refining sector2

Between 2017 and 2021 there were by the refining sector 10-85 patents applied for at the EPO[2].

Annual patent applications from the refining sector fluctuated between ~0-2% of total patent applications in the Netherlands.

In addition, the sector cooperates intensively with (technical) universities, especially in the field of sustainable techniques.

1) Measured as gross value added per number of employees based on 2021 base prices; 2) Data on patent applications in 2022 and R&D spending for entire period not available; Source: CBS, NOS

1. Refining

1.2 Economic impact

The NL refining industry has a strong local footprint, supplying 49% of NL and 13% and 11% of DE and BE refining needs in 2022, respectively

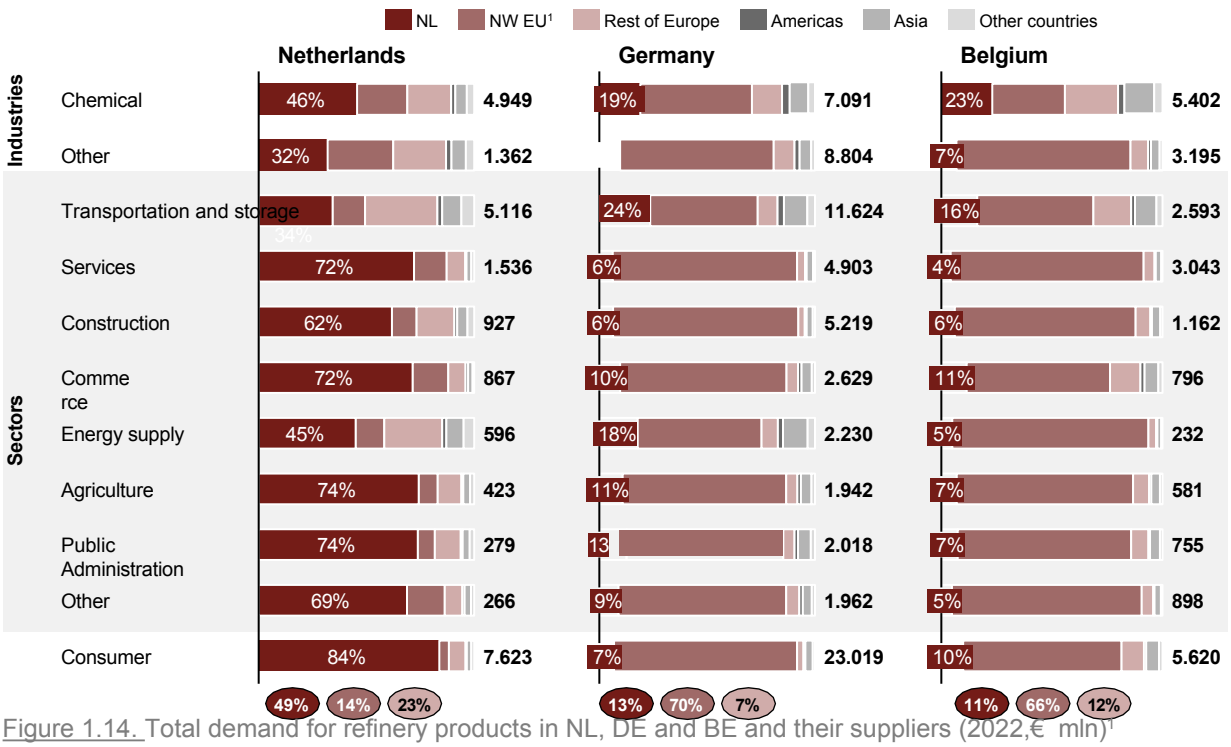


Figure 1.14. Total demand for refinery products in NL, DE and BE and their suppliers (2022,€ mln)[1]

The industry has a strong local footprint and is responsible for supplying 49% of total Dutch demand for refinery products. It also supplies 13% of total German demand and 11% of total Belgian demand.

Demand for refined products is strongest from the chemical (€4.9 bln) and transport and storage (€5.1 bln) sectors, as well as from consumers (€7.6 bln). The demand from the chemical sector is mainly driven for the demand for naphtha, ethylene and propylene and the demand from transport and storage and consumers by the demand for fuels, such as gasoline, diesel and kerosene.

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Demand from own sector is not shown in graph; Source: Eurostat Input-output data (2022, actual prices)

1. Refining

1.3 Environment

The refining sector was responsible 5% of total NL CO_2-eq. emissions and 29% of total NL sulfur dioxide emissions between 2021-2023

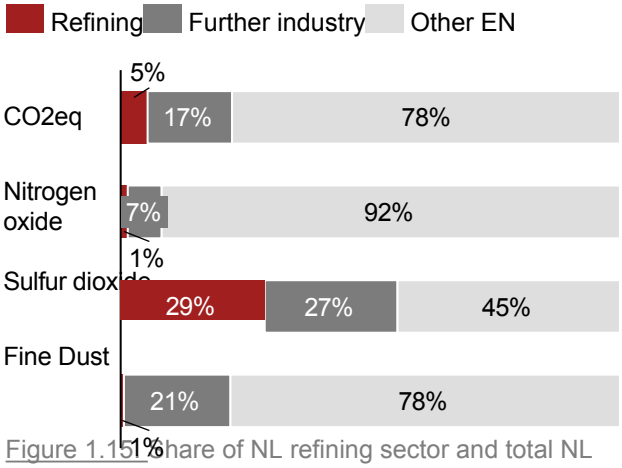


Figure 1.15. Share of NL refining sector and total NL industry in NL emissions (2021-2023, %)

Refining is an inherently energy-intensive process. The sector emitted an average of ~10.5 Mton CO_2-eq. between 2021 and 2023. This made the sector responsible for 24% of the total CO_2-eq. emissions of the Dutch industry and 5% of the Netherlands.

In addition, the sector is responsible for 29% of NL emissions of sulphur dioxide. Total NL sulphur dioxide emissions are so low that the EU limit value for sulphur dioxide has not been exceeded anywhere in the Netherlands since 1998.

CO_2-eq. emissions decreased ~7% from 1990 and once Porthos becomes operational, emissions decrease further

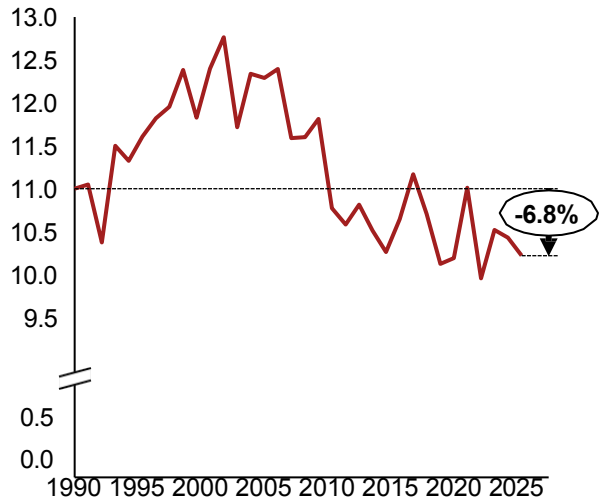


Figure 1.16. CO_2-eq emissions from NL refining sector (Mton).

CO_2-eq. emissions between 1990 and 2023 by ~7% decreased. When adjusted for production growth, CO_2-eq. emissions decreased by ~17% between 1990 and [20231]. This CO_2-eq. emission reduction was achieved through investments in process efficiency, among other things.

In addition, 2 parties from the refining and 2 parties from the chemical sector have signed contracts with Porthos (NL first large-scale CCS project), leading to a total CO_2-reduction of up to 2.5 Mton/year from 2026. It is unknown how the total capacity of 2.5 Mton/year is distributed among the 4 parties.

1) CO2-eq. emissions adjusted for sector production changes, calculated by actual CO2-eq. emissions for production index of relevant year.
Source: CBS, Netherlands Emissions Authority

1. Refining

1.3 Environment

ETS contribution averaged ~€165 mln between 2021 and 2022

All emissions from the sector are covered by ETS. The refining sector's ETS contribution was ~€133 mln in 2021 and ~€198 mln in 2022. Average over 2021 and 2022 was ~€165 mln, which is 7.6% of the total Dutch ETS costs over that period[1].

The refining sector can become more sustainable through carbon capture and/or hydrogen

For sustainable production of refined products, both techniques can be used to green energy use and reduce emissions from production processes. The main ways for the refining sector are the use of green hydrogen as an energy source and/or the capture of CO_2 through Carbon Capture and Storage (CCS) techniques (by directly capturing emissions or by converting residual gases to blue hydrogen). In addition, there is potential for electrification of, for example, turbines and compressors or through e-boilers.

Number of preconditions are necessary before large-scale sustainability of the sector can take place

Main barriers that currently impede large-scale sustainability are 1) an unprofitable top combined with an international playing field that limits the possibility of passing on the high costs and limited government support, 2) a lack of long-term future perspective in the Netherlands[1], 3) a lack of access to the necessary infrastructure (especially hydrogen and CCS), 4) complex and changing regulations around e.g. (nitrogen) permits.

1) ETS allowances are allocated based on historical production, 2023 is not included due to significant production declines in 2023 that may be corrected retrospectively Source: DNV-GL (2018) 'CO_2 Reduction Roadmap of Dutch Refineries'; CBS, Dutch Emissions Authority; Interviews with industry companies

1. Refining

1.4 Strategic relevance

Import share in total refined products use increased by 2 p.p. and EU trade balance for refined products decreased annually from '17

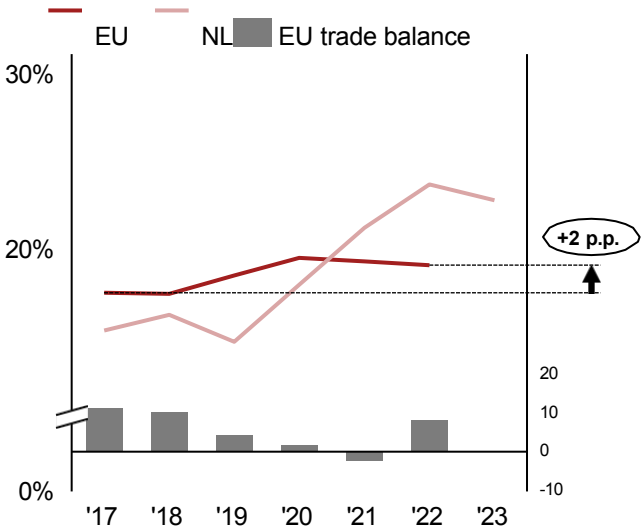


Figure 1.17. Import share in total use for EU and NL (left, %) and EU trade balance for the sector (right, (€ bln))

Between 2017 and 2022, import dependence on the EU increased by 2 percentage points. This increase is mainly visible between 2018 and 2020, after which dependence remains stable at this higher level in 2021 and 2022. For the Netherlands, the import dependence for refinery products increased from 15% to 22% between 2017 and 2023, and is especially visible between 2019 and 2022.

In addition to increasing imports at the EU level, EU exports of refinery products also decreased, to a declining trade balance between 2017-2021. The decline is such that in 2021 the trade balance became negative. In 2022, the trade balance again. This appears to be driven by price effects due to the

Ukraine war.

In 2022, 48% of EU imports came from Asia, 78% of which came from Russia

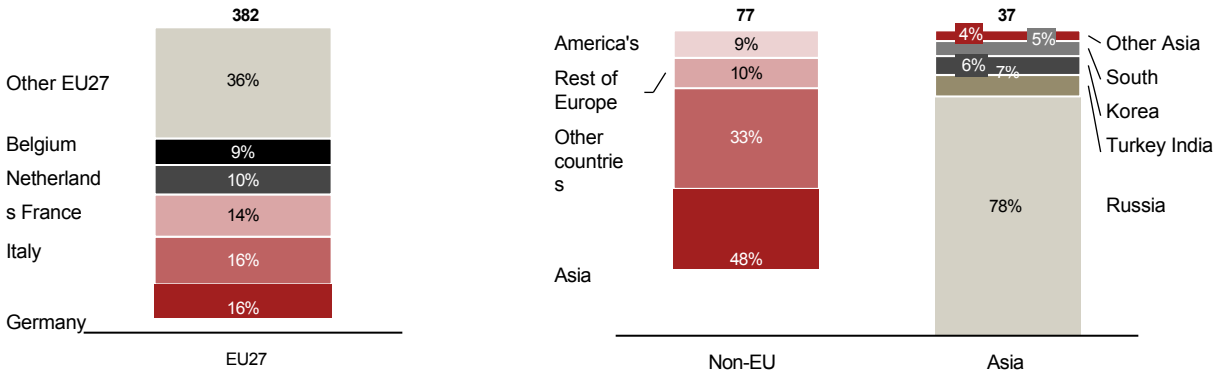


Figure 1.18. Distribution of refinery product suppliers to EU27 by country (2022,€ bln)

48% of imports from non-EU countries came from Asia in 2022. The largest Asian supplier of refinery products to the EU in 2022 was Russia (78%). Since 2022, the EU has been greatly reducing its dependence on Russian energy products.

The largest EU suppliers in 2022 were Germany (16% of the EU market in 2022), Italy (16%), France (14%), the Netherlands (10%) and Belgium (9%).

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the . Source: Eurostat Input-output data (2022, actual prices), CBS, Rabobank, Interviews with companies in the industry

1. Refining

1.4 Strategic relevance

The CBS business cycle indicators signal that the (international) competitive position of the NL refining sector has deteriorated since 2022 which may lead to a (further) increase in the import share

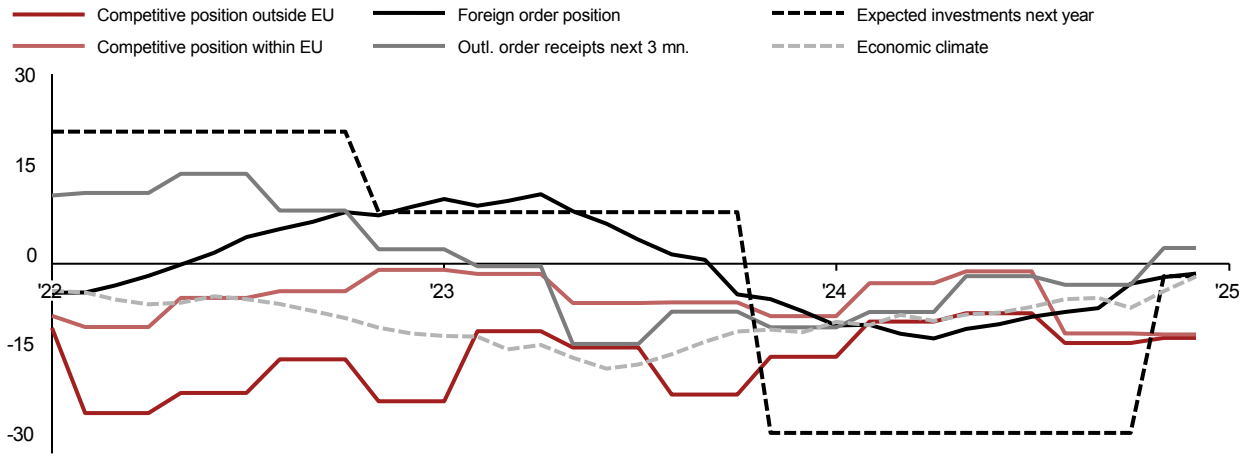


Figure 1.19. Economy indicators for the refining sector (balance weighted percentage, 2022-2025, 12-month trailing moving average)

CBS's periodic COEN survey shows from various business cycle indicators (trend measurement) that the Dutch refining sector's sentiment about its international competitive position deteriorated from 2022 onwards. For example, confidence about the "foreign order position" and about "receipts of foreign orders in the next 3 months" declined from the end of 2023 and is structurally negative, meaning that the majority of entrepreneurs consider their foreign order position too small and expect their order receipts from abroad to decline.

In addition, as of the end of 2023, a majority of business owners indicate that expected investments next year will decrease compared to the current year, whereas before this, business owners were still positive about expected investments in the next year.

Confidence in the competitive position of the Netherlands both inside and outside the EU as well as in the economic climate in NL is structurally negative from 2022, meaning that the majority of entrepreneurs believe that their competitive position inside and outside the EU as well as the economic climate in NL has deteriorated.

The deterioration in sentiment surrounding the international competitiveness of the Dutch refining sector is an indication that the observed trend of a declining trade balance and increasing import dependence is continuing and possibly accelerating.

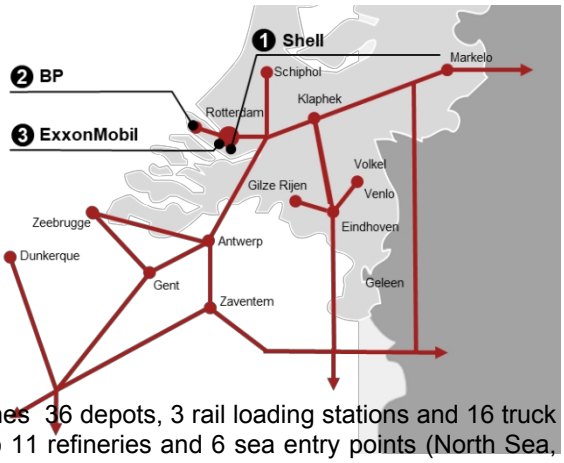
1. Refining

1.4 Strategic relevance

In addition to reducing dependence on other countries, the sector appears to be relevant to broader Dutch public interests, based on examples around defense

Within the short time available for this study, we were not able to conduct a full analysis of the relevance of the 6 sectors in relation to the public interests defined by the Dutch government. However, some examples show that the 6 sectors can contribute to safeguarding the Dutch public interests.

Defense: CEPS pipeline system The Central Europe Pipeline System (CEPS) is a pipeline system managed by (an agency of) NATO. Participating in CEPS are 6 NATO countries participate: Netherlands, Belgium, Luxembourg, France, Germany and the United States. main purpose of CEPS is to supply military bases with fuel (military need has priority), but the network is also used by civilian organizations such as Schiphol Airport.



The total network involves more than 5,000 km of pipelines 36 depots, 3 rail loading stations and 16 truck loading stations. In addition, the system is connected to 11 refineries and 6 sea entry points (North Sea, Atlantic and Mediterranean). The CEPS mainly transports kerosene but can also be used to transport diesel oil, gasoline and naphtha. The Dutch Defense Pipeline Organization (DPO), with its pipeline network, is part of the CEPS and is involved in the transport movements measure group in the event of a crisis. The Dutch part of the CEPS is managed by the Dutch Defense Pipeline Organization (DPO). Three Dutch refineries are connected to the CEPS system.

Due to security reasons, it is not known which other refineries are connected to the network and the relative importance of Dutch refineries in ensuring security of supply for Dutch and NATO purposes. Nonetheless, the Dutch refining sector appears to contribute to the security of supply of fuels in crisis situations. Further (internal) research could provide more certainty on the relative importance of the Dutch refineries.

Source: Defense, NATO, Interviews with industry companies

Sector-specific analyses
2. Chemistry

2. Chemistry

2.1 Introduction

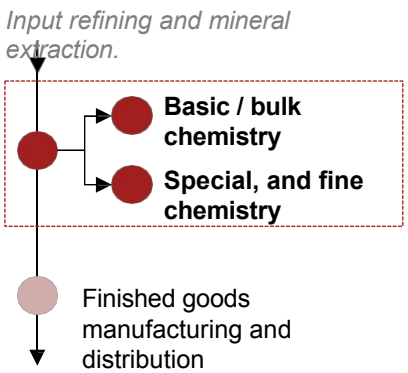


Figure 2.1. Chemistry value chain.

Figure 2.2. Average employment 2021-2023

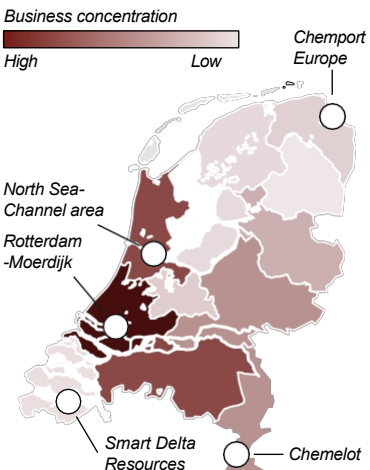


Figure 2.3. Geographic location of chemical companies.

The chemical industry produces basic or bulk, specialty and fine chemicals

The chemistry sector in the Netherlands consists of 3 main activities: basic or bulk chemistry, specialty and fine chemistry.

Base chemistry focuses on the production of high-volume raw materials such as ethylene, propylene and methanol, which are commodities for many other industries, produced in high volumes. For example, ethylene, propylene and methanol are essential in plastics and fuels. Specialty chemicals and fine chemicals products are often of very high purity and have a more direct application as end or intermediate products, such as food additives and photochemicals.

The different types of chemical production lead to an integrated production chain, both within the chemical industry and with other industries, within the Netherlands but with foreign countries.

Between 2021 and 2023, the Dutch chemical industry produced ~€67 billion per year on average, of which 74% (€49 billion) was exported

Over the same period, imports amounted to ~€26 bln per year[1]. This brings the NL trade balance for chemical products to +€23 bln per year.

The Netherlands has ~1,100 chemical companies employing ~45,000 people

The Dutch chemical industry comprises about 1,100 companies, which together employ about 45,000 people. Of these companies, about 960 are considered SME organizations.[2]

Provinces of South Holland, North Holland and North Brabant house a large portion of chemical companies and the Rotterdam-Moerdijk and Noordzeekanaalgebied industrial clusters. The other 3 major chemical clusters, Chemelot, Smart Delta Resources and Chemport Europe, are outside these regions.

1) Adjusted for re-exports; 2) Companies with fewer than 250 employees are classified as SMEs, according to CBS standards; Source: CBS
Source: DNBL; KVK; CBS; Companies on the ; VNCI

2. Chemistry

2.1 Introduction

Figure 2.4.
Applications/industries

Basic chemicals are used in virtually every other basic and manufacturing industry Chemicals are an important building block in most everyday products, such as plastic packaging and electronics. In addition, chemicals are widely used in industry, medical, agriculture, construction and defense.

Within the medical sector, chemicals are used for medication, but also for blood bags, for example. In addition, chemicals in agriculture serve for fertilizers, among other things. The construction industry uses chemicals for cement, bricks and insulation materials. Within the energy sector, chemicals are used for solar panels, wind turbines and essential components of the power grid. Finally, Dutch chemicals are used in the defense industry for the production of, for example, bulletproof vests and components of helicopters and combat vehicles.

