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Decarbonisation strategies in sectors

……insights into GHG reduction options for more than 30 sectors across the Dutch economy

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January 2023

Introduction - Decarbonisation strategies in sectors

Introduction:

This publication gives insight into the state of greenhouse gas (GHG) emissions for 30 different sectors across the Dutch economy and what options companies have to reduce GHG emissions. It shows which sector is responsible for the most emissions and which sector has the highest emission intensity. For each sector, we show the path for further emission reduction up to 2030. Finally, we map some GHG emission reduction strategies to shape this path towards 2030 - but sometimes also partly towards 2050. In total, this publication **maps about 80% of the Netherlands' total GHG emissions**. Although the focus is on the Netherlands, much of the analysis is relevant for the equivalent sectors in other European countries.

Companies across different sectors are increasingly faced with politics, consumers, end users, NGOs and (regional) governments putting pressure on them to accelerate their GHG emission reduction efforts. Among other things, it also translates into stricter laws and regulations from the EU and national government. Companies are required to monitor their energy consumption and/or make investments in energy-saving solutions if payback periods permit, while also transitioning towards green energy sources. This publication offers a helping hand in part by making the underlying GHG figures transparent and providing some possible solutions for different sectors. We show the most effective decarbonisation options, with the highest technical readiness, which are also efficient in terms of the amount of capital that needs to be employed.

Companies in sectors within the Dutch economy have several opportunities to reduce GHG emissions that yield good results in the **short term**. For instance, companies can reduce their emissions by introducing energy efficiency measures. This is low-threshold and, if properly implemented, also effective in reducing GHG. In addition, processes can be electrified, but heat pumps, hybrid boilers and exploiting waste heat also help. These techniques are widely available and face relatively few obstacles.

In the **medium term**, numerous other decarbonisation options for companies are under development or suitable for further scaling up. To reach the 2030 target, it is necessary to implement current (demonstration) projects of technologies with known working principles. Think of Carbon Capture & Storage (CCS) with high CO_2 concentrations, recycling (plastics, scrap, biomass), green fuels and geothermal projects.

In the **longer term**, an acceleration of the transition is needed, especially for the period between 2030 and 2050. This involves innovative breakthrough techniques and further development of existing technologies, from, for example, process innovations, further electrification, deployment of (green) hydrogen and biomass.

It is important to realise that ABN AMRO finances companies and not sectors. As such, the dashboards give a general picture of decarbonisation options for companies. For each decarbonisation option, several more variations are sometimes possible to reduce emissions, which have not been included here. All in all, the bottom line is that **making a good business case is almost always tailor-made** and the (financial) feasibility needs to be considered per company (and technique). Not every technique is applicable in every company and some techniques are also mutually exclusive. In any case, we invite you to discuss this with your ABN AMRO relationship manager and share your experiences.

Reading guide:

The fourth sheet of this publication gives a schematic overview of the Dutch economy with all the economic actors in it. From raw material extraction, transport, intermediate trade, further processing of raw materials to retail and wholesale trade and final consumption. The grey bar with sectors at the bottom concerns mainly the supporting sectors in the Dutch economy. Of course, the factor trade with foreign countries also has a prominent role. You can see at a glance where GHG emissions take place. A so-called pie chart is shown behind a number of sectors. This particular graph shows, with the green part, the share of the relevant sector in total GHG emissions in the Netherlands. For the sectors where no pie chart is shown, the share in total GHG emissions is less than 1%.

The text of the sectors on the schematic overview is coloured. The sectors that have dark green text are covered in this publication. By the way, you can click on these sectors for somewhat easier navigation through the document. The sectors that have a dark grey/black colour are not discussed further.

Each main sector responsible for a large share of emissions - such as agriculture, industry, built environment and mobility - is briefly introduced prior to the subsectors. The built environment is covered in the fifth sheet because trends in this overarching sector cut across almost all sectors. The same applies to mobility. However, the Transport & Storage sector has a large share in this and therefore mobility is discussed before the Transport & Storage sector.

In the remainder of the publication, each (sub)sector is discussed in two or three sheets with the current emission status with various indicators (1), the emission reduction pathway for the sector and the decarbonisation potential for the sector (2), supplemented by a further explanation of emission reduction technologies (3). In some cases, this explanation is missing, as insufficient information was available at the time of writing. The decarbonisation options by sector are plotted in a matrix against investment level and GHG reduction potential. This gives an overall picture of the most interesting options. To some extent, the matrix remains dynamic and is subject to change. This is because the further development of known decarbonisation options and innovation with new technologies will not stand still in the coming years.

In this publication, the 2030 emission reduction target for each sector is set at 60% of the 1990 emission level, according to the Cabinet Rutte IV climate target. However, there are sectors that have their own target in terms of emission reduction towards 2030. These have not been taken into account in this publication for the sake of simplicity and comparability between sectors. At the end of this publication, the appendix contains various rankings by sectors on the various indicators discussed.

If you have any questions, comments or additions to this publication, please let us know. Please contact Casper Burgering (casper.burgering@nl.abnamro.com).

Summary - Decarbonisation strategies in sectors

Decarbonisation requires hefty investments and public policy support

Within many of the economic sectors of the Dutch economy, the transition to a low-carbon or carbon-free pathway is now well underway. But our publication shows that some sectors are struggling, while for others, the emission reduction path towards 2030 is a viable option. The sectors responsible for most greenhouse gas (GHG) emissions face a major challenge to decarbonise their processes and products. This is an especially important task for many industry subsectors, some of which are complex and face many obstacles. However, our research also shows that there are not only numerous solutions and opportunities for GHG reduction in all sectors, but that these techniques are sometimes within reach.

Decarbonisation is a term used for removing or reducing emissions of carbon dioxide (CO_2) in particular. This can be achieved in several ways and the best practice decarbonisation technique varies greatly from sector to sector. For companies in one sector, switching to renewables or fuel substitution is most promising, while companies in other sectors achieve more through electrification and efficiency measures.

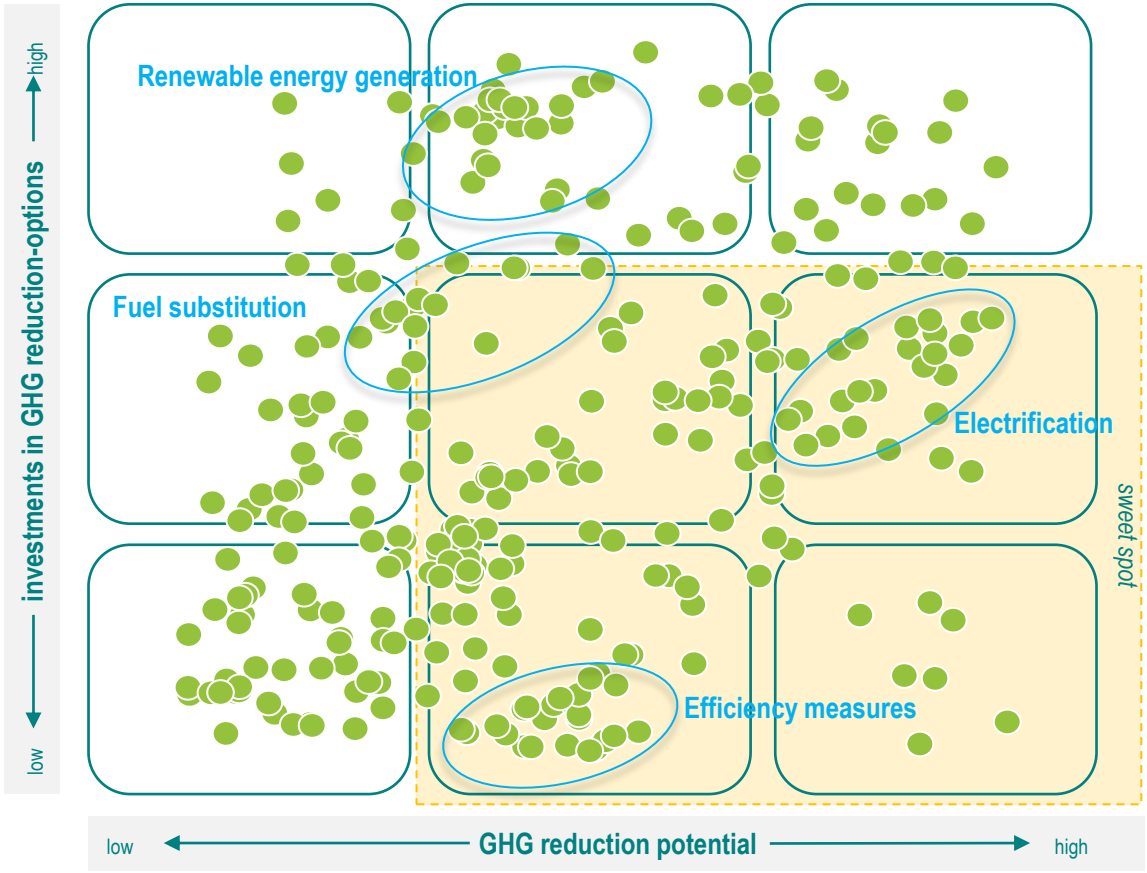
In the matrix, all decarbonisation technologies from all sectors are plotted anonymously (green dots), with on the axes investment level in GHG reduction technology (vertical) and GHG reduction potential (horizontal). This shows that there are decarbonisation options in each spectrum. Once we cluster, three decarbonisation technologies emerge that are in the so-called 'sweet spot' for several sectors of the Dutch economy. This is the position where GHG reduction potential is relatively high and investment in the technology is relatively low. These include electrification, efficiency measures and fuel substitution (renewables instead of fossil). A fourth regular decarbonisation option for various sectors is renewable energy generation (such as from solar, wind, geothermal, etc.). Unlike the previous four options, investment here can sometimes be relatively high. However, this is often actually a lot more profitable both ecologically and economically in the longer term.