European demand for chemical products is expected to increase, especially for sustainable chemical Strong growth is forecast for a number of key products produced by the Dutch chemical industry. For example, ethylene is forecast to grow 3.6% p.y., driven in part by application in packaging, and methanol is expected to grow 4.3%, driven mainly by renewable fuels. Fertilizer demand is expected to decline ~1.5% p.a., partly due to environmental regulations, but will continue to be needed to ensure food supply.

Furthermore, there is expected to be a shift toward sustainable chemicals, which are made from renewable, rather than fossil, raw materials.

	2022 vs. 2032
Ethylene	+3,6%
Methanol	+4,3%
Fertilizer	-1,5%

Figure 2.5. Predicted growth in European demand (% per year).

Source: CBS; Chamber of Commerce; ICIS; CEFIC & Advancy; Fertilizers Europe

2. Chemistry

2.1 Introduction

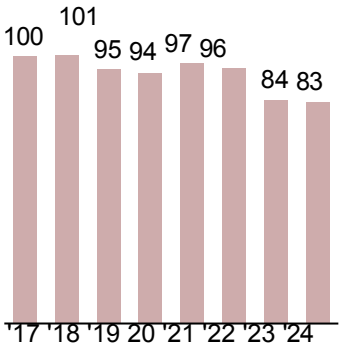


Figure 2.6. Historic NL production normalized to 2017

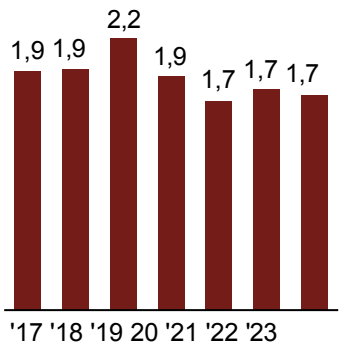


Figure 2.7. Investment in the chemical industry (€ bln).

Production of the Dutch chemicals sector has declined in recent years

The production of the Dutch chemical sector declined by ~17% from 2018 (with the exception of COVID years 2021 and 2022). This production decline is driven by rising production costs due to high energy and CO_2 prices, global overcapacity, and a decline in demand for finished products (such as plastic packaging, furniture, etc.) following the expiration of COVID-19.

In May 2024, Sabic shut down its Geleen naphtha cracker and in January 2025, Dow announced it was (temporarily) shutting down one of its crackers and postponing major maintenance.

Investments in maintenance, capacity expansion and sustainability deferred

Investments by the chemical industry in 2021 to 2023 were lower (~€1.7 bln) than in previous years (~€1.9 - €2.2 bln). Investment in capacity expansion has not been made in recent years, partly because of global overcapacity. Chemical companies indicate that in recent years investments have only been made in specific plants to meet niche demand. Maintenance investments have remained relatively stable, although chemical companies indicate that this too has been increasingly postponed in recent years (e.g. recent Dow announcement).

Large investments in sustainability are increasingly being postponed, partly due to uncertainties about the international playing field and a lack of future prospects in NW Europe (see also section 2.3). Nevertheless, new capacity is sometimes opened on a smaller scale, e.g. BASF opened a new production line in Heerenveen and Avantium opened an FDCA plant (feedstock for plastic PEF) in Delfzijl.

Industry companies indicate that the figures through 2023 may not yet fully reflect the major changes from the Ukraine crisis (2022), as investment decisions (FIDs) are generally 2-4 years ahead of actual spending (capex).

Source: CBS; CEFIC & Advancy; Interviews with chemical companies; Energeia; VNCI; Industrielinqs

2. Chemistry

2.2 Economic impact

€ 11.6 billion
Added value
(2021-2023 average)

45k
Jobs *(average 2021-2022)*[2]

€ 993 million
Corporate and other business taxes *(average 2021-2022)*[1, 2]

Direct value added by the chemical industry averaged ~€11.6 billion between 2021 and 2023

The Dutch chemical industry contributed an average of ~€11.6 billion to Dutch GDP between 2021 and 2023 (1.3% of total) and employs ~45k people (0.5% of total).
The chemical industry paid an average of ~€993 million in taxes between 2021 and 2022.

Figure 2.8. Key figures of economic impact

Total value added including direct, indirect and derived impact of the chemical industry averages ~€29.5 billion between 2021 and 2023

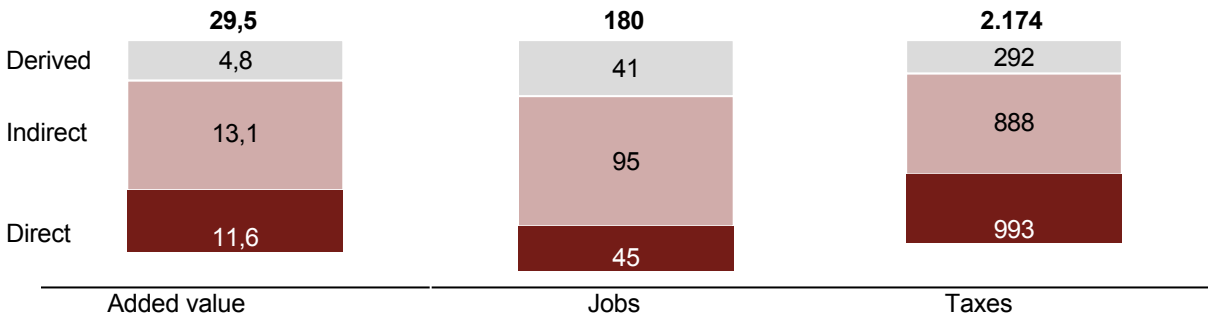


Figure 2.9. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

In addition to the direct economic impact, the chemical industry also leads to indirect economic impact for the Netherlands as the chemical industry purchases ~47% of its inputs within the Netherlands. As a result, the chemical industry indirectly leads to ~€13.1 bln in added value, ~95k jobs and ~€888 mln in taxes.

Finally, the chemical industry leads to derived economic impacts as workers within the Dutch chemical industry spend some of their income on Dutch manufacturers. The derived impacts of the chemical industry amount to ~€4.8 bln in value added, ~41k jobs and ~€292 mln in taxes.

As a result, the total added value of the chemical industry is ~€29.5 bln, the sector leads to ~180k jobs and ~€2,174 mln in tax revenue. This means that every euro of direct contribution generates €1.5 in additional value added, for every direct job 3.1 additional jobs are created and for every euro of direct tax €1.2 additional tax is paid.

1) Other business taxes include emissions taxes, sewer fees and water pollution charges;
2) Taxes and jobs are shown for 2021-2022 because CBS data on corporate taxes and employment are missing for 2023; Source: CBS Input-output data (2021-2023, actual prices)

2. Chemistry

2.2 Economic impact

The NL chemical industry supplies 54% of NL and 13% of Belgian chemical needs; in particular the refining and rubber and plastics industries and consumers depend on the NL chemical sector

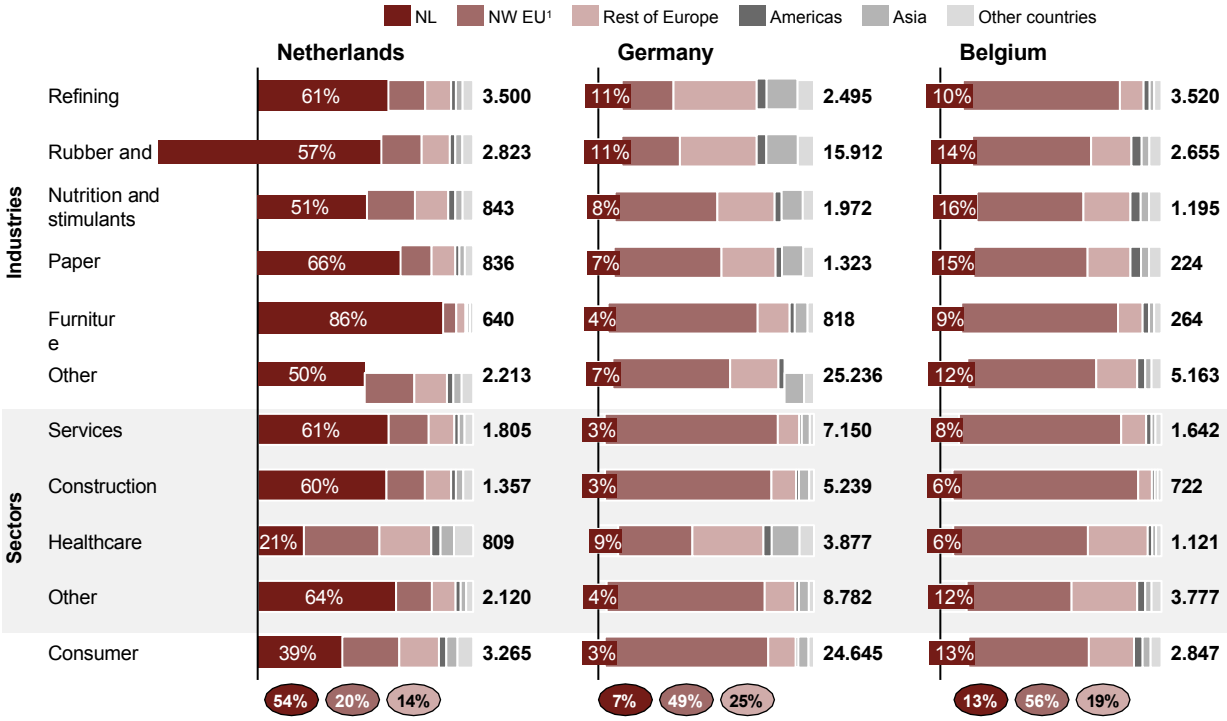


Figure 2.10. Total demand for chemical products in NL, DE and BE and the rest of EU and the providers thereof (2022,€ mln)[1]

The chemical industry has a strong local blueprint and is responsible for supplying 54% of total Dutch demand for chemical products. It also supplies 7% of total German demand and 13% of total Belgian demand.

Demand for chemical products is greatest from the refining (€3.5 bln) and rubber and plastics industries (€2.8 bln). From other sectors, demand is strongest from the service (€1.8 bln) and construction industries (€1.4 bln), as well as from consumers (€3.3 bln).

Demand from the refining sector is mainly driven by catalysts, acids and solvents, which are used to accelerate reactions or extract components. The rubber and plastics industry mainly takes small plastic granules (pellets) from the chemical industry, which are further manufactured into plastics. The construction industry purchases additives for the production of cement, insulation materials and coatings from the chemical industry, among other things. From services and consumers, demand is driven by household chemicals such as bleach, vinegar and soda, among others.

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Demand from own sector is not shown in chart;
Source: Eurostat Input-output data (2022, actual prices); PCC, Reagent

2. Chemistry

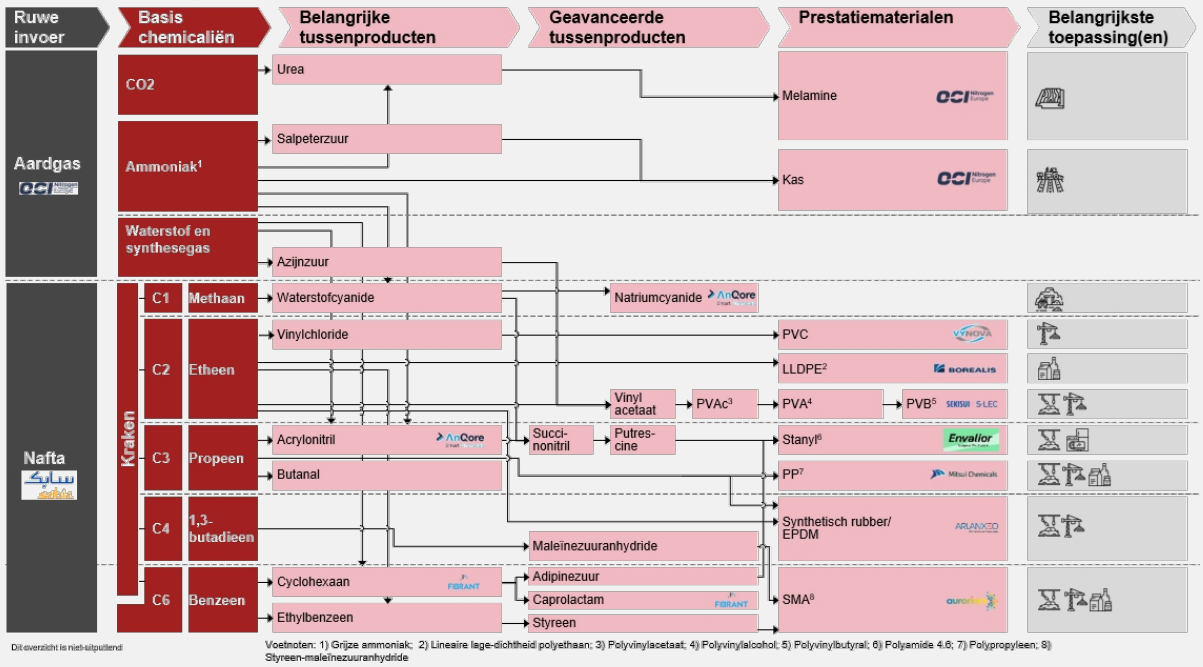
2.2 Economic impact

Chemical companies work closely together in chemical clusters, leading to chain effects and cost advantages

Within the chemical industry, there is great interconnectedness as many companies are largely dependent on each other's product imports. This leads to the formation of industrial clusters. Within these clusters, companies can supply semi-finished products, exchange residual streams and reuse flue gases. This clustering often offers economies of scale and synergy. Examples of such clusters are Chemelot in South Limburg and the Chlorine cluster in Rotterdam.

Chemelot

Chemelot consists of more than 60 plants cooperating within the chemical industry. Naphtha and natural gas are 2 import products for Chemelot. These import products are ultimately used for applications such as laminate flooring, agriculture, packaging and the automotive industry. The figure below illustrates the complex relationship and interdependencies between the various products and companies



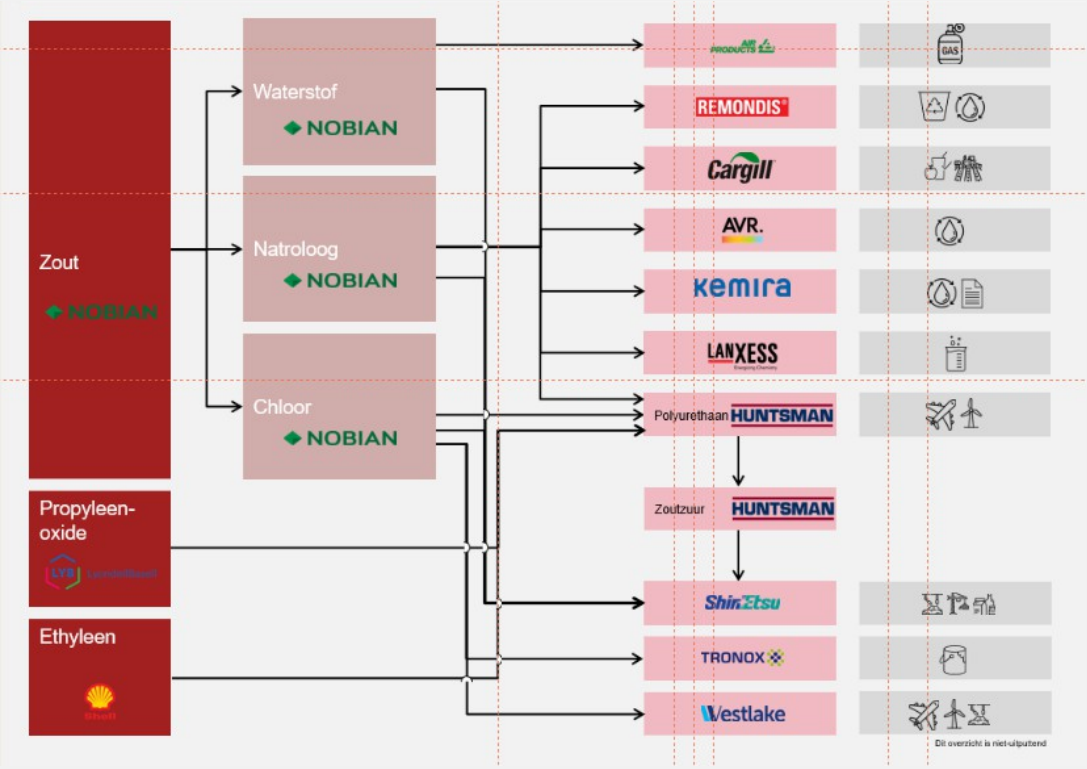
Source: Chemelot

2. Chemistry

2.2 Economic impact

Chlorine cluster Rotterdam

The Rotterdam chlorine cluster is another example of a regional cluster. This value chain starts with Nobian's production process, which uses high-purity salt as a raw material to chlorine, caustic soda and hydrogen. These products then find their applications within several companies, including Shin Etsu, Huntsman, Remondis and Tronox. In addition, the chain also includes LyondellBassel and Shell, which provide chemical building blocks for Huntsman's products. These products are then used, for example, in the production of wind turbine blades, parts of (electric) cars, water treatment, packaging and applications for defense. For chlorine in particular, it is important that customers are located close to production, due to the safety challenges of chlorine transportation. This makes the companies within the chain highly interdependent.



Source: Nobian

2. Chemistry

2.2 Economic impact

Labor productivity in the chemical sector is above the NL average and decreased by ~23% between 2021 and 2023

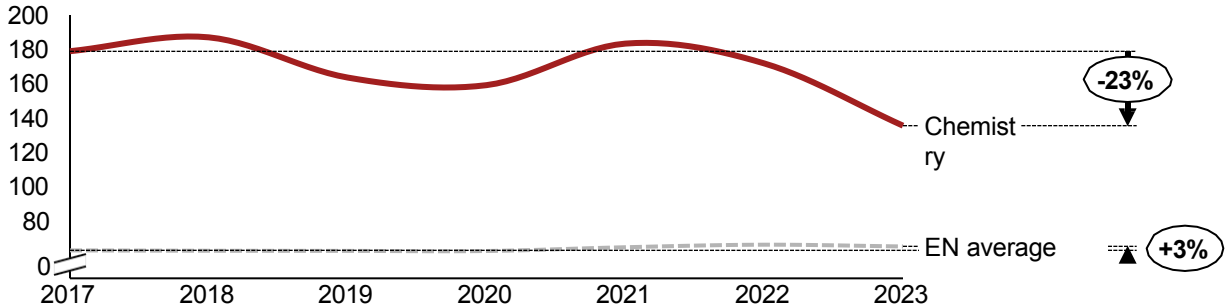


Figure 1.11. Labor productivity in NL chemical sector and NL total commercial sector (2017-2023, € per hour worked)

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and corporate profits, and also creates more room for higher wages. Absolute labor productivity within the chemicals sector averaged ~€170 per hour worked between 2017 and 2023. This is ~144% higher than the Dutch average of ~€69 per hour worked.

Labor productivity between 2017 and 2022 remained relatively stable between 2017 and 2021. There was a decline in labor productivity in 2022 and 2023, most likely driven by lower production (and additional diseconomies of scale) and margins that were under pressure in these years (see section 2.1).

The chemistry sector was responsible for ~4-5% of Dutch R&D spending and ~6-11% of NL EPO patent applications between 2017 and 2022

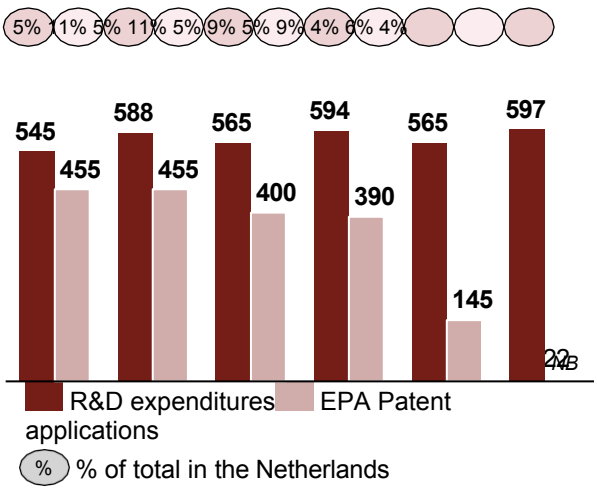


Figure 2.12. Spending on own R&D activities in the Netherlands and number of EPO patent applications for NL chemical sector

Between 2017 and 2022, the chemistry sector's R&D spending was ~€576 mln per year and 145-455 patents were filed with the EPA.

The chemistry sector's annual R&D expenditures and patent applications are ~4-5% and ~6- 11% of total R&D expenditures and patent applications in the NL. A sharp decline in the number of EPO patent applications is visible in 2021. This is driven by both a decrease in the number of patent applicants, and the
number of patents per applicant. The specific driver behind this decline is not known.

Innovations within the chemical sector include the plastic on a car window that prevents it from breaking and an artificial fiber 15 times more powerful than steel, which is widely used in aviation, fishing, defense and evacuations.

Source: CBS, measured as gross value added per number of employees based on basic prices 2021; Conversations with industry companies.

2. Chemistry
2.3 Environment

The chemical sector was responsible 9% of total NL CO_2-eq. emissions and 4% of total NL sulfur dioxide emissions between 2021-2023

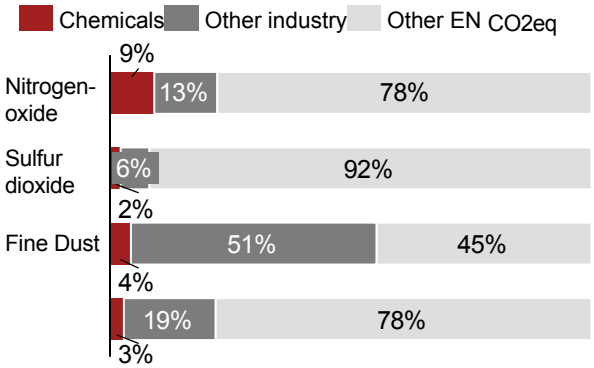


Figure 2.13. Share of NL chemical sector and total NL industry in NL emissions (2021-2023, %)

Chemistry is an inherently energy-intensive process, making it (for now) CO_2-intensive.

The chemical sector emitted ~18 Mton CO_2-eq. on average between 2021 and 2023 (41% of the total CO_2-eq. emissions of the NL industry and 9% of the Netherlands).

In addition, the sector is responsible for 4% of NL emissions of sulfur dioxide, 3% particulate matter and 2% nitrogen dioxide.