GHG emissions in the total Dutch economy decreased by 16% over the period 1990-2020, or only 0.5% per year. At this rate, the 2030 target is unattainable. The question then is: can companies and governments do enough in just eight years? The answer is relatively simple: achieving the 2030 target requires a lot of money and flexible (policy) terms. And public and private efforts also need to be accelerated.

A number of the emission reduction technologies named in this publication require a lot of investment. Not only in the technology itself, but also in infrastructure, for example. A good connection to the electricity grid with sufficient capacity, for instance, is a precondition. Here, the government has an important role to play. In any case, the government is an indispensable conductor in the entire transition to net zero emissions by 2030/50. Through information, knowledge sharing, policy, subsidies and targeted investments, it can give the transition the necessary impulse. What is clear is that only with a well-orchestrated interplay between private and public institutions and strong intervention by all parties will the 2030 target be achievable in the short term.

The European Commission (EC) believes that investing in climate neutrality will ultimately bring many benefits to European economies, provided those economies fully commit to the transition. Think of improved competitiveness and prosperity growth. This means that the Dutch economy has to bite the bullet now in order to benefit from a more innovative, circular and resilient economy in the long run.

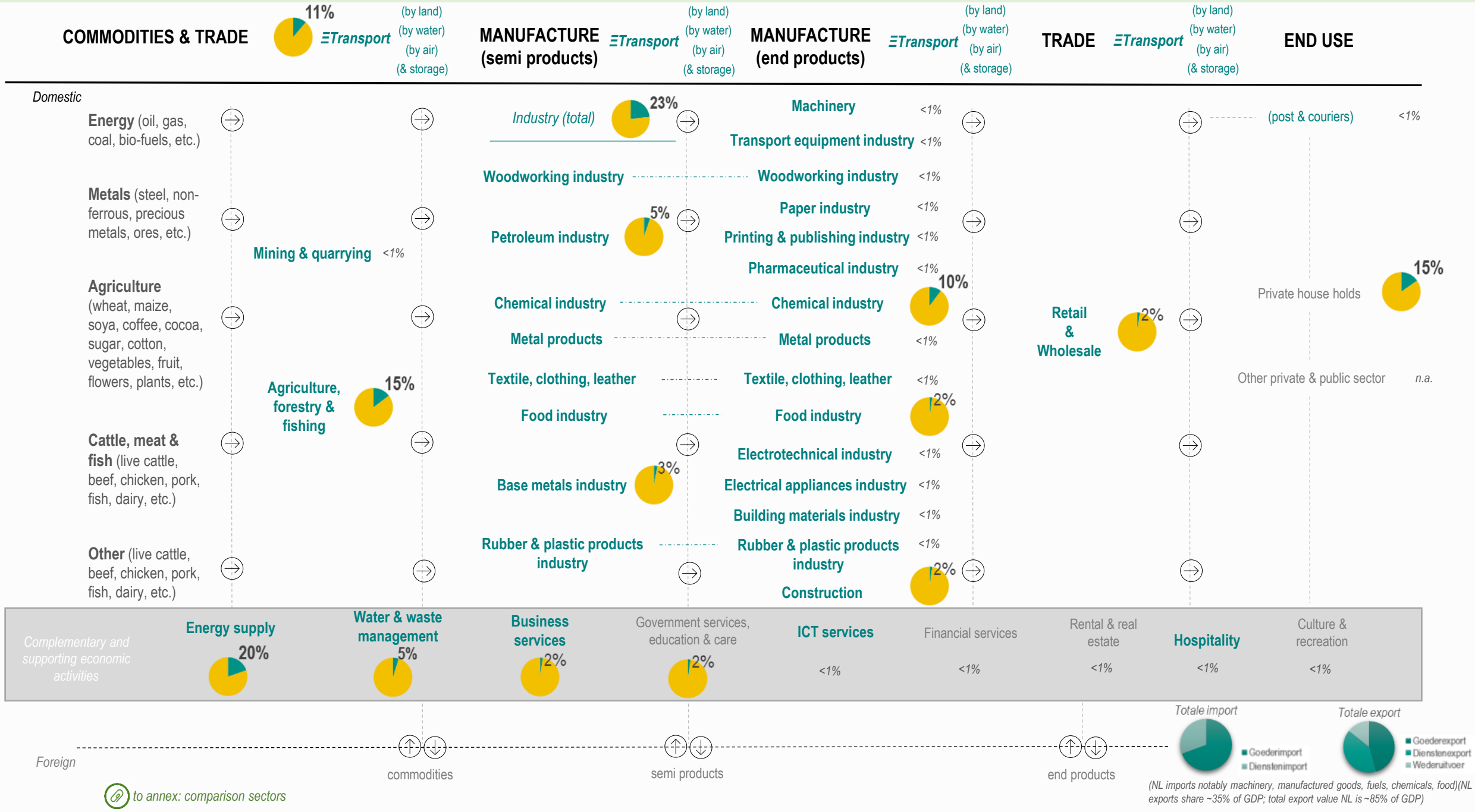
GHG-reduction options: investments & effectiveness