CO_2-eq. emissions within the chemical sector decreased by ~48.3% from 1990

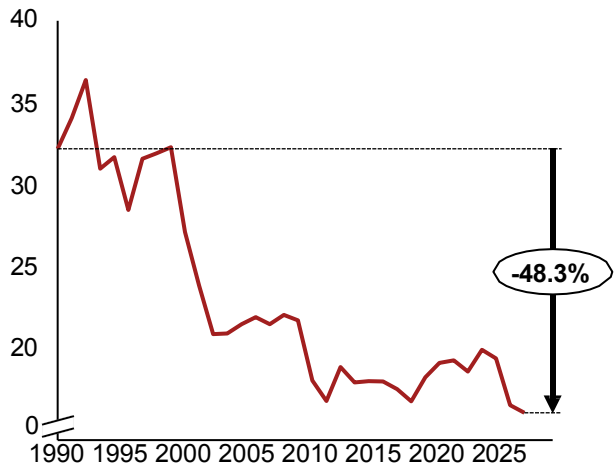


Figure 2.14. CO_{2eq} emissions from NL chemical sector (Mton).

CO_2-eq. emissions between 1990 and 2023 by ~48.3% decreased. When adjusted for production growth, CO_2-eq. emissions decreased by ~70.5% between 1990 and [20231].

The decrease in CO_2-eq. emissions was partly caused by emission reductions of F and nitrous oxide gases around 2000 and 2008, respectively. CO_2-emissions from the chemical sector were reduced by ~25% between 1990 and 2023, due, for example, to investments in process efficiency and electrification.

Several investment initiatives are underway and the first customization agreement was recently signed with Nobian, which will see the company produce net-zero by 2030 and reduce the sector's annual CO_2 emissions by ~0.5 Mton.

ETS contribution averaged ~€95 mln between 2021 and 2022

99% of the chemical sector's emissions are covered by ETS. The ETS contribution for the chemical sector averaged ~€95 mln between 2021 and 2022, or 4.8% of the total Dutch ETS costs over that period.

1) CO2-eq. emissions adjusted for industry production changes calculated by actual CO2-eq. emissions to be corrected for production index of relevant year; Source: CBS, VNCI, Netherlands Emissions Authority, CLO, RIVM

2. Chemistry
2.3 Environment

Electrification, low-carbon and green hydrogen are the primary options to reduce CO_2 emissions

Emissions from the chemicals sector are driven by several processes, with 1) the cracking of naphtha (as feedstock for plastics) (~36%) and 2) the production of ammonia (as feedstock for synthetic fertilizers) (~16%) emitting the most CO_2-eq.

For making the naphtha cracking process more sustainable there are 2 possible options; i) electric cracking and ii) using residual gases from the cracking process as fuel by upgrading them to low carbon hydrogen. For making ammonia production more sustainable, there are 2 possible options;
(i) ammonia production based on green hydrogen and (ii) CO_2 capture through CCS and useful reuse of residual gases in the rest of the (chemical) processes. In addition, it is possible to use sustainable fuels such as bio-naphtha, green gas and biomass for processes. For other processes in the chemical sector, electrification and the use of circular CO_2 (see also box on circularity) are the primary sustainability options.

Several barriers stand in the way of large-scale sustainability

Despite the fact that these technologies are largely mature enough to be used on a large scale, a number of barriers to date hinder investment in these large-scale sustainability options, such as 1) a lack of access to the necessary infrastructure (electric (congestion), hydrogen and CCS), 2) complex and changing regulations around e.g. (nitrogen) permits, 3) an unprofitable top (due to limited green demand (incentives)) combined with an international playing field that limits the possibility of passing on the high costs and limited government support and 4) a lack of long-term future perspective in the Netherlands.

Another factor for this sector is that the current European directives from RED-III regarding green hydrogen (RFNBO) make the sustainability options with CCS financially less attractive compared to the alternative option. In addition, the sector indicates that the intended implementation of the RFNBO obligation will lead to a further deterioration of its international competitive position.

TNO (2020), Project Midden; Average share of CO2-eq. emissions between 2017 and 2019 - this share may be slightly too high due to the fact that the estimate of emissions from the SABIC cracker includes additional activities, such as RWE's Swentibold power plant; European Environment Agency; average share of CO2-eq. Emissions between 2021 and 2023; InvestNL; Conversations with companies in the industry; TNO (2024), "How is plastic ?". Source: VNCI, Chemelot

2. Chemistry

2.3 Environment

Potential of existing chemical sector to contribute to Dutch circularity goals

The Netherlands has set the goal of being fully circular by 2050 and published the National Circular Economy Program 2023-2050 in 2023, aiming for 50% reduction in primary abiotic raw materials by 2030. Within this program, plastics have been as one of the priority products, for which specific policies are being developed. Broadly speaking, there are 2 techniques by which plastics can be recycled; mechanical recycling and advanced chemical recycling.

Currently, the most-used method for recycling plastics is mechanical recycling. In this recycling method, the chemical structure of the material remains virtually unchanged, so plastics can be directly reused. The disadvantage of mechanical recycling is that not 100 percent of contaminants can be removed. This is crucial because in certain applications such as the medical sector, or for food packaging, it is not allowed by law to use mechanically recycled plastics. For application in other sectors, this is less of an issue.

Because of the disadvantages of mechanical recycling, much research being conducted on chemical recycling. Through this technique, plastics are split into their original building blocks, allowing them to be used to make new plastics, with the same quality as new materials. One promising route for chemical recycling is pyrolysis. In this process, plastics are converted to pyrolysis oil. This pyrolysis oil can then act as a sustainable substitute for fossil naphtha.

For both mechanical and chemical recycling, existing infrastructure can contribute to the Netherlands' circularity goals. In the case of mechanical recycling, the recycled plastic is often mixed with virgin plastics to ensure that the material has the right properties. For chemical recycling, cracking the pyrolysis oil can use the same cracker currently used for cracking fossil naphtha.

Source: industry interviews; VNCI

2. Chemistry

2.4 Strategic relevance

EU import dependence for chemical products increased by 2 p.p. between '21 and '22 increased and EU trade balance decreased during this period

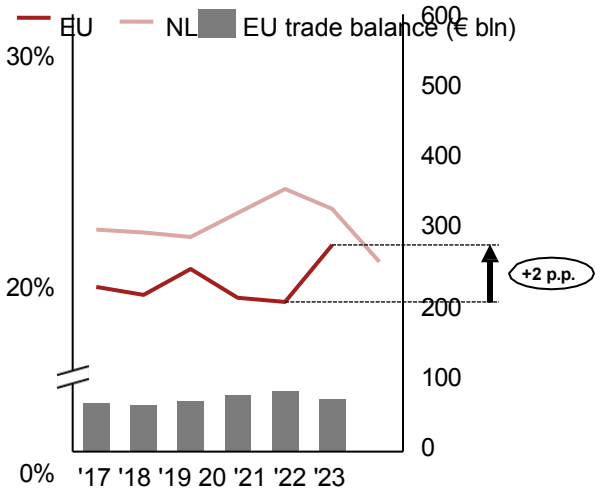


Figure 2.15. Import share of use for EU and NL (left, %) and EU trade balance for the sector (right, (€ bln))

Between 2017 and 2021, the EU's import dependence remained relatively stable and from 2021, import dependence increased by 2 percentage points to 20%. These results are in line with recent market report by CEFIC, which shows an increase of ~2 p.p. in import dependence between 2018 and 2023.

The overall EU trade balance shows a similar pattern and is between 2021 and 2022 with ~€11 bln decreased.

For the Netherlands, import dependency increased to 23% between 2019 and 2021, then decreased again to ~20% between 2021 and 2023. A decrease in the balance can also be seen in closures of, for example

cracker capacity (Sabic in Geleen, Dow in Terneuzen) because of more difficult market conditions.

In 2022, the EU imported mainly from Asian countries like China and India and further from Switzerland, the UK and the U.S.

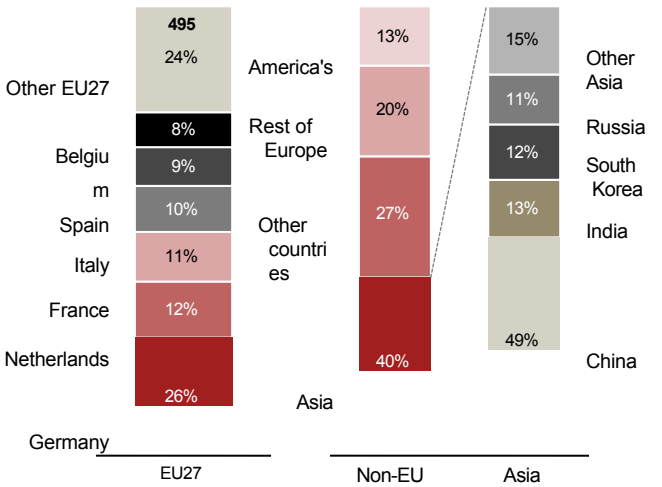


Figure 2.16. Distribution of chemical product suppliers to EU27 by country (2022,€ bln)[1]

40% of imports from non-EU countries came from Asia. The largest Asian suppliers of chemical products to the EU in 2022 were China (49%), India (13%) and Southern Korea (12%).

In addition to Asia, ~20% come from the rest of Europe; this includes Switzerland (50%) the UK (42%) in particular.

13% of EU imports come from the Americas, of which the US supplies ~82%. The largest EU suppliers in 2022 were Germany (26% of the EU market in 2022), the Netherlands (12%), France (11%), Italy (10%) and Spain (9%). The distribution of EU importing countries is in with alternative sources, such as CEFIC.

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United Kingdom; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Source: Eurostat Input-output data (2022, real prices); CBS; CEFIC. (Important to note that CEFIC shows an import dependency of 30% for 2023. This share was calculated based on internal CEFIC data, so the differences with Eurostat data cannot traced)

2. Chemistry

2.4 Strategic relevance

Several indicators show that the (international) competitive position of the NL chemicals sector has deteriorated since 2022 which may lead to a larger import share

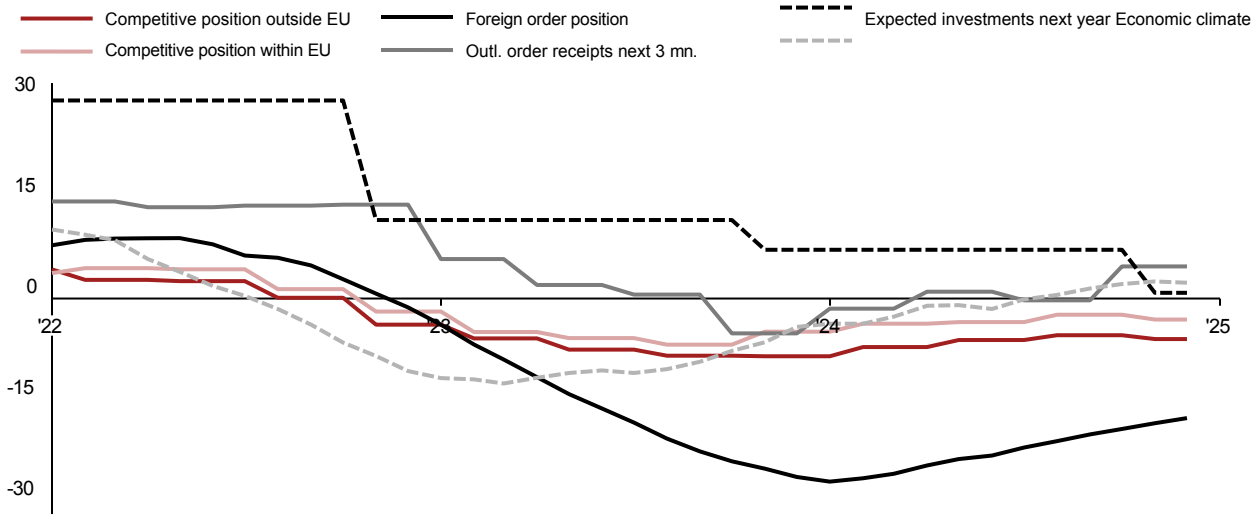


Figure 2.17. Chemical sector business cycle indicators (balance weighted percentage, 2022-2025, 12-month trailing moving average)

Periodically, CBS captures the mood among entrepreneurs through the Conjunctuurenquête Nederland (COEN), commissioned by the European Commission. The results of the survey are published aggregated by sector.

The COEN survey shows from various business cycle indicators that the Dutch chemical industry's sentiment about its international competitive position deteriorated from 2022. For example, confidence about the "foreign order position" and "foreign order receipts for the next 3 " declined from the end of 2023. Confidence about foreign order position has been structurally negative since the end of 2023 which means that the majority of entrepreneurs expect the volume of their foreign orders to decrease.

In addition, starting in 2022, fewer and fewer entrepreneurs indicate that expected investments will increase compared to the current year. In 2022, on balance, 30% of entrepreneurs still expect investments to increase; at the beginning of 2025 this is only 1%. Confidence in the competitive position of the Netherlands both inside and outside the EU is structurally negative from the end of 2023, meaning that the majority of entrepreneurs believe that their competitive position both inside and outside the EU has deteriorated.

The deterioration in sentiment surrounding the international competitiveness of the Dutch chemicals sector is an indication that the import share may increase at the EU and NL levels.

Source: CBS

Sector-specific analyses

3. Rubber and Plastic

The Socioeconomic Impact of 6 Sectors within Basic Industry.

3. Rubber and plastic

3.1 Introduction

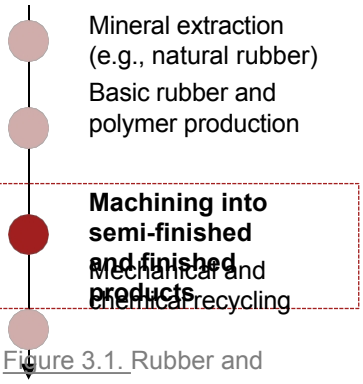


Figure 3.1. Rubber and plastic value chain.

1,400 companies in the rubber and plastics sector in the Netherlands

~34,000 people employed in the rubber and plastics sector

Figure 3.2. Average employment 2021-2023

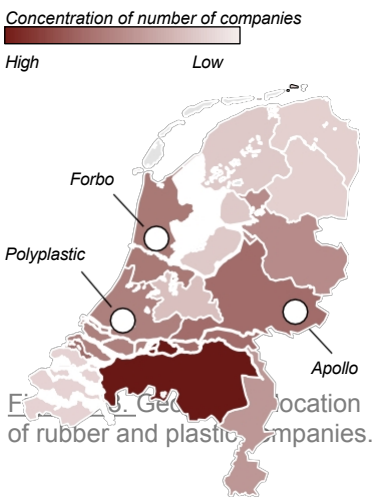


Figure 3.3. Geographical location of rubber and plastic companies.

The rubber and plastics industry processes raw materials into finished products for various industries

The rubber and plastics industry includes the production and processing of plastics and rubber in their primary form. Important processes within this sector include processing basic materials such as natural or synthetic rubber and basic plastics into finished products. This includes, for example, injection molding of plastic products and shaping of rubber profiles.

Between 2021 and 2023, the Dutch rubber and plastics industry produced ~€12 billion per year on average, of which 54% (€6 billion) was exported

In the same period, imports amounted to ~€10 bln. This brings the NL trade balance for rubber and plastic products to -€4 bln.

The rubber, and plastics industry consists of ~1,400 companies employing about 34k persons[1,2]

In the past 3 years (2021-2023), according to CBS, an average of 1,400 companies were active in the sector, employing ~34,000 persons. Almost all companies (98%) have less than 250 employees, thus falling under SMEs.

North Brabant and Gelderland are to most rubber and plastic manufacturers. Apollo tires, with more than 1,000 employees in the Netherlands the largest rubber company, car, tractor and track tires. Major plastics companies include Polyplastic in Rotterdam and Forbo Flooring in Assendelft. These companies make plastic floors, and plastic walls, chairs and tables for trains, interiors for companies, and refrigerators for supermarkets, among other things.

Source: NOS; CBS; Companies on the map

3. Rubber and plastic

3.1 Introduction

Rubber- and plastic products are important for a wide range of applications

Products from the rubber and plastics industry are the building blocks of many everyday products.

Plastic products play an important role in everyday life. For example, plastics are used in food packaging (e.g., plastic bottles, refrigerator shelves), household items (e.g., buckets, detergents), electronics (e.g., phones, computers, televisions), clothing (e.g., polyester and nylon), toys, furniture and car parts. In addition, plastic finds its way back into construction, where it is used for
including flooring and window frames.

Rubber products specifically include automotive tires, and hoses and rings used in automobiles and motorcycles, as well as "high-purity" rubber products widely used in the medical industry for such things as tubing, mouthpieces and respirators.

European demand for rubber and plastic products growing at ~1% per year, with demand expected to shift to circular products

Demand for rubber and plastic products in Europe is expected to grow 0.5% to 1.0% per year toward 2030.

For plastics, demand will increase for circular (recycled and biodegradable) synthetic products for packaging, for example. This will be driven by net-zero ambitions that have been set.

Figure 3.4. Applications/ industries

Source: Plastics Europe ("Recycled" includes plastic with both mechanically, and chemically recycled plastic as raw material)

3. Rubber and plastic

3.1 Introduction

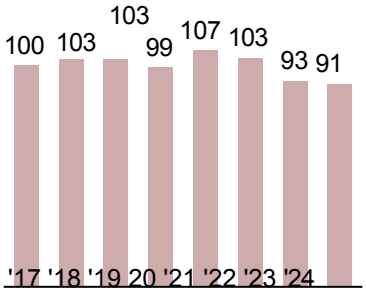


Figure 3.5. Historical production normalized to 2017

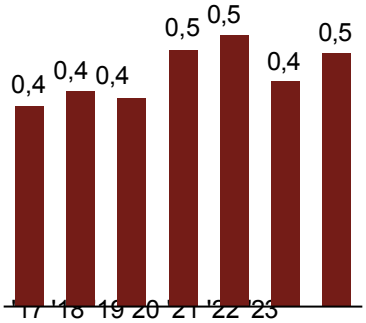


Figure 3.6. Historical Investment (€ bln).

Production of the Dutch rubber and plastics sector has declined in recent years

The production of the Dutch rubber and plastics sector declined by ~9% compared to 2017 (excluding COVID years 2021 and 2022).

The decline in plastic production is driven by rising production costs due to high energy and CO_2 prices and a decline in demand for finished products (such as plastic packaging, furniture, etc.) following the expiration of COVID-19. In addition,

national headlines (e.g. The Circular Plastic Standard and the plastic levy) to further competitive disadvantages, which could further shrink plastic manufacturing companies by as much as 40% in the coming years.

The rubber industry has to contend with overcapacity within Europe and high labor and energy costs, as a result of which production has partly relocated to Eastern Europe. The impact of falling demand from the German automotive industry has caused a further drop in production, although this impact is relatively limited as the NL rubber sector produces mainly for the replacement market.

Investments by Dutch rubber and plastics sector have been past years increased, but large-scale investments are hampered Investments of the rubber and plastics sector between 2020 and 2023 were higher (~€0.5 bln) than the years before (~€0.4 bln).

Within the plastics sector, there is a ready investment agenda of several billions in innovation and technology for circularity, but these are currently hampered by a lack of financial viability due to little demand for circular products from end consumers and practical obstacles (e.g., permits), among others.

Companies in the rubber sector indicate that investments are mainly focused on maintaining current operations, while large-scale investments in sustainability are hampered (see also section 3.3).

Source: CBS, Interviews with companies in the sector; ING; VNO-NCW

3. Rubber and plastic

3.2 Economic impact

€ 3.5 billion
Gross value added *(2021-2023 average)*

34k
Jobs *(average 2021-2022)*[2]

€ 239 million
Corporate and other business taxes *(average 2021-2022)*[1, 2]

The direct value added of the rubber and plastics industry averaged ~€3.5 billion between 2021 and 2023

The Dutch rubber and plastics industry contributed on average ~€3.5 billion to Dutch GDP between 2021 and 2023 (0.4% of total) and employs ~34k people (0.4% of total).
The rubber and plastics industry paid an average of ~€239 million in taxes between 2021 and 2022.

Figure 3.7. Key figures of economic impact

Total value added including direct, indirect and derived impact of the rubber and plastics industry was ~€7.2 billion on average between '21 and '23

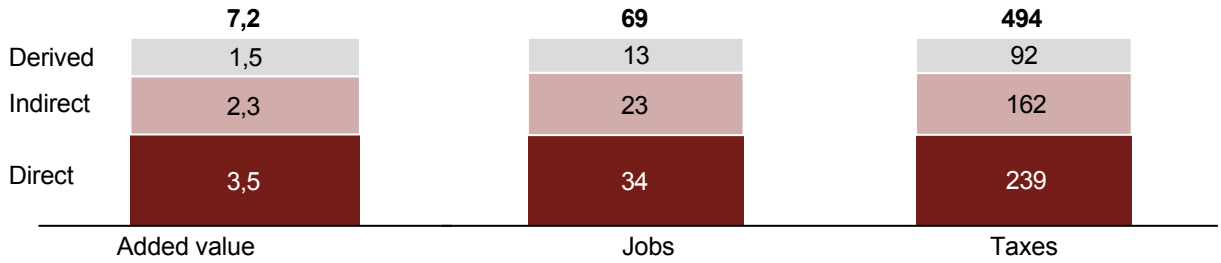


Figure 3.8. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

Besides the direct economic impact, the rubber and plastics industry also leads to indirect economic impact for the Netherlands as the rubber and plastics industry purchases ~53% of its inputs within the Netherlands. As a result, the rubber and plastics industry indirectly leads to ~€2.3 bln in added value, ~23k jobs and ~€162 mln in taxes.

Finally, the rubber and plastics industry leads to derived economic impacts as workers within the Dutch rubber and plastics industry spend some of their income with Dutch producers. The derived impacts of the rubber and plastics industry amount to ~€1.5 bln in value added, ~13k jobs and ~€92 mln in taxes.

As a result, the total value added of the rubber and plastics industry is ~€7.2 bln, the sector leads to ~69k jobs and ~€494 mln in tax revenue. This means that every euro of direct contribution generates €1.1 of additional value added, for every direct job 1.1 additional jobs are created and for every euro of direct tax €1.1 additional tax is paid.

1) Other business taxes include, for example, emission allowances, sewer fees and charges on water pollution; 2) Taxes and jobs are shown for 2021-2022 because CBS data On corporate tax and employment for 2023 lacks
Source: CBS Input-output data (2021-2023, actual prices)

3. Rubber and plastic

3.2 Economic impact

The Dutch rubber and plastics industry supplies 38% of total NL needs and demand is widespread across sectors

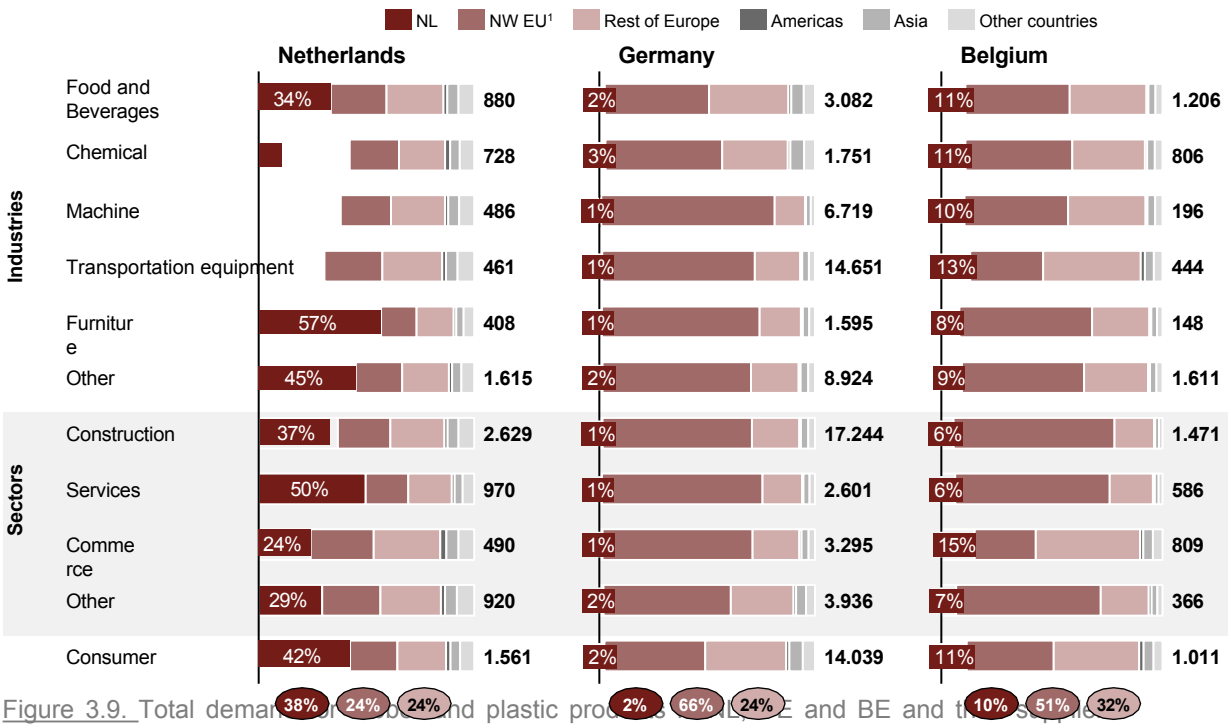


Figure 3.9. Total demand for rubber and plastic products in NL, NW EU and BE and their supplies (2022, € mln)[1]

The rubber and plastics industry is responsible for supplying 38% of total Dutch demand. It also supplies 2% of total German demand and 10% of total Belgian demand.

Demand for rubber and plastic products is highest from the construction industry (€2.7 bln) and consumers (€1.6 bln). Furthermore, it appears that a wide range of industries use rubber and plastic products (see also section 3.1).

The Dutch rubber and plastics industry supplies more than 24% of the total demand for rubber and plastic products for every sector shown in the Netherlands.

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Demand from our own sector is not shown in graph; Source: Eurostat Input-output data (2022, actual prices)

3. Rubber and plastic

3.2 Economic impact

Labor productivity in the rubber and plastics sector is below the NL average, increasing by ~12% between 2017 - 2021 and decreasing from 2022 onwards

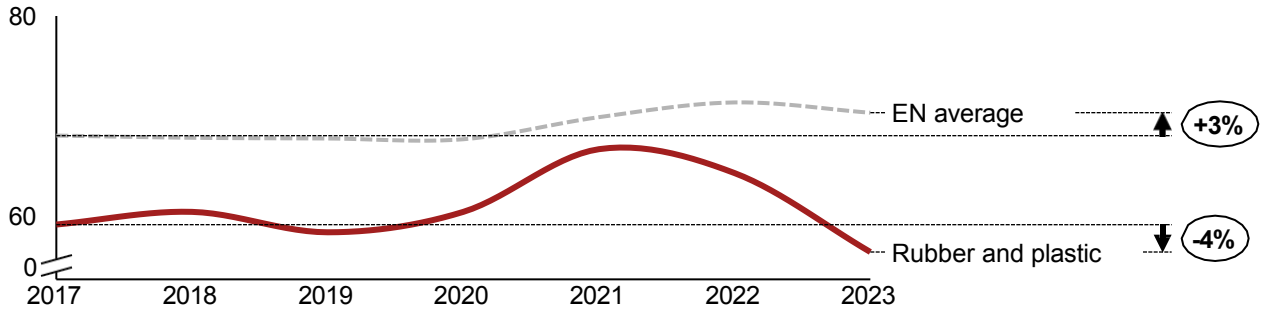


Figure 3.10. Labor productivity in NL rubber and plastics sector and NL total commercial sector (2017-2023, € per hour worked)

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and firms' profits and also creates more room for higher wages. Absolute labor productivity within the rubber and plastics sector averaged ~€62 per hour worked between 2017 and 2023; 11% lower than the Dutch average of ~€69 per hour worked.

In addition, between 2017 and 2021, labor productivity within the sector increased by ~12%. There was a dip in labor productivity in 2022 and 2023, possibly driven by lower output in these years (see section 3.1). Total labor productivity decreased by ~4% between 2017 and 2023.

Between 2017 and 2022, the rubber and plastics sector was responsible for ~1% of Dutch EPO patent applications

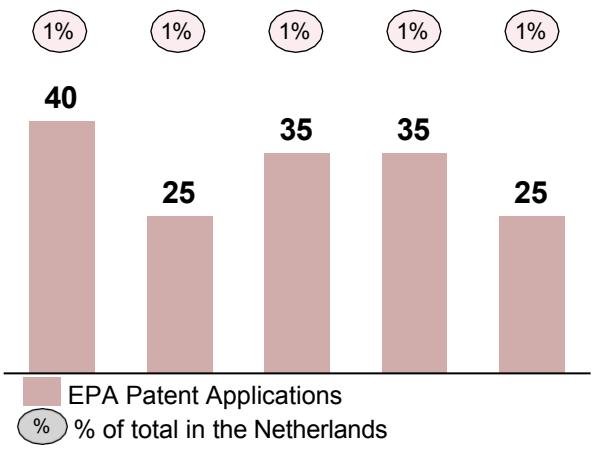


Figure 3.11. Number of EPO patent applications for NL rubber and plastics sector.

Between 2017 and 2021, 25-40 patents were filed at the EPO; ~1% of the Dutch total.

Industry research, in addition to improving product properties, is particularly focused on increasing the circularity of plastics and rubber. Thus, the plastics industry plays an important role in materials research and process technology.

Source: CBS, Measured as gross value added per number of employees based on base prices 2021; VNO-NCW

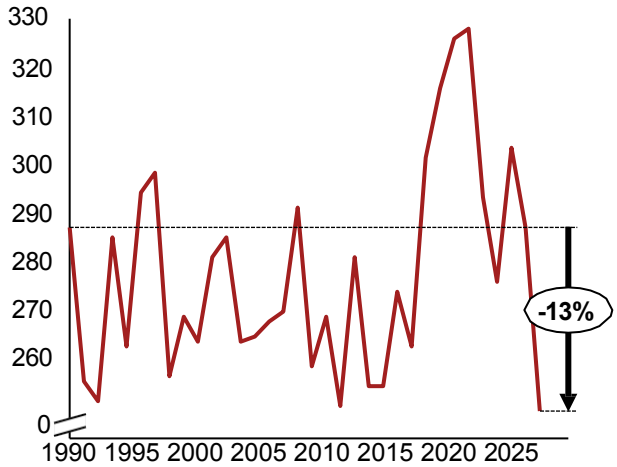
3. Rubber and plastic

3.3 Environment

The rubber and plastics sector was responsible 0.1% of total NL CO_2 emissions between 2021-2023

The rubber and plastics sector emitted an average of ~0.3 Mton CO_2-eq. between 2021 and 2023. This made the sector responsible for ~0.7% of the total CO_2-eq. emissions of the Dutch industry and less than 0.1% of the Netherlands. According to CBS, the sector hardly emitted any nitrogen oxide, sulfur dioxide, ammonia and particulate matter.

CO_2-eq. emissions within the rubber and plastics sector from 1990 have been decreased by ~13%



CO_2-eq. emissions between 1990 and 2023 by ~13% decrease. This decrease in emissions is partly driven by the observed production decline (see section 3.1). When for production decline, CO_2-eq. emissions decreased by ~46% between 1990 and [20231].

This CO_2-eq. emission reduction was achieved through investments in process efficiency and electrification, among other things.

Figure 3.12. CO_2-eq. emissions from NL. refining sector (kton)

ETS contribution averaged ~€11 mln between 2021 and 2022

The ETS contribution of the rubber and plastics sector was ~€9.7 mln in 2021 and ~€12.1 mln in 2022. Average over 2021 and 2022 was ~€10.9 mln, which is 0.5% of the total Dutch ETS costs over that period.

Note: Due to the large overlap between the chemicals and rubber and plastics sectors, a separate analysis of decarbonization options and barriers has not been made for this sector, but the results have been aggregated in the section for chemicals. 1) CO_2-eq. emissions adjusted for sector production changes, calculated by correcting actual CO_2-eq. emissions for production index of relevant year; Source: CBS

3. Rubber and plastic

3.4 Strategic relevance

EU and NL import dependence for rubber and plastic products increased and EU trade balance decreased

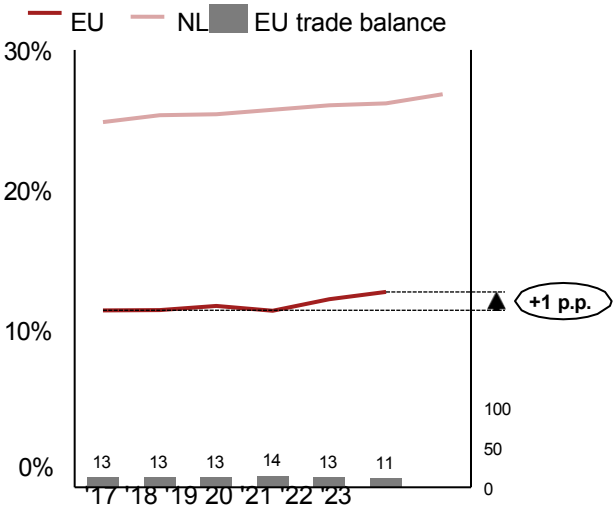


Figure 3.13: Import share in total use for EU and NL (left, %) and EU trade balance for the sector (right, (€bn))

Between 2017 and 2022, the EU's import dependence increased from 12% to 13%. This increase in import dependence materialized particularly between 2020 and 2022.

The EU trade balance for rubber and plastic products shows a similar trend, with the trade balance decreasing from €13 bln in 2020 to €11 bln in 2022.

For the Netherlands, import dependence for rubber and plastic products increased from 24% to 27% between 2017 and 2023.

In 2022, the EU imported mainly from Asian and ROW countries

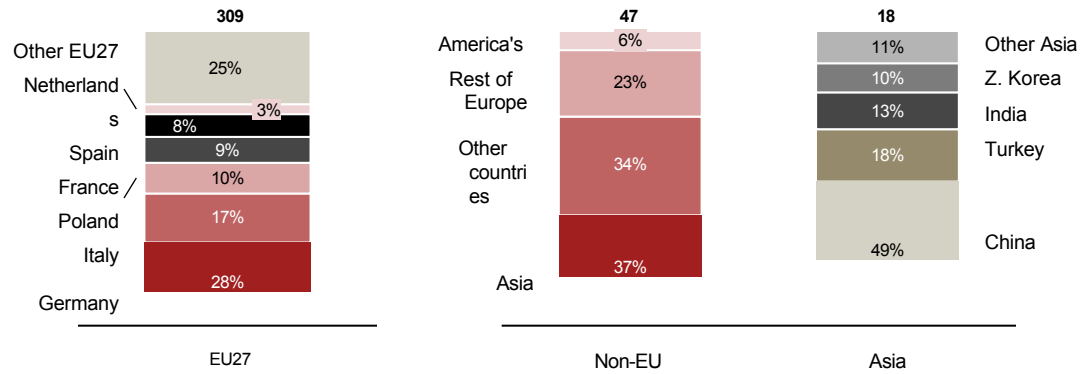


Figure 3.14. Distribution of suppliers of rubber and plastic products to EU27 by country (2022, € bln)[1]

37% of imports from non-EU countries came from Asia. The largest Asian suppliers of rubber and plastic products to the EU in 2022 were China (49%), Turkey (18%) and India (13%). 23% of EU imports came from other European countries, such as Switzerland (48%) and the UK (48%). The largest EU suppliers in 2022 were Germany (28% of the EU market in 2022), Italy (17%), Poland (10%), France (9%) and Spain (8%). Dutch production in 2022 accounted for
~3% of the total EU market.

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries include Saudi Arabia, South Africa and the Eurostat category Rest of the World. Source: Eurostat Input-output data (2022, real prices); CBS

3. Rubber and plastic

3.4 Strategic relevance

Several indicators show that the (international) competitive position of the NL rubber & plastics sector has deteriorated since 2022: this may lead to a larger import share

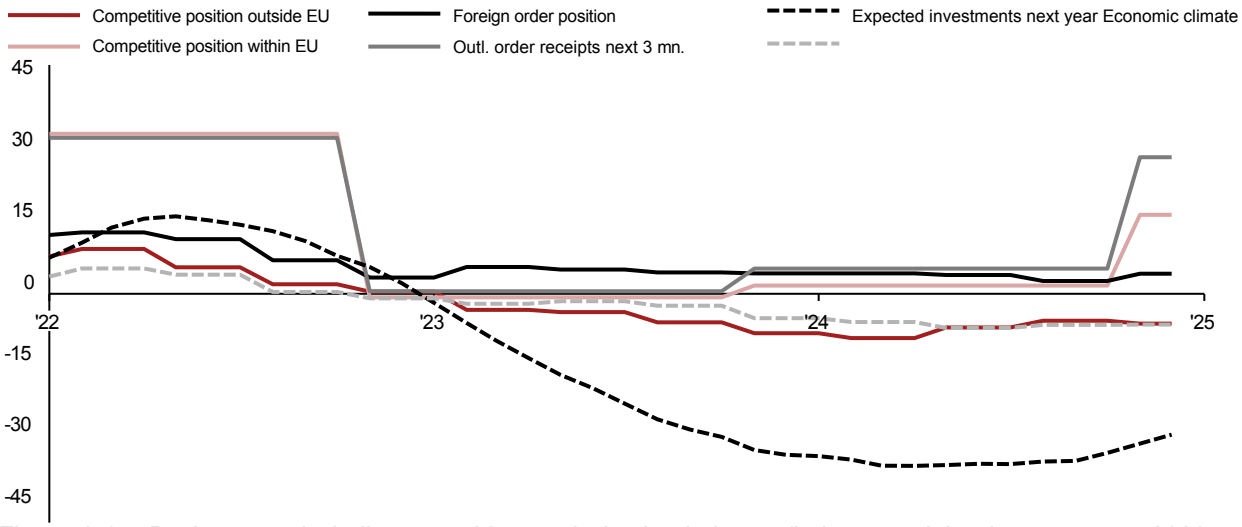


Figure 3.15. Business cycle indicators rubber and plastics industry (balance weighted percentage, 2022-2025, 12-month trailing moving average)

CBS's periodic COEN survey shows from various business cycle indicators that the Dutch rubber and plastics industry's sentiment on international competitiveness deteriorated from 2022.

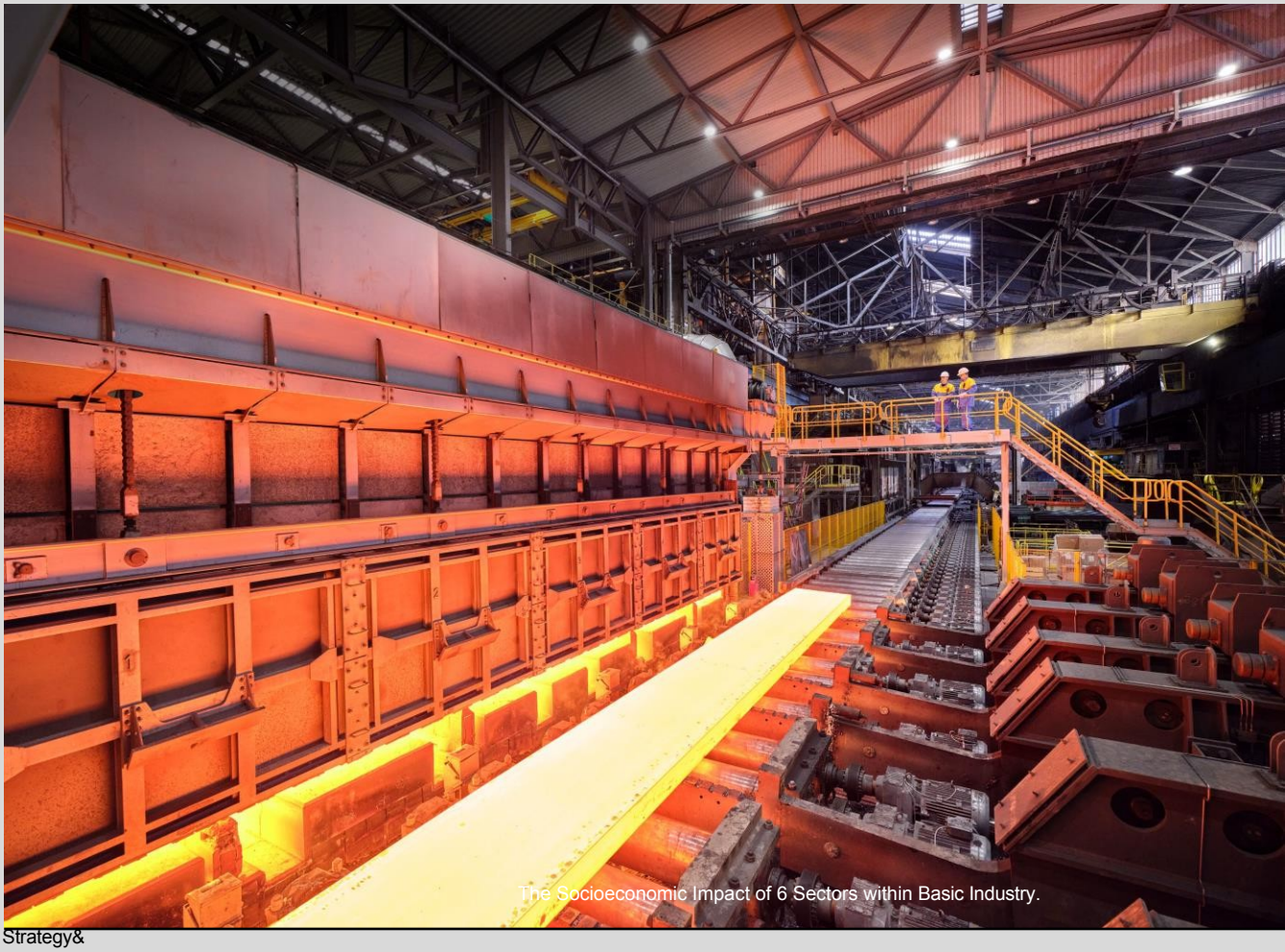
Thus, confidence in the competitive position of the Netherlands, both inside and outside the EU, and in the NL economic climate declined from 2022. About the competitive position outside the EU and the NL economic climate, entrepreneurs are structurally negative from 2023 onwards. This means that the majority of entrepreneurs believe that their competitive position outside the EU and the economic climate in NL has deteriorated.

In addition, it is that from 2023 onward, the sentiment around planned investments decreases from, on balance +15% by mid-2022 to -28% by early 2025.

Early 2025 indicators around competitive position within EU and foreign order receipts seem to improve slightly over the next 3 months - these indicators seem to focus mainly on competitive position within the EU rather than outside. Thus, the deterioration in sentiment around the international competitiveness of the Dutch rubber and plastics sector is an indication that the observed trend of increasing import dependence at EU level may continue and accelerate.

Sector-specific analyses

4. Basic Metal



The Socioeconomic Impact of 6 Sectors within Basic Industry.

4. Basic Metal

4.1 Introduction

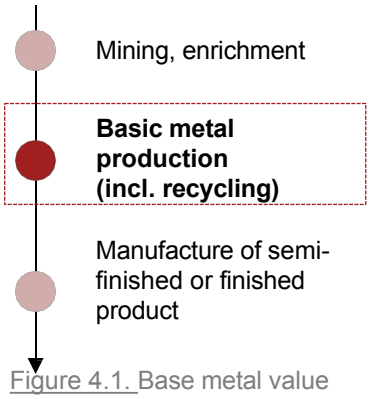


Figure 4.1. Base metal value chain

410 companies in the base metal sector in the Netherlands

~20,000 people employed in the base metal industry

Figure 4.2. Average employment 2021-2023

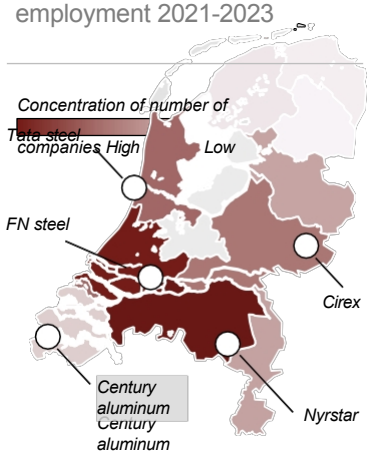


Figure 4.3. Geographic location of rubber and plastic companies.

Base metal industry processes raw materials into high-quality base metals

The base metal industry includes the production and processing of metals in their primary form, such as iron, steel, aluminum, copper and zinc. Major processes include the exploration and extraction of metals from ores, the manufacture of pig iron in blast furnaces, the production of various types of base metals (e.g., primary zinc via electrolysis), the development of specific alloys, and processing into long (e.g., steel wire) or flat (e.g., steel sheets) products.

Between 2021 and 2023, the Dutch base metal industry produced ~€12 billion per year on average, of which 72% (€9 billion) was exported

During the same period, imports amounted to ~€12 bln. This brings the NL trade balance for base metal products to -€3 bln.

The base metal industry consists of 410 companies and employs about 20,000 people

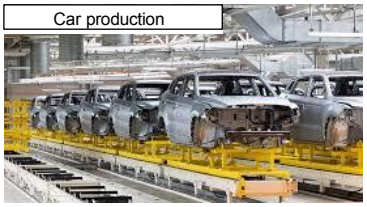
In the past 3 years (2021-2023), according to CBS, 410 were companies active in the Dutch base metal industry, where ~20,000 persons were employed. Over 90% of these companies are SMEs; that is, companies with fewer than 250 employees.