Note: The green dots in the matrix represent all possible decarbonisation options from all sectors in this publication. Within the matrix, clustering has been done with the five most important techniques to reduce GHG emissions. These are indicated with a blue oval. Not all points within the respective blue oval relate to said decarbonisation option.

Shares of sectors in emissions CO_2 equivalents Netherlands (2020, National Accounts)

(whole pie chart is total CO_2 eq emissions in the Netherlands; green area and % show the share of the relevant sector in total emissions; sectors with no pie chart, the share in total emissions is less than 1%)



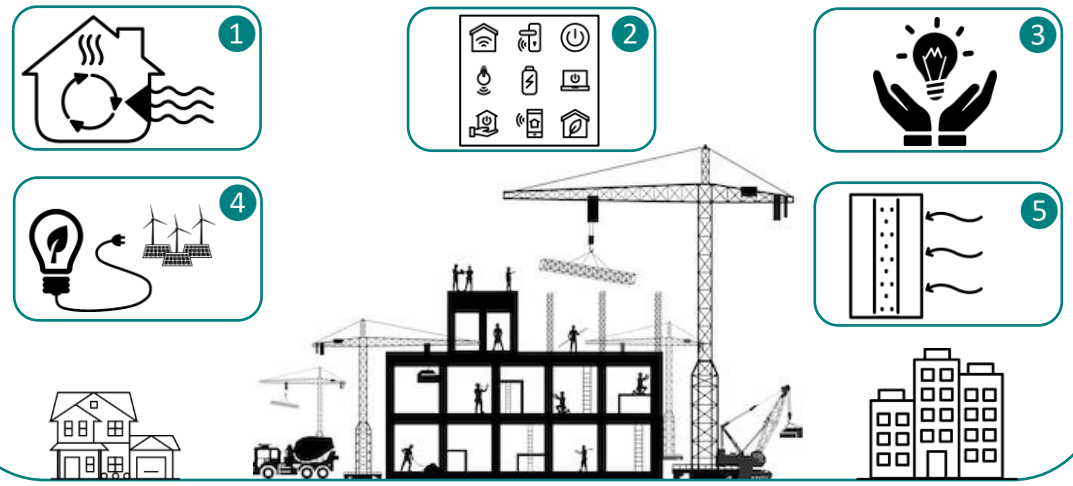
(NL imports notably machinery, manufactured goods, fuels, chemicals, food)(NL exports share ~35% of GDP; total export value NL is ~85% of GDP)

to annex: comparison sectors

GHG emissions: Built Environment

The 'built environment' is central to almost all sectors in the Dutch economy, as the vast majority of businesses in each sector deal with buildings. These can be shops, warehouses, offices, factory halls, residential and recreational areas, public/public spaces and buildings but also car parks. Over 87% of the built environment in the Netherlands consists of residential properties. Of all non-residential properties, about 18% are manufacturing sites of industry and 11% account for both shops and accommodation (such as hotels, guesthouses, etc.).