North and South Holland and North Brabant are home to most metal producers. Tata Steel, the largest metal company in the Netherlands with sites in Zwijndrecht, Oosterhout, IJsselstein, Geldermalsen and Maastricht in addition to IJmuiden, currently employs ~10,000 people.

Source: Metal Netherlands; NOS; CBS; Eurostat

4. Basic Metal

4.1 Introduction



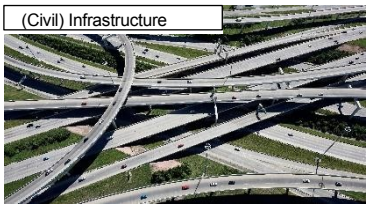


Figure 4.4. Applications/industries

	2022 vs. 2030
Aluminum	~40%
Copper	~30%
Steel	~20%
Zinc	*~14%**

**= in 2050*

Figure 4.5. Future demand Europe

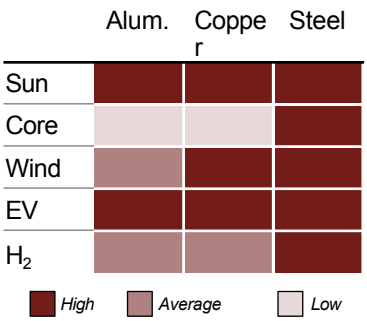


Figure 4.6. Importance of metals in green power

Base metal is in many everyday products and is critical for energy transition and infrastructure, among other things

The base metal industry processes raw materials into high-quality base metals, which then form the building blocks for everyday finished products such as washing machines, furniture, cars and electric vehicle charging cables. Base metals are also important in the construction industry for construction of buildings, bridges or railroads, for example. Energy transition also requires base metals: for example, steel is used in the production of wind turbine foundations and pipelines for gas and hydrogen, facade panels of buildings, in machinery and for various means of transportation. Aluminum is used for frames of solar panels and zinc is needed to prevent erosion of offshore wind turbines.

The Dutch base metal industry focuses not only on commonly used metals such as zinc, (cast) iron, steel and lead. Steps are also being taken to extract critical metals such as germanium (designated as a critical metal by the European Commission), in the Netherlands.

European demand for several base metals expected to rise sharply

Economic growth, investment in civil infrastructure, and the energy transition will contribute to an increase in demand for metals in the future. Steel, aluminum, zinc and copper are examples of metals where strong growth is expected (within Europe), due to their key role in energy transition.

For example, European demand for aluminum is expected to increase by 4.8Mt towards 2030 ('22-'30), a growth of ~40%. Copper demand growth is estimated at ~30% towards 2030 and zinc demand is expected to increase by 14% towards 2050. Steel demand in the EU and the UK is projected to increase from 130 Mton in 2023 to 155 Mton in 2030 (+20%) and 177 Mton in 2040 (+35%). Thus, base metals will continue to play a key role in the European economy and energy transition.

Source: CBS and Bedrijvenopdekaart; Companies with fewer than 250 employees are classified as SMEs, according to CBS standards; International Aluminum Institute; International Copper Association Europe; EOXS; Bronk & Company; Fitch Ratings, CRU; IEA 2021; Eurofer; KU Leuven (*growth toward 2050)

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4. Basic Metal

4.1 Introduction

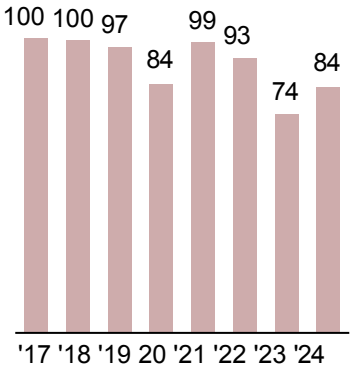


Figure 4.7. Historical production normalized to 2017

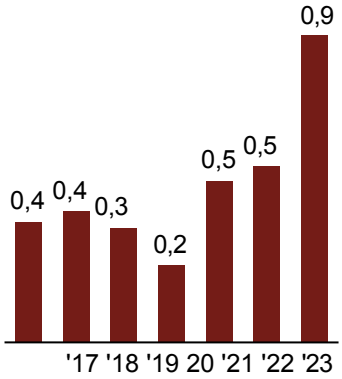


Figure 4.8. Historical investments (€ bln)

Metal production declines and focus of investment is mainly on maintenance, although there are plans to invest in greening

Production of base metal products decreased 16% between 2017 and 2024. Investment increased over the same period. This pattern of lower production and higher investment is largely driven by Tata Steel's periodic large-scale maintenance of one of its blast furnaces. In addition, Tata Steel has several investments that reduce its impact on habitat.

The past 2 years have seen reduced demand for base metal products in the EU and increased supply in the export market due to global overcapacity. This combined with higher energy prices, grid tariffs and EU ETS costs, has made the competitive position for the Dutch base metal sector more difficult.

This situation has resulted in several companies going out of business in recent years (e.g., Aldel in 2022 (320 employees) and Aluchemie in 2021 (220 employees)) and several companies in the sector partially scaling back production (e.g., Nyrstar in early 2024). A number of other companies indicate that they are largely continuing production but at lower/negative margins, as scaling back production does not directly lead to lower costs per unit of output. In addition, companies in the sector indicate that investments for some time now have consisted mainly of maintaining current capacity and complying with new regulations (e.g. CSRD, environmental impacts).

Source: CBS, Ketenoverleg Duurzame Metaalbouw, Wageningen , CE Delft 2021, NOS, Interviews with companies in the sector

4. Basic Metal

4.2 Economic impact

€ 2.8 billion
Gross value added *(2021-2023 average)*

20k
Jobs *(average 2021-2022)*[2]

€ 354 million
Corporate and other business taxes *(average 2021-2022)*[1, 2]

The direct value added of the base metals industry averaged ~€2.8 billion between 2021 and 2023

The Dutch base metal industry contributed on average ~€2.8 billion to Dutch GDP in 2023 (0.3% of total) and employed ~20k people (0.2% of total).

The base metal industry paid an average of ~€354 million in taxes between 2021 and 2022. Here the CBS data has been corrected for Tata Steel's EU ETS construction with Vattenfall. Tata Steel pays part of the EU ETS costs through Vattenfall, so this is not included in the CBS data as tax payments of the base metal sector. The correction amount of €42 million was determined based on EU ETS data.

Figure 4.9. Key figures of economic impact

The total value added including the direct, indirect and derived impact of the base metal industry averages ~€6.6 billion between 2021 and 2023

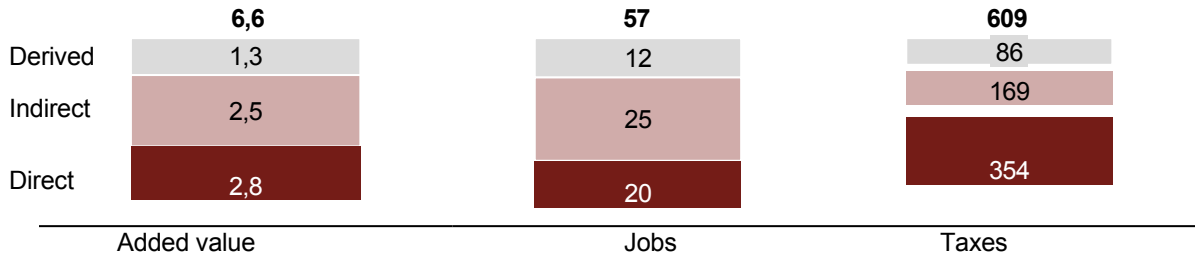


Figure 4.10. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

Besides the direct economic impact, the base metal industry also leads to indirect economic impact for the Netherlands as the base metal industry purchases ~41% of its inputs within the Netherlands. As a result, the base metal industry indirectly leads to ~€2.5 bln in added value, ~25k jobs and ~€169 mln in taxes.

Finally, the base metal industry leads to derived economic impacts, as workers within the Dutch base metal industry spend some of their income on Dutch producers. The derived impacts of the base metal industry amount to ~€1.3 bln in value added, ~12k jobs ~€86 bln in taxes$_{(.)}$.

As a result, the total added value of the base metal industry is ~€6.6 bln, the sector leads to ~57k jobs ~€609 mln in net tax revenue. This means that every euro of direct contribution generates €1.4 of additional value added, for every direct job ~1.9 additional jobs are created and for every euro of direct tax €0.7 additional tax is paid.

1) Other business taxes include emissions taxes, sewer fees and water pollution charges;
2) Taxes and jobs are shown for 2021-2022 because CBS data on corporate taxes and employment for 2023 are missing;
3) The derived multipliers for value added, jobs and taxes are in line with recent impact studies conducted by Oxford Economics (2.1, 2.9 and 2.5 for VAT, jobs and taxes, respectively) and Ecorys (2.0 for VAT and 3.0 for jobs). Source: CBS Input-output dates (2021-2023, actual prices)

4. Basic Metal

4.2 Economic impact

The NL base metal industry is an important supplier to the metal products and machinery industry and construction sector

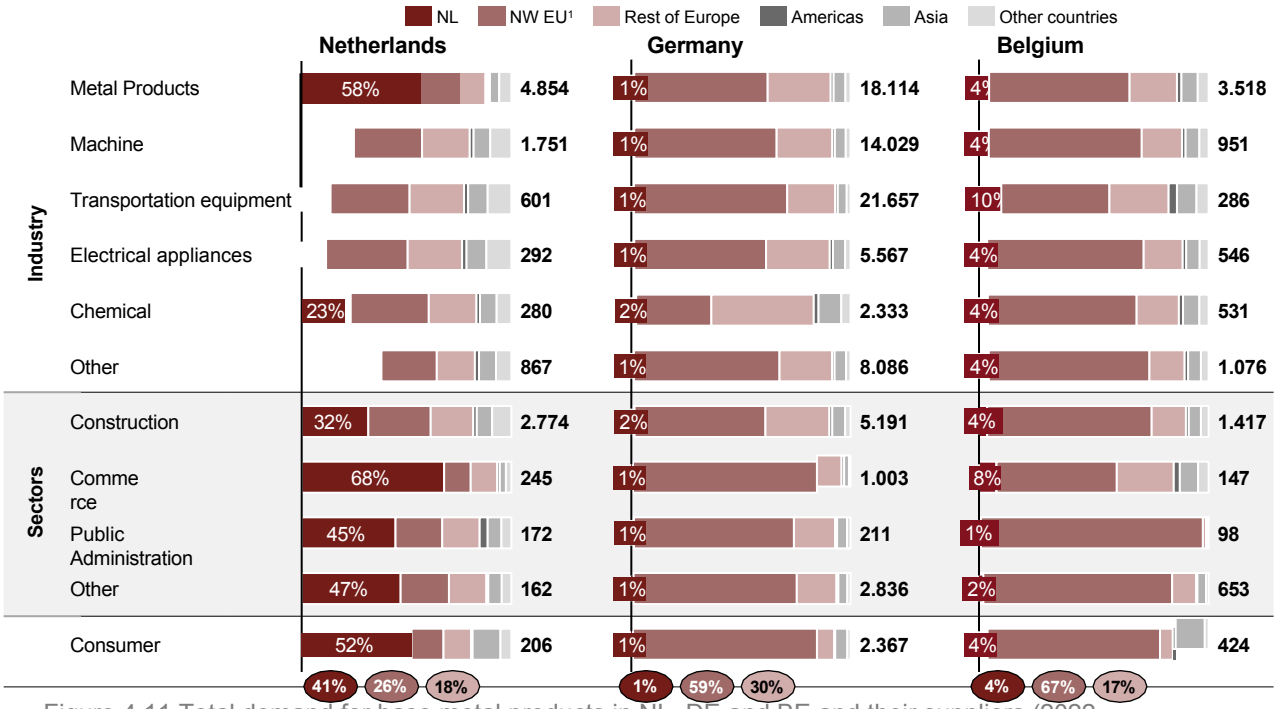


Figure 4.11 Total demand for base metal products in NL, DE and BE and their suppliers (2022, € mln)[1]

The base metal industry has a strong local blueprint and is responsible for supplying 41% of total Dutch demand for base metal products. It also supplies 1% of total German demand and 4% of total Belgian demand.

Demand for base metal products is highest from metal products (€4.9 bln) and machinery industries (€1.8 bln). From other sectors, demand is greatest from the construction industry (€2.8 bln). Direct demand from consumers is limited (€206 bln), as many of the base metal industry's products undergo further processing before being used by consumers (see also section 4.1). 58% of the demand for base metal products from the Dutch metal products industry is supplied by the Dutch base metal sector.

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Demand from own sector is not shown in the graph; Source: Eurostat Input-output data (2022, actual prices)

4. Basic Metal

4.2 Economic impact

Labor productivity in the base metal sector is above NL average and increased by ~1% between 2017 and 2023

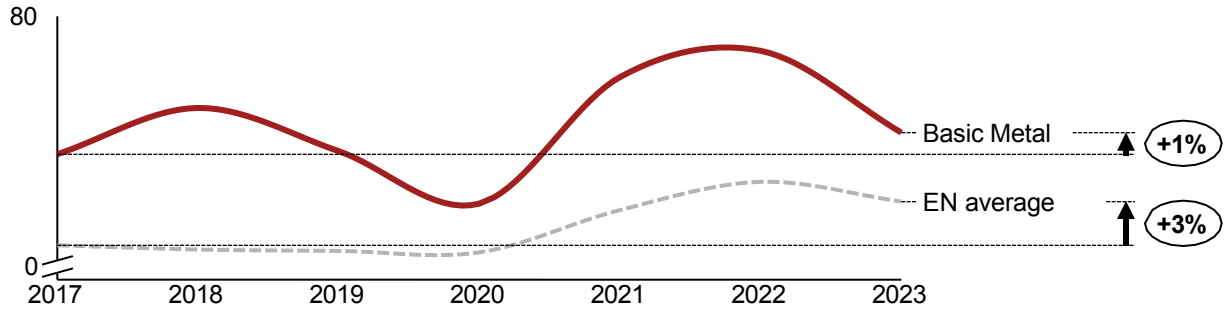


Figure 4.12. Labor productivity in NL base metal sector and NL total commercial sector (2017-2023, € per hour worked)

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and firms' profits and also creates more room for higher wages. The absolute labor productivity within the base metal sector averaged between 2017 and 2023 was
~€75 per hour worked. This is ~7% higher than the Dutch average of ~€69 per worked.

In addition, between 2017 and 2022, labor productivity within the sector increased by ~7%. There was a dip in labor productivity in 2019-2020 and 2023, most likely driven by lower output in these years (see section 4.1) and additional diseconomies of scale. Total labor productivity increased ~1% between 2017 and 2023.

The base metal sector accounted for ~1% of Dutch R&D spending and EPO patent applications between 2017 and 2022

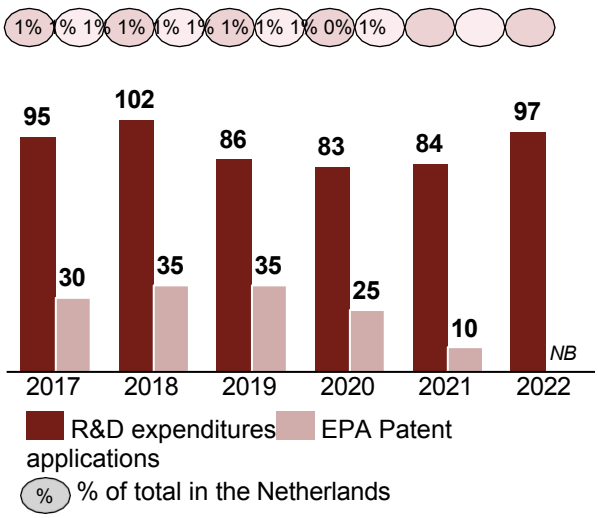


Figure 4.13. Expenditures on own R&D activities in the Netherlands and number of EPO patent applications for NL base metal sector

Between 2017 and 2022, base metal sector spending was ~€80-100 mln per year and 10-35 patents were applied for at the EPA; ~1% of total R&D spending and patent applications in the Netherlands.

Innovations relate, e.g., to product improvement and process efficiency. For product improvements, the entire ecosystem of companies usually comes together (e.g. primary steel producer to end user). There is also intensive cooperation with colleges and universities (e.g. Tata and TU Delft are investigating more sustainable production methods for wind turbines) and Nyrstar and TU Eindhoven (through Metalot) are investigating the role that metals can play in energy production.

Source: CBS, measured as gross value added per number of employees based on basic prices 2021; Metalot

4. Basic Metal

4.3 Environment

Base metal sector was responsible for 3% of total NL CO_2-eq emissions and 11% of total NL sulfur dioxide emissions between 2021-2023

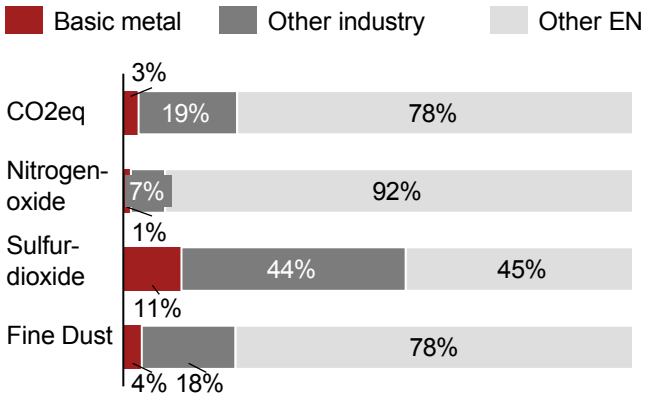


Figure 4.14. Share of NL base metal sector and total NL industry in NL emissions (2021-2023, %)

The base metal sector is inherently energy-intensive and therefore (for now) $CO_{(2)\text{-intensive}}$. The sector therefore emitted ~5.8 Mton CO_2-eq. on average between 2021 and 2023 (13% of the total CO_2-eq. emissions of NL industry and 3% of the Netherlands). If emissions from the relevant Vattenfall power plants are included, CO_2-eq emissions are ~10.9 Mton; 25% of NL industry and 7% of NL. In addition, the sector is responsible for 11% NL sulfur dioxide emissions. Total NL sulfur dioxide emissions are so low that EU limit value for sulfur dioxide has not been exceeded anywhere in the Netherlands since 1998.

CO_2-eq. emissions within the base metal sector decreased from 1990 by ~42%, through investments in process efficiency and electrification

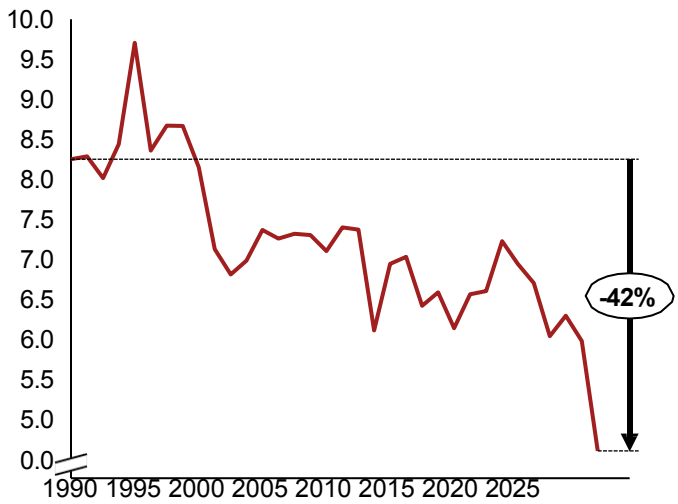


Figure 4.15. CO_{2eq} emissions from NL base metal sector (Mton).

CO_2-eq. emissions decreased by ~42% between 1990 and 2023. When adjusted for production decline1 , CO_2-eq. emissions decreased by ~46% between 1990 and 2023.

Major efforts that led to CO2-eq. emission reductions are reductions of F-gases between 1997 and 2004. CO_2 emissions decreased 37% between 1990 and 2023.

This CO_2 emission decrease was achieved through investments in process efficiency and electrification (e.g., e-boilers), among other things. The CO_2-eq. emission decrease between 2022 and 2023 is mainly driven by the observed production decrease (see section 4.1).

ETS contribution averaged ~€73 mln between 2021 and 2022

The base metal sector's ETS contribution was ~€79 mln in 2021 and ~€66 mln in 2022. Average over 2021 and 2022 was ~€73 mln, which is 3.4% of the total Dutch ETS costs over that period.

1) CO_2-eq. emissions adjusted for industry production changes calculated by Actual CO_2-eq. emissions to be corrected for production index of relevant year
Source: CBS, Netherlands Emissions Authority

4. Basic Metal

4.3 Environment

Electrification and hydrogen are the primary options to reduce CO_2 and sulfur dioxide emissions, but several preconditions are necessary for large-scale sustainability

Mature electrification technologies exist for most production processes in the base metal sector, with the exception of iron production. Sustainable iron production is expected to require DRI technology, based on sustainable hydrogen, with gas expected to act as an intermediate step. The replacement of the current iron production technology for the sustainable DRI technology, leads to a reduction in sulfur dioxide emissions, by then no longer using coal.

By 2030, it is expected that ~30-40% of the sector's CO_2-eq. emissions can be reduced, and by 2050 the entire sector can produce net-zero base metals. At the corporate level, net-zero CO_2 emissions could be achieved even before 2050.

In recent years, a number of barriers existed that hindered large-scale sustainability, such as 1) a lack of affordable access to the necessary infrastructure (both electricity (congestion) and hydrogen and CCS), 2) complex and changing regulations around, for example, (nitrogen) permits, and 3) an unprofitable top combined with an international playing field that limits the ability to pass on the high costs and limited government support.

Contribution of existing steel production to circularity goals

The Netherlands aims to a circular economy by 2050, in which as many sustainable renewable raw materials as possible are used, products and raw materials are reused and hardly any waste exists. The government's guiding goal is for the Netherlands to use 50% less abiotic raw materials (minerals, metals and fossil) by 2030. Although there are no specific targets for steel recycling yet, steel can play an important role in a circular economy because of its potential for endless reuse. Besides circularity, recycling scrap also has a positive effect on reducing CO_2 emissions, since the first (CO_2-intensive) step of the steelmaking process is skipped.

Steel scrap is currently recycled in the Netherlands by Tata Steel and by 2023 the recycling rate of steel produced by Tata Steel was ~17%. For this purpose, Tata Steel currently uses scrap that comes from its own production process, such as excess steel cut away when finishing steel coils, and some is purchased from, for example, demolition companies and waste processors.

Nonetheless, currently higher use of steel scrap is still technically challenging and much of the available steel scrap in the EU and the Netherlands is exported outside the EU to new steel. In 2023, the EU was a net exporter of scrap, with net exports of 14.8 Mt (exports of 18.7 Mt and imports of 3.9 Mt). Turkey has historically been the main recipient of these exports, with 56% by 2023 (10.4 of the 18.7 Mt). The Netherlands was the largest exporter in the EU, shipping a total of 4.1 Mt of scrap.

Towards 2030, Tata Steel's ambition is to increase recycling content to 30%. The planned new production facilities that should lead to the targeted CO_2 reduction should also make increasing the recycling content technically possible.

Source: Ministry of I&W, Eurostat, Tata Steel, Interviews with companies in the sector.

4. Basic Metal

4.4 Strategic relevance

EU import dependency for base metal increased and in 2022 there was a negative EU trade balance for the first time

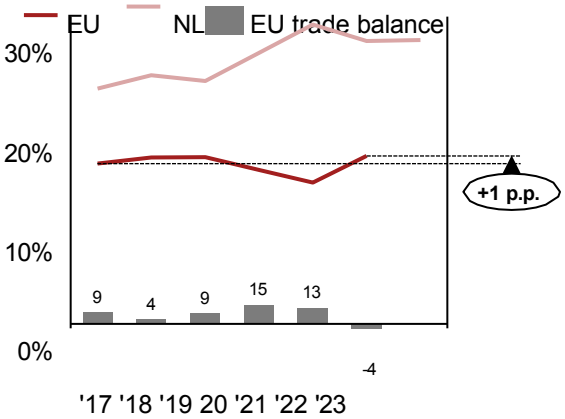


Figure 4.16. Import dependence of EU and NL and EU trade balance

Between 2017 and 2022, the EU's import dependence increased from 16% to 17%. For the Netherlands, import dependence for basic metal products increased from 23% to 28% over the same period.

In addition to an increasing level of imports at the EU level, EU exports of base metal products also decreased, resulting in a negative trade balance for the first time in 2022. The observed rising trend in import dependence is in line with reports on the steel market. Over a longer period, import dependence for steel has increased more. For example, the share imports from non-EU countries for flat steel increased from 15% in 2013

to 24% by 2022 and the share for long steel from 8% to 14%.

By 2022, 52% of EU imports of base metal came from Asian countries such as Russia, China, Turkey and India

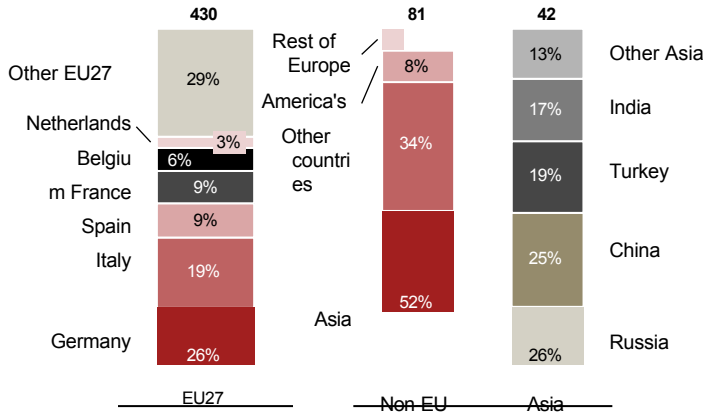


Figure 4.17 Distribution of suppliers of base metal products to EU27 by country (2022,€ bln)[1]

52% of imports from non-EU countries were originating from Asia. The largest Asian base metal suppliers to the EU were in 2022 Russia (26%), China (25%), Turkey (19%) and India (17%).

The largest EU suppliers in 2022 were Germany (26% of the EU market in 2022), Italy (19%), Spain (9%), France (9%) and Belgium (6%). Dutch production accounted for ~3% of the total EU market in 2022.

The observed distribution of EU suppliers corresponds to production in EU countries. For example, the production of steel in Germany is ~37 Mton and in Italy, France and Spain 22, 12 and 12 Mton respectively. Steel production in the Netherlands was ~6 Mton in 2022.

Deteriorated sentiment about international competitiveness is a signal are that import share continued to increase after 2022

No CBS data is available for base metal. However, interviews with those employed in the sector and the recent report "Forging the Future" reveal a negative picture about the competitive position within and outside the EU. A survey by RAND shows that of 22 Dutch base metal companies interviewed, 45% are concerned about global competition until 2035, especially due to large cost disadvantages. This may signal that the trend of increasing import dependence is continuing and possibly accelerating.

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United Kingdom; Americas are Argentina, Brazil, Canada, Mexico and the United ; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the .
Source: Eurostat Input-output data (2022, actual prices); Eurofer, RAND (2025), *Forging the future*

4. Basic Metal

4.4 Strategic relevance

Empirical analysis shows that Dutch chemical and base metal sectors currently export 35 products to other European countries, which can be labeled as critical products according to the EC's methodology

In the context of current geopolitical risks, the European Commission monitors strategic dependencies and for this purpose it has developed a methodology.

In March 2023, the latest European Commission monitor was published and based on this analysis, there are 564 critical products where the EU is highly dependent on a limited number of non-EU countries. Of these, 204 products were important for sensitive ecosystems, being security, health and the green and digital transition.

For this report, we replicated this analysis[1], to then identify the critical products that the 6 Dutch sectors currently export to the EU. The loss of Dutch production for these products would in all likelihood mean that the EU's dependence on non-EU countries would increase.[2]

The empirical analysis shows that the list of critical products includes 87 chemical or base metal products. Of these 87 products, there are 30 chemical and 5 base metal products for which the Netherlands supplied more than 2% of total EU imports of this product in 2022.

The results were validated with several base metal and chemical companies, but given the short timelines of this project, it was not possible to fully validate the list. Nevertheless, a number of products were directly recognized by the companies we consulted during the study. An example is Dead Burned Magnesia which is produced by Nedmag in Veendam and is crucial for the production of, for example, refractory bricks needed for production of green cement and steel.

In addition, there are plans among several base metal companies to start producing critical products in the Netherlands. For example, Nedmag is in talks with a company that wants to produce magnesium metal based on Nedmag's magnesium chloride. Currently, the EU is ~97% dependent on China for this product. Nyrstar plans to extract germanium from the zinc concentrates it currently purchases for zinc mining. Germanium is on the European Commission's critical raw materials list because of its high dependence on China and the importance of germanium for energy transition, security and high-tech applications. For example, germanium is used for semiconductors, infrared optical instruments and night vision goggles. To this end, Nyrstar has submitted a proposal to the European Commission for funding of a demonstration plant.

In conclusion, based on an empirical analysis, in line with the methodology of the European Commission, it seems that there are 35 chemical and base metal products produced and exported in the Netherlands that are considered critical by the EU. An initial qualitative interpretation of these results confirms that some of these products actually produced in the Netherlands. However, further depth on these products is needed to validate the full list. In addition, this follow-up study should take into account specialty products, for which the current HS6 product codes are currently too broadly defined (e.g. specialty steel from Tata Steel used for batteries).

1) The filtering of critical products into products for sensitive ecosystems was not done because the methodology for this was not described in the European Commission studies; 2) In doing so, we also broadened the criterion around extra-EU imports to take into account products that are not now, but could potentially become so with the elimination of Dutch exports. This did not lead to an expansion of the product list. Source: European Commission (2023), An enhanced methodology to
Monitor the 's strategic dependencies and vulnerabilities; Nedmag; interviews with companies from the 6 sectors

Sector-specific analyses
5. Glass & ceramics

The Socioeconomic Impact of 6 Sectors within Basic Industry.

5. Glass & ceramics

5.1 Introduction

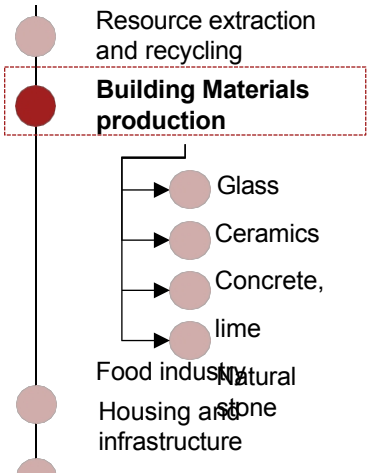


Figure 5.1. Value chain construction materials

2,100 companies in the glass and ceramics sector in the Netherlands

~22,000 people employed in the glass and ceramics sector

Figure 5.2. Average employment 2021-2023

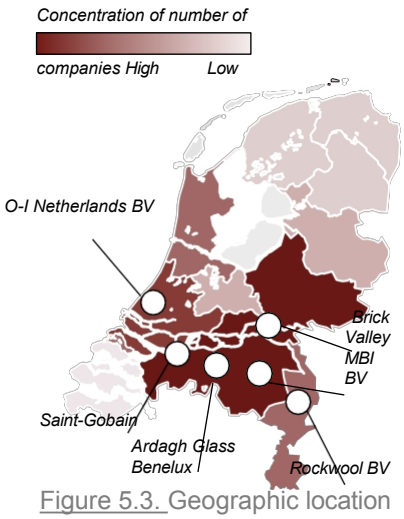


Figure 5.3. Geographic location companies on map

The CBS building materials industry sector consists mainly of glass & ceramic producers

The CBS building materials industry sector includes the production of different types of building materials. The Dutch building materials industry mainly produces/works glass (~33% of all companies in this sector), concrete, lime or gypsum (~25%), natural stone (~22%), ceramics (bricks, roof tiles) (~20%) and other mineral products (~3%). Most large companies operate in glass and ceramics sector, which is why we use this designation.[1] The glass industry consists of 3 components; container glass, insulating glass and table glass. The production processes in this sector vary by subsector, but all involve the high temperature or pressure remelting, drying or compressing of raw materials such as sand, clay and lime into glass, insulating material and ceramics. Because of the high pressures and temperatures , the production processes are energy intensive.

Between 2021 and 2023, the Dutch glass & ceramics sector produced ~€8 billion per year on average, of which 27% (€2 billion) was exported

During the same period, imports amounted to ~€3 bln. This brings the NL trade balance for glass & ceramics to -€1 bln.

The glass & ceramics industry consists of ~2,100 companies and employs ~22,000 people

Between '21-'23, an average of 2,100 companies were active in the Dutch glass & ceramics industry, employing ~22,000 people. Almost all companies (99%, ~20,700 employees) have less than 250 employees and thus fall under SMEs.

North Brabant, Gelderland and South Holland are home to most of the producers of glass & ceramics. Rockwool BV, O-I Netherlands BV and Ardagh Glass Benelux are some of the largest producers of glass in the Netherlands, producing insulation material, or glassware.

Brick Valley in Gelderland is home to many ceramic producers. Brick Valley is located near the floodplains of several major rivers. The ceramic products use the deposits of river clay as raw material in their production.

1) All CBS figures presented refer to the CBS Building Materials sector
Source: CBS; Based on supply and use tables CBS 2021-2023 actual prices; TNO;

5. Glass & ceramics

5.1 Introduction

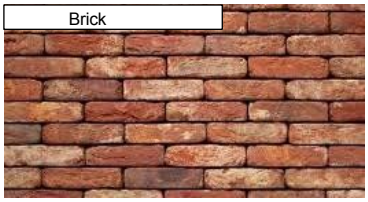


Figure 5.4. Applications

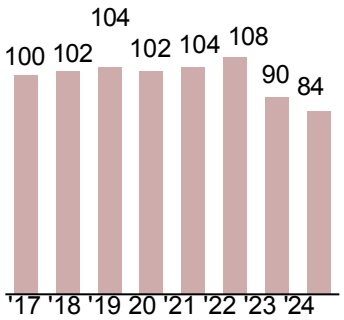


Figure 5.5. Historical production normalized to 2017

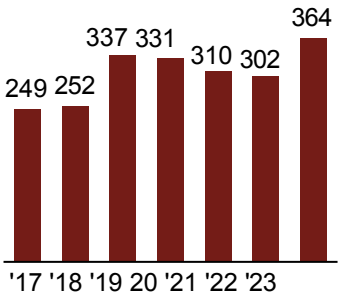


Figure 5.6. Historical investments (€ mln).

Ceramics & insulating glass is essential for residential construction and infrastructure, packaging glass especially for the food industry

The sector processes (raw) raw materials into ceramics and glass. Ceramics and insulating glass are the building blocks for housing construction and offices. The production of packaging glass is particularly important for the food industry.

European demand for glass and ceramics is expected to rise in the future due to the transition to energy-efficient buildings

The Netherlands has a task to build 100,000 homes per year, and to make a large proportion of existing homes more sustainable, for which an increasing demand for building and preservation materials is expected.

As for packaging glass, demand tends to grow with the overall economy. Nevertheless, companies note that in recent years has been a substitution from packaging glass to can and plastic in the food industry, due to the lower cost of these materials. The specific development of Dutch demand for packaging glass in the coming years will largely depend on the extent to which the current trend of substitution from glass to can and plastic in the food industry continues. Nevertheless, the need for glass and ceramic products is expected to continue.

Production remained constant through 2022 and decreases from 2023, investment remained constant through 2022 and increases in 2023

Production increases through 2022 and decreases from 2022 by ~24%. Investment is increasing at an average annual rate of 5% and peaks in 2023.

The decline in production from 2023 can be attributed to a decrease in the number of new homes completed (-7%) in residential construction compared to '22. The glass & ceramics market is expected to recover in 2025 (+0.5%-2.5%). Declining production in the packaging glass industry from 2023 is driven by reduced demand from the food industry.

Investments increased between 2017-2023. Investments are mainly related to product improvement, process optimization, and sustainability through own energy generation or use of waste heat. Larger investments for innovation of production processes remain absent.

Source: CBS; TNO; central government; Glass for ; Joint Research Centre European Commission; Universidad de Huelva; OECD; Cembureau; Central government: housing agreements

5. Glass & ceramics

5.2 Economic impact

€ 2.5 billion
Gross value added *(2021-2023 average)*

22k
Jobs *(average 2021-2022)*[2]

€ 156 million
Corporate and other business taxes *(average 2021-2022)*[1, 2]

The direct value added of the glass & ceramics industry averaged ~€2.5 billion between 2021 and 2023

The Dutch glass & ceramics sector contributed an average of ~€2.5 billion per year to Dutch GDP between 2021 and 2023 (0.3% of total) and employed an average of ~22k people between 2021 and 2022 (0.2% of total).
The glass & ceramics industry averaged between 2021 and 2022.
~€156 million a year paid in taxes.

Figure 5.7. Key figures of economic impact

The total value added including direct, indirect and derived impact of the glass & ceramics industry averages ~€5.3 billion between 2021 and 2023

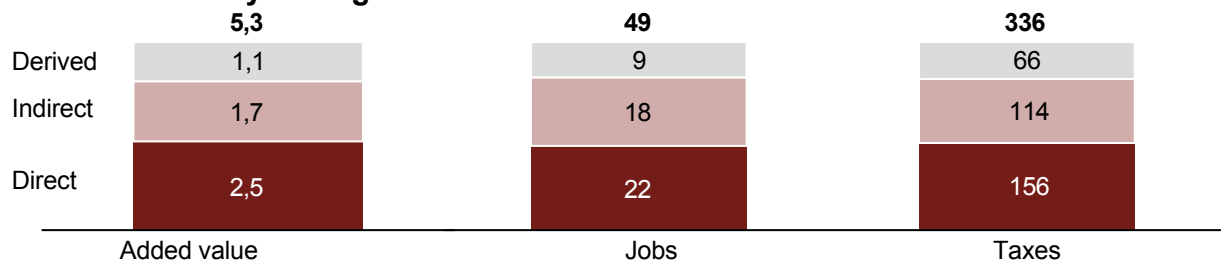


Figure 5.8. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

Besides the direct economic impact, the glass & ceramics industry also leads to indirect economic impact for the Netherlands as the glass & ceramics industry purchases ~57% of its inputs within the Netherlands. As a result, the glass & ceramics industry indirectly leads to ~€1.7 bln in added value, ~18K jobs and ~€114 mln in taxes.

Finally, the glass & ceramics industry leads to derived economic impacts, as workers within the Dutch glass & ceramics industry spend some of their income on Dutch manufacturers. The inferred impacts of the glass & ceramics industry amount to ~€1.1 bln in value added, ~9K jobs and ~€66 mln in taxes.

As a result, the total value added of the glass & ceramics industry is ~€5.3 bln, the sector leads to ~49K jobs and ~€336 mln in tax revenue. This means that every euro of direct contribution generates €1.1 of additional value added, for every direct job ~1.2 additional jobs are created and for every euro of direct tax €1.2 additional tax is paid.

1) Other business taxes include, for example, emission allowances, sewer fees and charges on water pollution; 2) Taxes and jobs are shown for 2021-2022 because CBS data On corporate tax and employment for 2023 lacks
Source: CBS Input-output data (2021-2023, actual prices)

5. Glass & ceramics

5.2 Economic impact

The Dutch glass and ceramics industry supplies 68% of total NL needs; the construction industry in particular is dependent on the NL sector

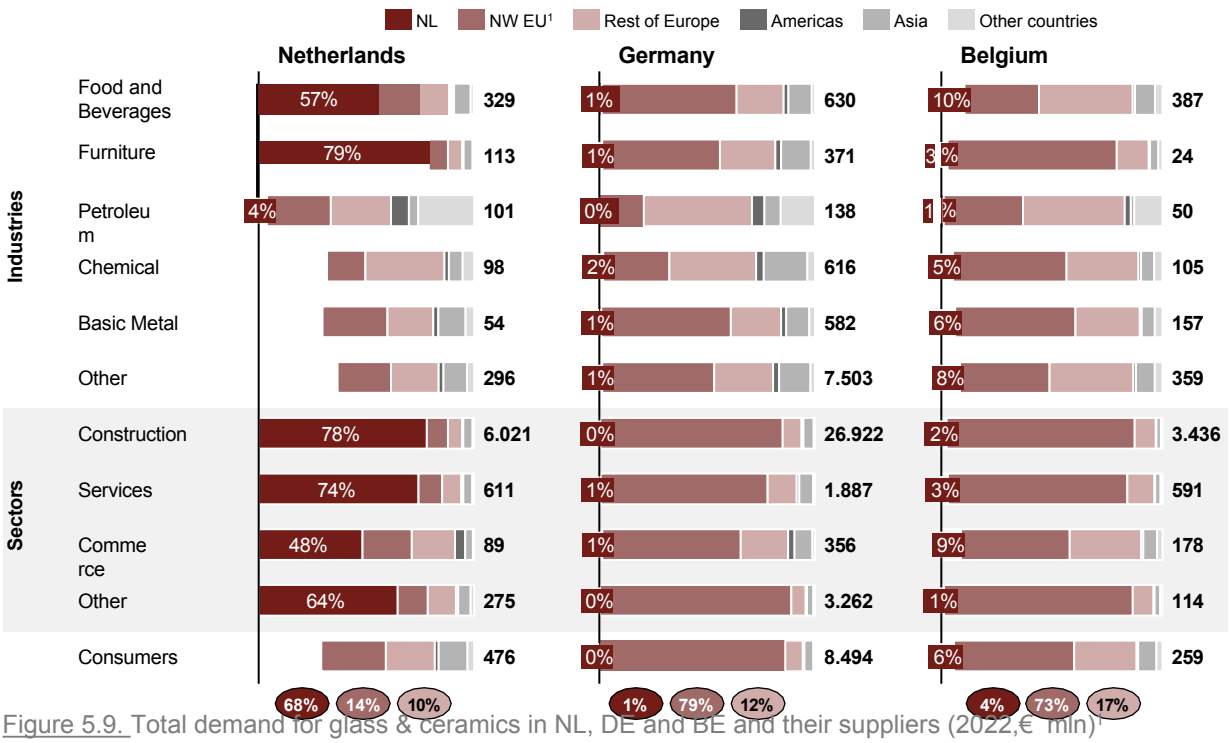


Figure 5.9. Total demand for glass & ceramics in NL, DE and BE and their suppliers (2022,€ mln)[1]

The glass & ceramics industry has a strong local blueprint and responsible for supplying 68% of total Dutch demand for glass & ceramics. It also supplies 1% of total German demand and 4% of total Belgian demand.

The primary consumer of glass & ceramics is the construction industry. The Dutch construction industry purchased €6.0bn from the glass & ceramics industry in 2022, which is 72% of Dutch production. This demand is mainly driven by demand for ceramics (bricks, roof tiles), glass and insulation materials (see also section 5.1). In addition, demand is high from services (€0.6 bln) and the food industry (€0.3 bln). The demand for glass & ceramics from the service industry is driven by specific types of services closely linked to construction, such as housing associations. Demand from the food industry is driven by demand for glass packaging (see section 5.1).

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United Kingdom; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category
Rest of the . Demand from own sector not shown in chart
Source: Eurostat Input-output data (2022, actual prices)

5. Glass & ceramics

5.2 Economic impact

Labor productivity in the glass and ceramics sector is below the NL average and decreased by 4% due to declining production

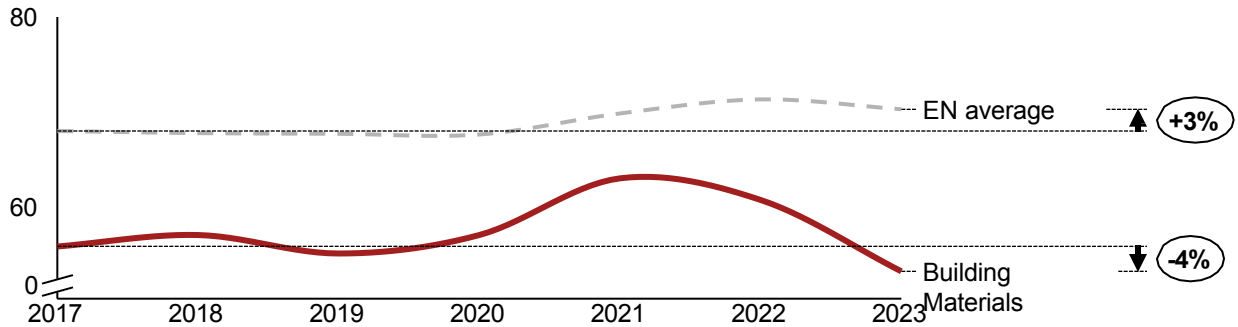


Figure 5.10. Labor productivity in NL glass and ceramics sector and NL total commercial sector (2017- 2023, € per hour worked)

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and corporate profits, and also creates more room for higher wages. Absolute labor productivity within the glass and ceramics sector averaged ~€59 per hour worked between 2017 and 2023. This is ~16% lower than the Dutch average of ~€69 per hour worked.

In addition, between 2017 and 2021, labor productivity within the sector increased by ~12%. There was a dip in labor productivity in 2022 and 2023, most likely driven by lower output in these years (see section 5.1). Total labor productivity decreased by ~-4% between 2017 and 2023.