Mainstream decarbonisation options



1. Electrification, heat pumps
2. Energy efficiency

(digitisation, applications, lighting)

3. Behaviour changes

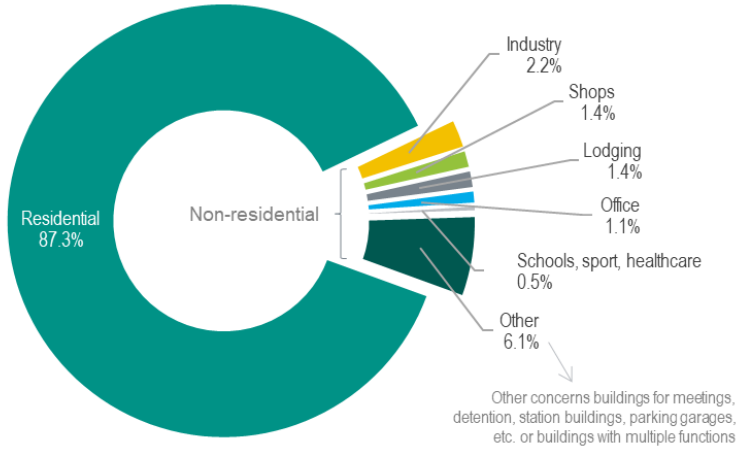
(energy awareness, waste management)

4. Renewable energy

(hydrogen, bioenergy, solar power)

5. Building insulation

Structure built environment Netherlands:

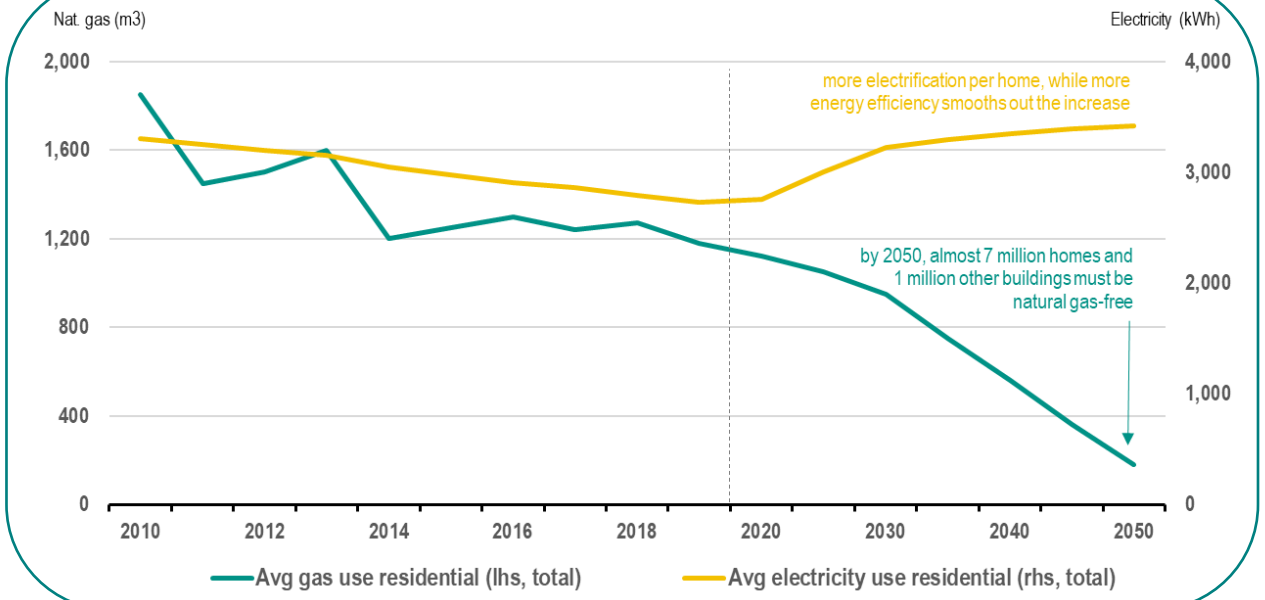


In terms of CO_2 equivalents, the built environment has a 13% share in the Netherlands' total emissions. Residential buildings have a 60% share of total built environment emissions in 2020. In this context, public services have a 13% share and commercial services account for 27%. This makes it immediately clear that almost every energy-saving measure in the built environment affects just about every sector of the Dutch economy.