Between 2017 and 2022, the glass & ceramics sector accounted for ~0.2% of Dutch R&D spending and EPO patent applications

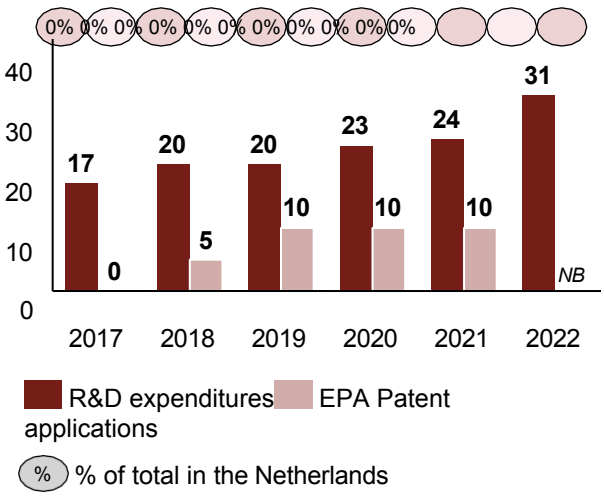


Figure 5.11. Expenditure on own R&D activities in the Netherlands and number of EPO patent applications for NL glass and ceramics sector sector

Between 2017 and 2022, spending by the glass and ceramics sector on R&D was ~€23 mln per year and 0-10 patents were filed with the EPA.

Annual R&D expenditures and patent applications of the glass and ceramics sector amount to ~0.2% of total R&D expenditures and patent applications in the Netherlands. Innovations relate in particular to product improvement, process efficiency and the use of renewable energy sources. Within product improvement the focus is on reducing raw materials and energy consumption, and within process efficiency on increasing the energy efficiency of existing processes and increasing the recycling rate.

Source: CBS, measured as gross value added per number of employees based on basic prices 2021; CBS; ING; TNO; Interviews with glass and ceramics companies

5. Glass & ceramics

5.3 Environment

The glass and ceramics sector was responsible for 1% of total NL CO_2-eq. emissions between 2021-2023.

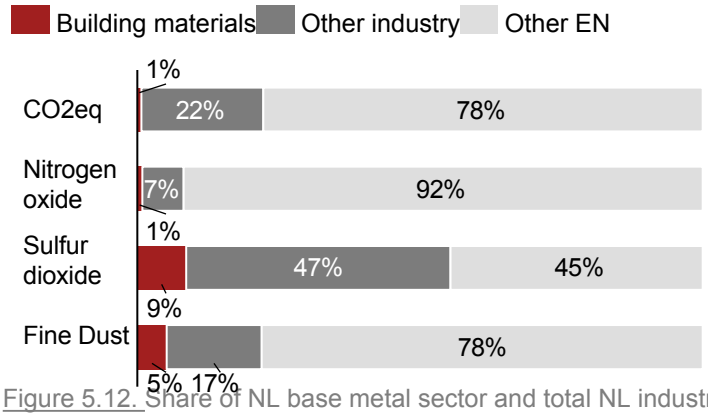


Figure 5.12. Share of NL base metal sector and total NL industry in NL emissions (2021-2023, %)

The glass & ceramics sector is energy-intensive and thus (for now) CO_2-intensive. The sector emitted an average of ~1.4 Mton CO_2-eq. between 2021 and 2023 (3% Dutch industry and 1% of the Netherlands).

In addition, the sector is responsible for 9% of NL emissions of sulfur dioxide and 5% of particulate matter emissions.

CO_2-eq. emissions within the glass and ceramics sector decreased ~60% from 1990, due to investments in process efficiency and electrification

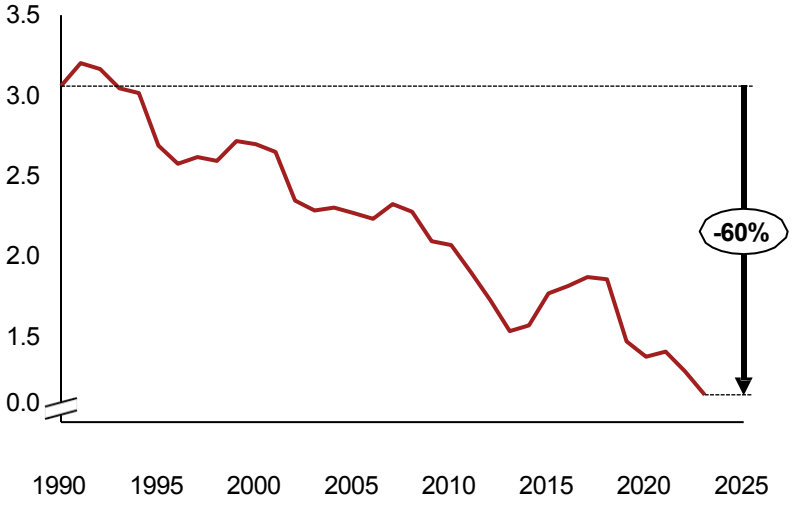


Figure 5.13. CO_{2eq} emissions from NL base metal sector (Mton).

CO_2-eq. emissions fell ~60% between 1990 and 2023. This decrease in emissions is partly driven by the observed production decline (see section 5.1). When adjusted for production decline, $CO_{(2)\text{-eq}}$. emissions decreased by ~57.3% between 1990 and 2023.

This CO_2-eq. emission reduction was achieved through investments in among other things, process efficiency (improved furnace insulation and residual heat recovery), electrification and product optimization (reducing use (carbonized) raw materials).

ETS contribution averaged ~€21 mln between 2021 and 2022

The glass and ceramics sector's ETS contribution was ~€19.6 mln in 2021 and ~€23.0 mln in 2022. Averaged over 2021 and 2022, this was ~€21.3 mln, which is 1.0% of the total Dutch ETS costs over that period.

Source: CBS, Netherlands Emissions Authority; TNO

5. Glass & ceramics

5.3 Environment

Electrification, biogas, hydrogen and CCS are the primary options for reducing CO_2 emissions, but a number of preconditions are necessary for large-scale sustainability

In the glass & ceramics industry, 30-80% of emissions are due to the use of fossil fuels to create the high temperatures and pressures required in the production process. In the production of bricks, roof tiles, insulation materials and drywall, CO_2 is additionally required as a raw material.

For the glass industry, electrification, biogas and hydrogen are the primary decarbonization options. Glass production using biogas is possible using current production methods. Glass production using electricity or hydrogen requires innovations regarding the existing production process and the applicability of hydrogen for glass production is not yet proven. Hybrid options where part of the energy source becomes renewable are likely to be an intermediate solution. By 2030 it is expected that 88% of energy can come from renewable sources, and by 2050 99%. The glass industry has a target of 20-40% energy efficiency by 2030, and net zero production by 2050.

For the ceramics industry, hydrogen and biogas are the primary decarbonization options. Biogas-based production is a mature technology and can lead to 74% CO_2-eq reduction. Hydrogen-based production, electrification and emission reduction by CCS are being investigated, but these techniques are not yet mature or technically proven. The high power requirements and required modifications to existing furnaces and production processes are barriers to electrification. The relatively low concentration of CO_2 emissions make CCS relatively expensive and require modifications to available CCS techniques. The ceramics sector has a target of reducing CO_2 emissions by 55% by 2030, and Brick Valley has a target of climate-neutral production by 2050.

In recent years, a number of barriers existed that hindered large-scale sustainability, such as 1) a lack of access to the necessary infrastructure (both electricity (congestion) and, hydrogen and CCS), 2) complex and changing regulations around, for example, (nitrogen) permits, 3) an unprofitable top combined with an international playing field that limits the ability to pass on the high costs, and limited government support,
4) low volumes of available biogas. The location of many glass & ceramic producers in relation to the main energy infrastructure may further hinder opportunities for large-scale sustainability.

Contribution of existing glass production to circularity goals

The Netherlands aims to have a circular economy by 2050, in which as many sustainable renewable raw materials as possible are used, products and raw materials are reused and hardly any waste exists. The government's guiding goal is for the Netherlands to use 50% less abiotic raw materials (minerals, metals and fossil) by 2030.

In the Netherlands, glass is recycled into 2 groups: deposit glass and one-way glass. Deposit bottles are inspected and cleaned after return. Approved bottles are refilled and can be reused 10 to 30 times. By 2023, approximately 50% of glass consisted of deposit bottles. Single-use glass is cleaned, heated, molded and formed.

In particular, the glass industry contributes to the recycling of single-use glass. According to a VNG report, Dutch packaging glass consists of more than 65% recycled glass (cullet).

Source: TNO; Interviews with companies; VNG; FEVE; NPVI; Brick Valley

5. Glass & ceramics

5.4 Strategic relevance

EU import dependence for glass and ceramics increased and EU trade balance decreased

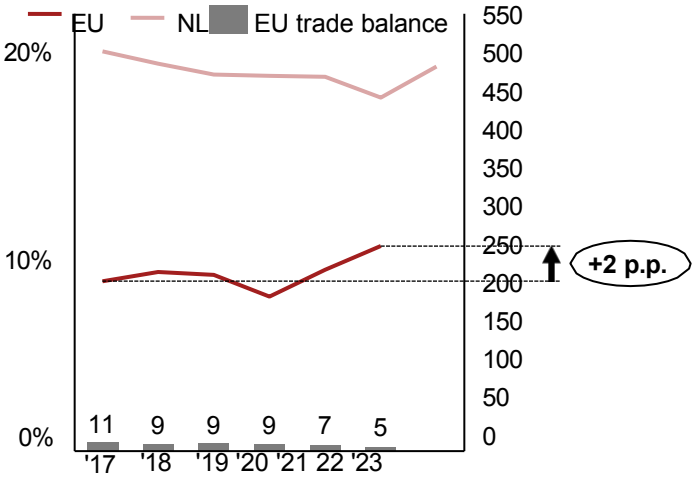


Figure 5.14. Import dependence of EU and NL

Between 2017 and 2022, the EU's import dependence increased from 8% to 10%. For the Netherlands, import dependence for glass & ceramics decreased from 19% to 18% between 2017 and 2023.

In addition to an increasing level of imports at the EU level, EU exports of glass & ceramics also declined, reducing the trade balance from €11 bln to €5 bln.

In 2022, Germany and Italy were the largest EU suppliers of glass & ceramics to the EU and the EU imported mainly from China

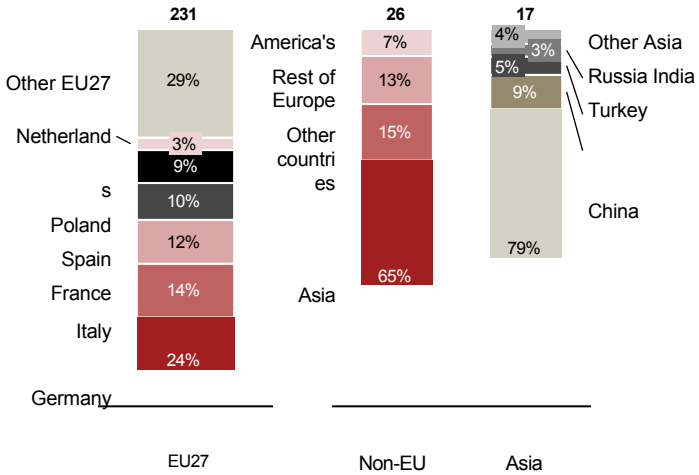


Figure 5.15. Distribution of glass & ceramic suppliers to EU27 by country (2022, €bn)[1]

The largest EU suppliers in 2022 were Germany (24% of the EU market in 2022), Italy (14%), France (12%), Spain (10%) and Poland (9%). Dutch production accounted for ~3% of the total EU market in 2022.

65% of imports from non-EU countries came from Asia. The largest Asian suppliers of glass & ceramics to the EU in 2022 was China (79%).

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the . Source: Eurostat Input-output data (2022, actual prices); CBS

5. Glass & ceramics

5.4 Strategic relevance

Several indicators show that the (international) competitive position of the NL glass & ceramics sector has worsened since 2022

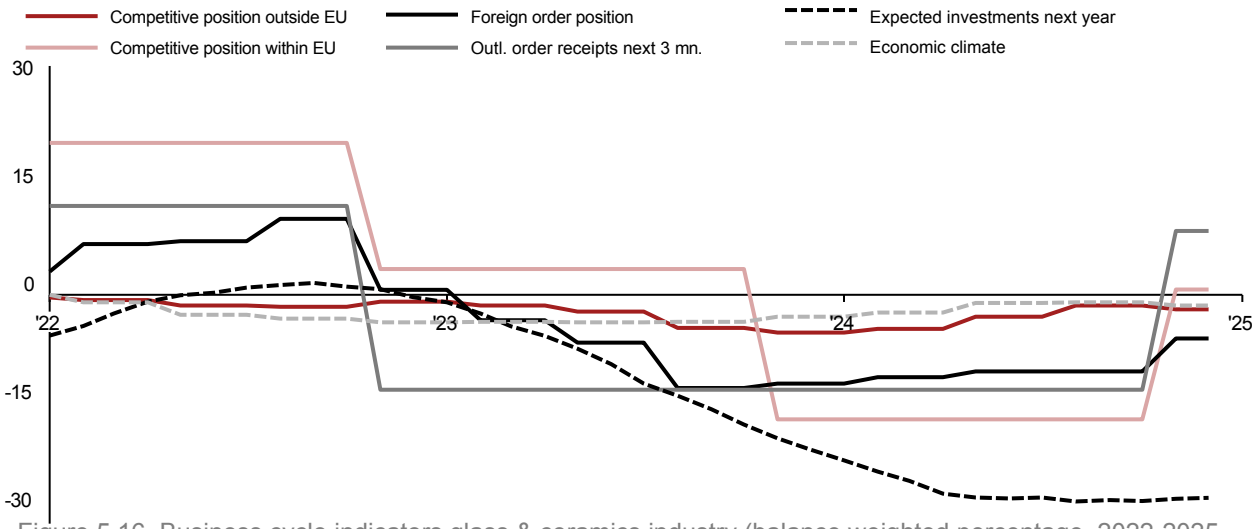


Figure 5.16. Business cycle indicators glass & ceramics industry (balance weighted percentage, 2022-2025, 12-month trailing moving average)

Periodically, CBS captures the mood among entrepreneurs through the Conjunctuurenquête Nederland (COEN), commissioned by the European Commission. The results of the survey are published aggregated by sector.

The COEN survey shows from various business cycle indicators that the sentiment of the Dutch glass & ceramics industry about the international competitive position has deteriorated from 2022 onwards. For example, expectations about the foreign order position and foreign order receipts for the next 3 months decreased from 2022 and became structurally negative from 2023, meaning that the majority of entrepreneurs believe that the foreign order position is too small and will decrease in the next 3 months.

In addition, from 2023 entrepreneurs indicate that expected investments will decrease compared to the current year. At the beginning of 2025, on balance, 27% of entrepreneurs expect their investments to decrease compared to the current year.

Confidence in the competitive position of the Netherlands both inside and outside the EU and in the economic climate in NL has decreased from 2022 onwards and is structurally negative for the latter two from 2022 onwards. This means that the majority of entrepreneurs that their competitive position outside the EU and the economic climate in NL has deteriorated. At the end of 2024, sentiment about foreign orders over the next 3 months and competitiveness within the EU improves, but expectations remain lower than in 2022.

The deterioration in sentiment surrounding the international competitiveness of the Dutch glass & ceramics sector is an indication that import dependence may increase in the future.

Source: CBS

Sector-specific analyses
6. Paper

The Socioeconomic Impact of 6 Sectors within Basic Industry.

6. Paper

6.1 Introduction

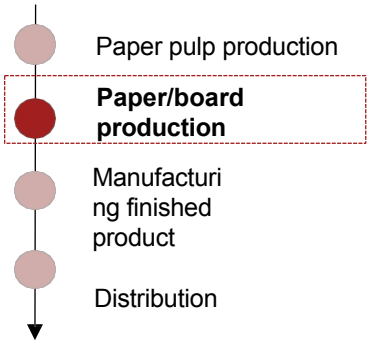


Figure 6.1. Paper value chain

360 companies in the paper industry in the Netherlands

22,100 people employed in the paper industry

Figure 6.2. Average employment 2021-2022

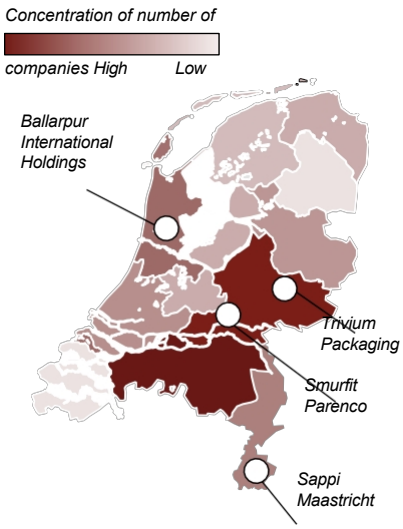


Figure 6.3. Geographic location paper companies

Paper industry processes pulp into paper and paperboard

The paper industry processes fresh or recycled paper pulp into paper and paperboard products, with recycled paper being an important raw material. Depending on the purpose, the paper is further processed. Examples of further processing include coloring, printing and/or forming into packaging, for example.

Between 2021 and 2023, the Dutch paper industry produced ~€9 billion per on average, of which 65% (€6 billion) was exported

In the years 2021, 2022 and 2023~€7 bln was imported. This brings the NL trade balance for paper products to
-€1 bln.

The paper industry in the Netherlands consists of 360 companies and employs 22,100 people

In the years 2021 and [20221], according to CBS, 360 companies were active in the Dutch paper industry and provided jobs for 22,100 people.

Over 95% of these companies can be categorized under SMEs. shelved, these are companies with fewer than 250 employees.

North Brabant and Gelderland are home to most of the activities of paper producers. Smurfit Westrock and Sappi are examples of large paper mills in the Netherlands.

1) CBS data available through 2022; Source: CRB, VNP, CBS

6. Paper

6.1 Introduction

Applications/industries

Product	Growth p.y.
Packaging	+1,3%
Paper and cardboard	-1,0%
Coated and uncoated paperboard	+1,0%
Tissue	+1,7%
Newsprint	-9,0%

Figure 6.5. Growth per year EU for major applications (2015-2050)

Paper and cardboard are indispensable for various everyday applications

Paper packaging acts to protect products during transportation and storage. In addition, paper contributes to hygiene and comfort in everyday life. Think of toilet paper, paper tissues and paper napkins. Furthermore, we use paper to make books and magazines.

Overall, ~81% of Dutch production consists of packaging paper and board, ~4% of sanitary paper and the remaining ~15% of graphic paper.

Demand for paper is increasing, partly due to higher demand for paper packaging

Sales are expected to improve slightly from 2025, despite declining demand for printing and writing paper due to digitization. The expected growth per year until 2050 averages 0.21%. Annual declines in newsprint will be met by rising applications such as packaging and tissues.

This overall increase is partly due to population growth and the growth of e-commerce, which requires more packaging materials. In addition, greater environmental awareness and new regulations in Europe (and thus circularity goals of companies), encourages the use of paper and paperboard. This change is particularly evident in commercial, food and pharmaceutical industries.

Source: CRB, VNP, European Commission, Allianz, JRC

6. Paper

6.1 Introduction

Historical production

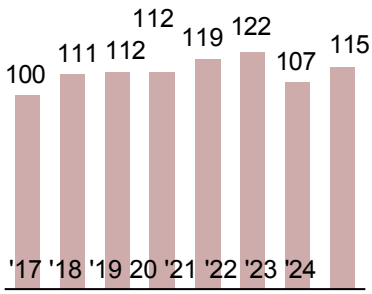


Figure 6.6. Historical production normalized to 2017

Historical investments

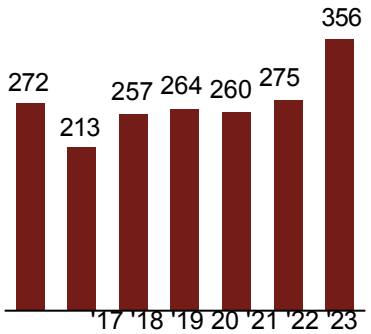


Figure 6.7. Historical investments (€ mln).

Historical production experienced a major dip in 2023 due to rising costs and falling demand especially in the graphic paper sector

After years of stable growth between 2017 and 2022, paper production fell sharply in 2023. The year 2023 is seen as a bad year in Europe due to a weak economy, continued high energy costs and a huge inventory drawdown.

Investments in innovation and sustainability rise after years when companies were limited to maintenance investments

Investment in the paper industry has been stable for an extended period, rising to €356 mln by 2023. Companies in the industry say they do not recognize this picture and expect this increase to be something one-off.

Source: CBS; Cepi; VNP; Veyzle

6. Paper

6.2 Economic impact

€ 2.0 billion
Gross value added *(2021-2023 average)*

18k
Jobs *(average 2021-2022)*

€ 84 million
Corporate and other business taxes *(average 2021-2022)*[1]

Direct value added of the paper industry averaged ~€2.0 billion between 2021 and 2023

The Dutch paper industry contributed ~€2.0 billion to Dutch GDP between 2021 and 2023 (0.2% of total) and employed ~18k people between 2021 and 2022 (0.2% of total).
The paper industry paid an average of ~€84 million in taxes between 2021 and 2022.

Figure 6.8. Key figures of economic impact

Total value added including direct, indirect and derived impact of the paper industry averages ~€4.8 billion between 2021 and 2023

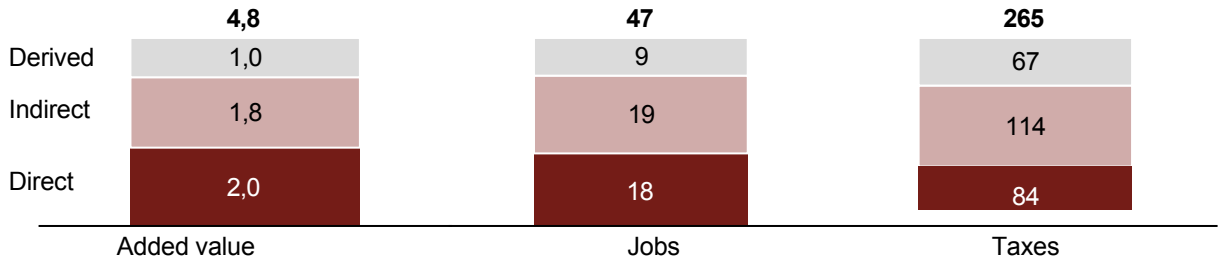


Figure 6.9. Direct, indirect and derived gross value added (€ bln, average 2021-2023), jobs (k, average 2021-2022) and corporate and other taxes (€ mln, average 2021- 2022)

In addition to the direct economic impact, the paper industry also leads to indirect economic impact for the Netherlands because the paper industry purchases ~47% of its inputs within the Netherlands. As a result, the paper industry indirectly leads to ~€1.8 bln in added value, ~19K jobs and ~€114 mln in taxes.

Finally, the paper industry leads to derived economic impacts as workers within the Dutch paper industry spend some of their income on Dutch producers. The derived impacts of the paper industry amount to ~€1 bln in value added, ~9K jobs and ~€67 mln in taxes

As a result, the total value added of the paper industry is ~€4.8 bln, the sector leads to ~€265 mln in tax revenue and ~47K jobs. This means that every euro of direct contribution generates €1.4 of additional value added, for every direct job ~1.6 additional jobs are created, and for every euro of direct tax €2.2 additional tax is paid.

1) Other business taxes include, for example, emission allowances, sewer fees and charges on water pollution; 2) Taxes and jobs are shown for 2021-2022 because CBS data On corporate tax and employment for 2023 lacks
Source: CBS Input-output data (2021-2023, actual prices)

6. Paper

6.2 Economic impact

The Dutch paper industry supplies 55% of total NL needs; in particular, food, services and consumers use products from the paper industry

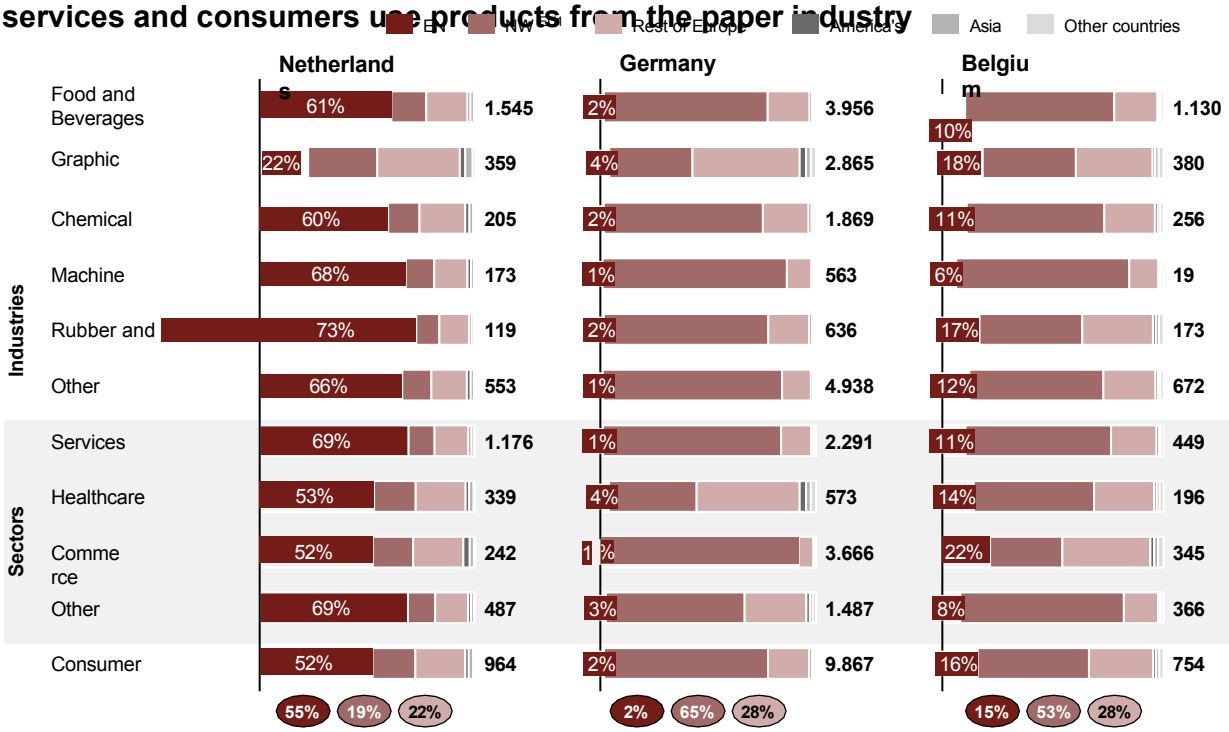


Figure 6.10. Total demand for paper products in NL, DE and BE and their suppliers (2022,€ mln)[1]

The paper industry has a strong local blueprint and is responsible for supplying 55% of total Dutch demand for paper products. It also supplies 2% of total German demand and 15% of total Belgian demand.

Demand for paper products is strongest from food and beverage (€1.5 bln), service (€1.2 bln) and additionally from consumers (€964 bln). Demand from the food and beverage industry is particularly driven for demand for paper and cardboard packaging. Services, in addition to packaging, purchase office supplies (printing paper, notebooks, etc.) and marketing materials (business cards, brochures, etc.) from the paper industry. Demand from consumers is driven by demand for personal care products (toilet paper, handkerchiefs) and graphic paper (magazines/newspapers, writing paper, wallpaper) (see also section 6.1).

1) NW EU is Northwest Europe and includes Germany and Belgium, Rest of Europe are other EU-27 countries, Switzerland, Norway and the United ; Americas are Argentina, Brazil, Canada, Mexico and the States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Demand from own sector is not shown in the graph; Source: Eurostat Input-output data (2022, actual prices); TNO; Statista

6. Paper

6.2 Economic impact

The labor productivity of the wood, paper and graphics sector is around the NL average, increasing between 2017 and 2020 and decreasing from 2020 onwards

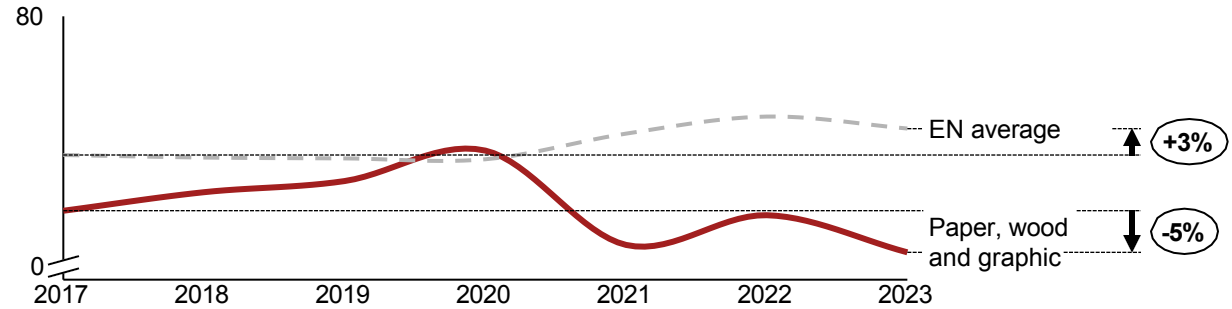


Figure 6.11. Labor productivity in NL paper sector and NL total commercial sector (2017-2023,€ per hour worked)

Labor productivity is a key economic indicator: growing productivity increases a country's prosperity and corporate profits, and also creates more room for higher wages. Absolute labor productivity within the paper sector averaged ~€64 per hour worked between 2017 and 2023. This is in line with the Dutch average of ~€69 per hour worked.

In addition, between 2017 and 2020, labor productivity within the sector increased by ~8%. From 2020, there was a decline in labor productivity, possibly driven by increasing pressure on margins. Total labor productivity decreased by ~5% between 2017 and 2023.

The paper sector accounted for ~0.3% of Dutch R&D spending and EPO patent applications between 2017 and 2022

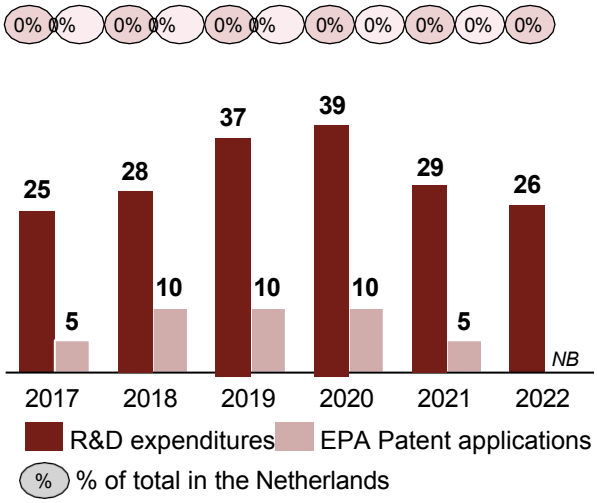


Figure 6.12. Expenditure on own R&D activities in the Netherlands and number of EPO patent applications for NL paper sector

Between 2017 and 2022, expenditures of the paper sector to R&D ~€25-39 mln per year and 5-10 patents were applied for at the EPA; ~0.3% of total R&D expenditures and patent applications in the Netherlands.

Source: CBS, measured as gross value added per number of employees based on basic prices 2021

6. Paper

6.3 Environment

The paper sector was responsible ~0.5% of total NL CO_2-eq emissions between 2021-2023

The paper sector emitted an average of ~0.9 Mton of CO_2-eq. between 2021 and 2023. This made the sector responsible for ~2% of the total CO_2-eq. emissions of Dutch industry and ~0.5% of the Netherlands. According to CBS, the sector emitted 1 kiloton of nitrogen oxide and hardly any sulfur dioxide, ammonia and particulate matter.

CO_2-eq. emissions within the paper industry have decreased by ~55% from 1990, due to investments in process efficiency and electrification

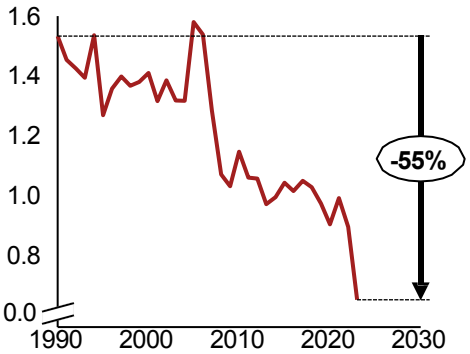


Figure 6.13. CO_{2eq} emissions from NL refining sector (kton)[1]

CO_2-eq. emissions decreased ~55% between 1990 and 2023. Adjusted for increasing production, total CO_2-eq. emissions fell ~67% between 1990 and 2023.[1]

This CO_2-eq. emission reduction was achieved through investments in process efficiency (reducing energy and water use, using residual heat) and electrification (e-boilers), among other things.

ETS contribution averaged ~€18 mln between 2021 and 2022

The paper industry's ETS contribution was ~€18.5 mln in 2021 and ~€18.3 mln in 2022. Averaged over 2021 and 2022, this was 0.9% of the total Dutch ETS costs.

1) CO_2-eq. emissions adjusted for industry production changes calculated by Actual CO_2-eq. emissions to be corrected for production index of relevant year
Source: CBS, Interviews with paper companies; EU ETS

6. Paper

6.3 Environment

Electrification, biogas and hydrogen are the primary options to reduce CO_2 and sulfur dioxide emissions, but a number of barriers stand in the way of large-scale sustainability

Decarbonization options for the paper industry are primarily focused on thermal (using steam) drying of paper, where ~80% of emissions in paper production occur. Primary decarbonization options are the use of boilers powered by electricity and/or biogas. These technology are all already commercially available and required modifications in the production process are relatively limited. In the short it is expected that these will be the primary decarbonization routes, ~5 paper mills in the Netherlands already run (partly) on biogas.

In addition, research is being conducted into other sustainability techniques, which can play a role in making the sector more sustainable in the long term. Paper refining by compression can reduce CO_2 emissions and halve electricity use, heat pumps can convert low-temperature waste heat into steam, and "dry" paper production halves the energy required in the drying process by producing paper without the use of water.

In recent years, a number of barriers have existed that impede large-scale sustainability. Lack of access to the necessary electricity infrastructure is one of the primary barriers. In addition, the high grid prices in NL and the investments required to access the infrastructure impact the profitability/applicability of these sustainability strategies.

Box: Contribution of existing paper production to circularity goals

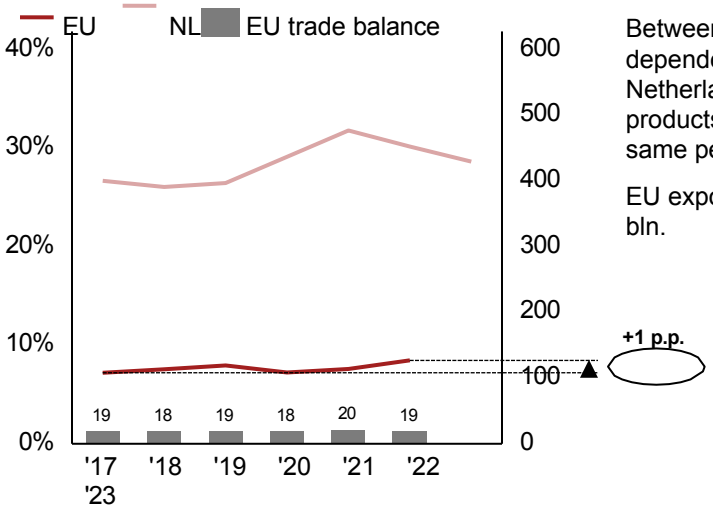
The Netherlands has set goals to be fully circular by 2050. Specifically for paper, this includes using recycled materials, reducing waste and promoting sustainable forestry practices. By 2023, 89% of paper was recycled (including circular packaging). The legal target in the Netherlands for 2023 was 85%, which is the same target set by the European Union for 2030.

Source: TNO; Verpact, VNP, Sustainable Business, Ministry of Infrastructure and Water Management, Interviews with companies in the industry

6. Paper

6.4 Strategic relevance

Import dependence of EU and NL for paper was relatively stable between '17 and '22 and EU remained net exporter of paper products



Between 2017 and 2022, the EU's import dependence increased from 7% to 8%. For the Netherlands, import dependence for paper products increased from 25% to 27% over the same period.

EU exports of paper products remained flat at ~€19 bln.

Figure 6.14. Import dependence of EU and NL

In 2022, Germany and Italy were the largest EU suppliers of paper products to the EU, and the EU imported from all other continents

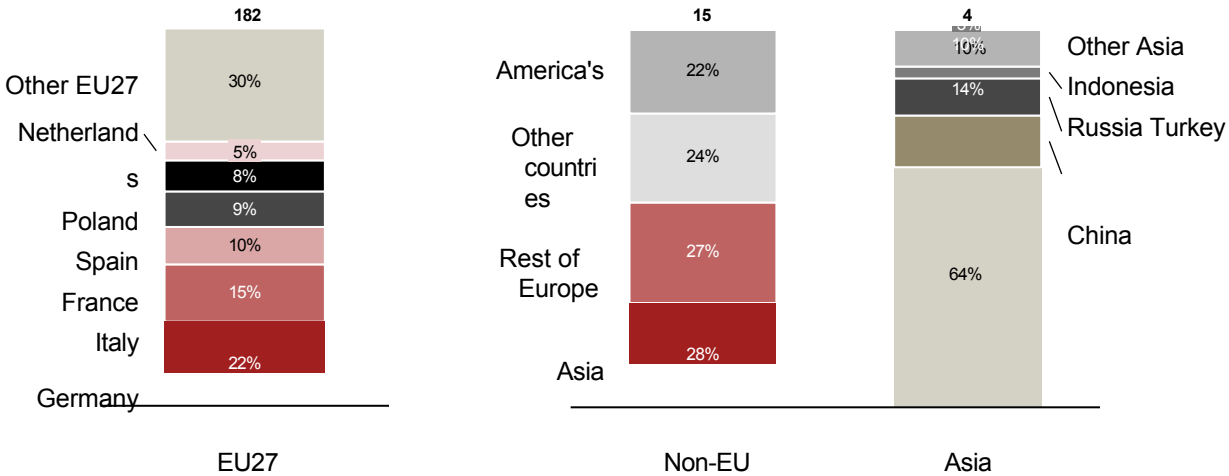


Figure 6.15. Distribution of suppliers of base metal products to EU27 by country (2022,€ bln)[1]

The largest EU suppliers in 2022 were Germany (22% of the EU market in 2022), Italy (15%), France (10%) Spain (9%) and Poland (8%). Dutch production accounted ~5% of the total EU market in 2022.

28% of imports from non-EU countries came from Asia. The largest Asian suppliers of paper products to the EU in 2022 was China (64%) followed by Turkey (14%).

1) EU27 are the EU27 countries; Non EU27 are Switzerland, Norway and the United Kingdom; Americas are Argentina, Brazil, Canada, Mexico and the United States; Asia is Australia, China, Indonesia, India, Japan, South Korea, Russia and Turkey; Other countries are Saudi Arabia, South Africa and the Eurostat category Rest of the World. Source: Eurostat Input-output data (2022, actual prices)

6. Paper

6.4 Strategic relevance

Several indicators show that the (international) competitive position of the NL paper sector has worsened since 2022

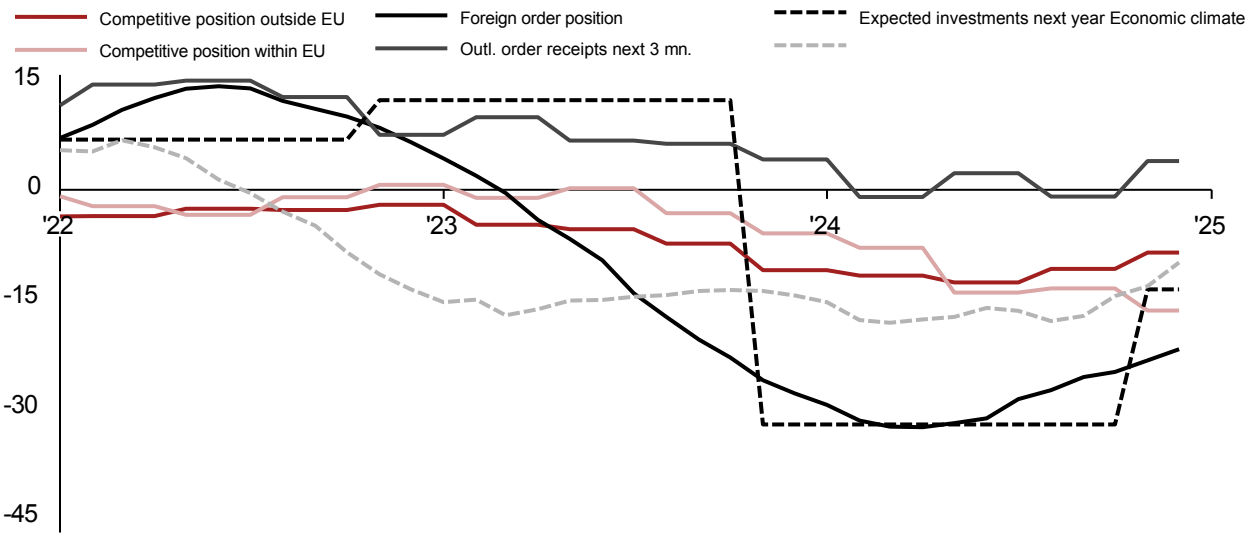


Figure 6.16. Paper industry business cycle indicators (balance weighted percentage, 2022-2025, 12-month trailing moving average)

Periodically, CBS captures the mood among entrepreneurs through the Conjunctuurenquête Nederland (COEN), commissioned by the European Commission. The results of the survey are published aggregated by sector.

The COEN survey shows from several business cycle indicators that the Dutch paper industry's sentiment about its international competitive position has deteriorated from 2022. For example, expectations about the foreign order position and foreign order receipts for the next 3 months declined from 2022. The foreign order position is structurally negative from 2023, which means that the majority of entrepreneurs believe that the foreign order position is too small, on balance 30% in 2024.

In addition, from the end of 2023, entrepreneurs indicate that expected investments will decrease relative to the current year. By the end of 2025, on balance, 13% of entrepreneurs expect their investments to decrease compared to the current year.

Confidence in the competitive position of the Netherlands both inside and outside the EU and in the economic climate in NL has declined and is structurally negative as of 2022. This means that the majority of entrepreneurs believe that their competitive position both within and outside the EU has deteriorated, and that the economic climate in NL has worsened.

The deterioration in sentiment surrounding the international competitiveness of the Dutch paper industry is an indication that import dependence may increase in the future.

About this report

Scope

We performed the work as agreed with you in the engagement letter. In accordance with the engagement letter, our scope included a factual, quantitative substantiation of the contribution of 7 sectors in terms of economy, environment, strategic relevance and future growth. Upon acceptance of the engagement letter, it was decided not to examine the Food and Spirits sector separately and to focus on the chain effects between it and the other 6 sectors.

We completed our analysis work on February 14, 2025. Therefore, this report does not include the impact of events after that date or the impact of information made available later.

Although the pillars examined (economic impact, environmental and strategic relevance) could be part an SCBA analysis, no full SCBA analysis was conducted. Nor has the relative competitive position of the Netherlands compared to other European countries been mapped.

Availability and quality of information

Our information is based as much as possible on publicly available data such as CBS (e.g., Input-output tables) and Eurostat and desk research. In some cases there were differences between the CBS and Eurostat datasets. We did not correct for these differences. For each analysis, we used one dataset to mitigate the impact. Through interviews with ~20 companies from the 6 sectors, we sought clarification on certain figures.

The information provided allowed us to gain a reasonable insight and understanding of the contribution of and dynamics within the 6 sectors. Given the short lead time of the project, the depth of the analyses was kept limited.

Starting point for our work

We have based our work as much as possible on publicly available data such as CBS and Eurostat. To the extent we have received data from companies, we have assumed that this information accurate, complete and not misleading. We did not perform an audit on this information or assessment aimed at determining its completeness and accuracy in accordance with international auditing or review standards.

Access to our report

We prepare the Report exclusively for you, the client, in accordance with the Engagement. The Report is strictly confidential and may not be disclosed (in whole or in part) to third parties without our consent. The information in the Report may also not be referenced. We do not accept any liability or duty of care towards any other party based on our work and (the contents of) our Report.

You agree indemnify and hold us, any shareholders, directors or employees engaged by us and any third parties, including other PwC firms, harmless from and against any liabilities, losses, expenses and other costs that we may reasonably incur or incur in connection with claims by third parties arising out of or in connection with the work performed by us in the context of the Engagement. This indemnification shall not apply insofar as it has been conclusively at law that such third-party claim is the result of intent or deliberate recklessness on the of PwC.

Our report has been prepared specifically for client with whom we agreed on the purpose and scope of our work or to whom we have explained the nature and scope of our work and the limitations therein. We therefore accept no responsibility, duty of care or liability - whether in contract, tort (including negligence) or otherwise - for the use of the report by parties other than the client.

Other comments

The Report as well as any dispute arising out of or related to (the contents of) the shall be governed exclusively by Dutch law.