Achieving climate-neutral new buildings is relatively easy with government policies and building codes. For existing buildings, the process will be much slower. In its scenarios, the IEA assumes that globally in many developed economies around 50% of the current building stock will still have a function by 2050. The European Commission (EC) thinks this will be around 85% for Europe by 2050. The Netherlands will not deviate much from this EU average. In concrete terms, this means that the bulk of the emission reduction will have to be achieved with climate-neutral measures in existing buildings. The challenge here is mainly to convince existing building owners, users and occupants of the need to make buildings more energy-efficient.

To shape the sustainability trajectory, building owners, users and occupants have, broadly speaking, five different options for speeding up emission reductions towards the climate-neutral target of 2030 and beyond. These include:
- Electrification (through electric or hybrid heat pumps, heat pump and electric boilers, air conditioning, electric cooking, among others)
- Energy efficiency (through e.g. digitisation, smart lighting, smart appliances and control systems)
- Behavioural changes (through e.g. education and awareness, changing consumption patterns and adapting habitual behaviour)
- Renewable energy (through e.g. bioenergy, solar panels, utilisation of waste heat and energy storage)
- Building insulation (through e.g. roof, wall and floor insulation and double glazing).

Many of these measures are also reflected in the various sectors and possible decarbonisation options. All climate-neutral initiatives by companies in relation to their buildings have a direct impact on total emissions from the built environment.

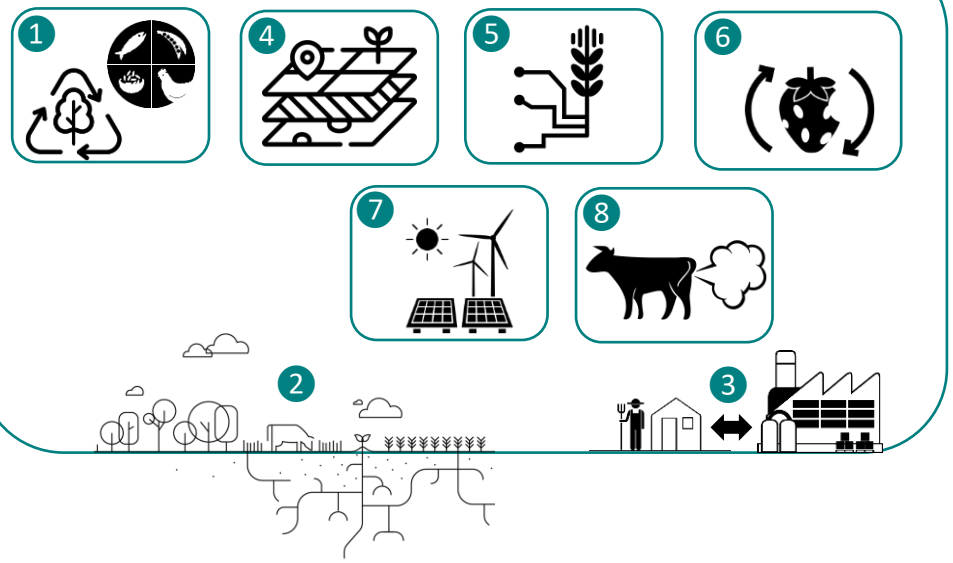


Source: CBS, ABN AMRO Group Economics

GHG emissions: Agricultural sector

The agricultural sector (agriculture, forestry & fishing) accounts for about 2% of GDP. According to CBS figures, it is responsible for 26 Mt of CO_2 equivalents in 2020 and this is equivalent to about 15% of the Netherlands' annual greenhouse gas emissions. Over the next eight years, the sector therefore needs to reduce another 15 Mt of CO_2 equivalents to reach the 2030 emission reduction target, based on 60% of 1990 levels. This target is separate from the Fit-for-55 targets (which show that the sector is allowed to emit more CO_2) and the agreements at the Climate Tables, where the sector is also committed to an additional reduction. However, LTO Netherlands argues that these ambitious targets can only be achieved if the preconditions regarding regulations, financing and cooperation with involved chain parties of the Climate Table on Agriculture and Land Use are also met at the same time.

Mainstream decarbonisation options



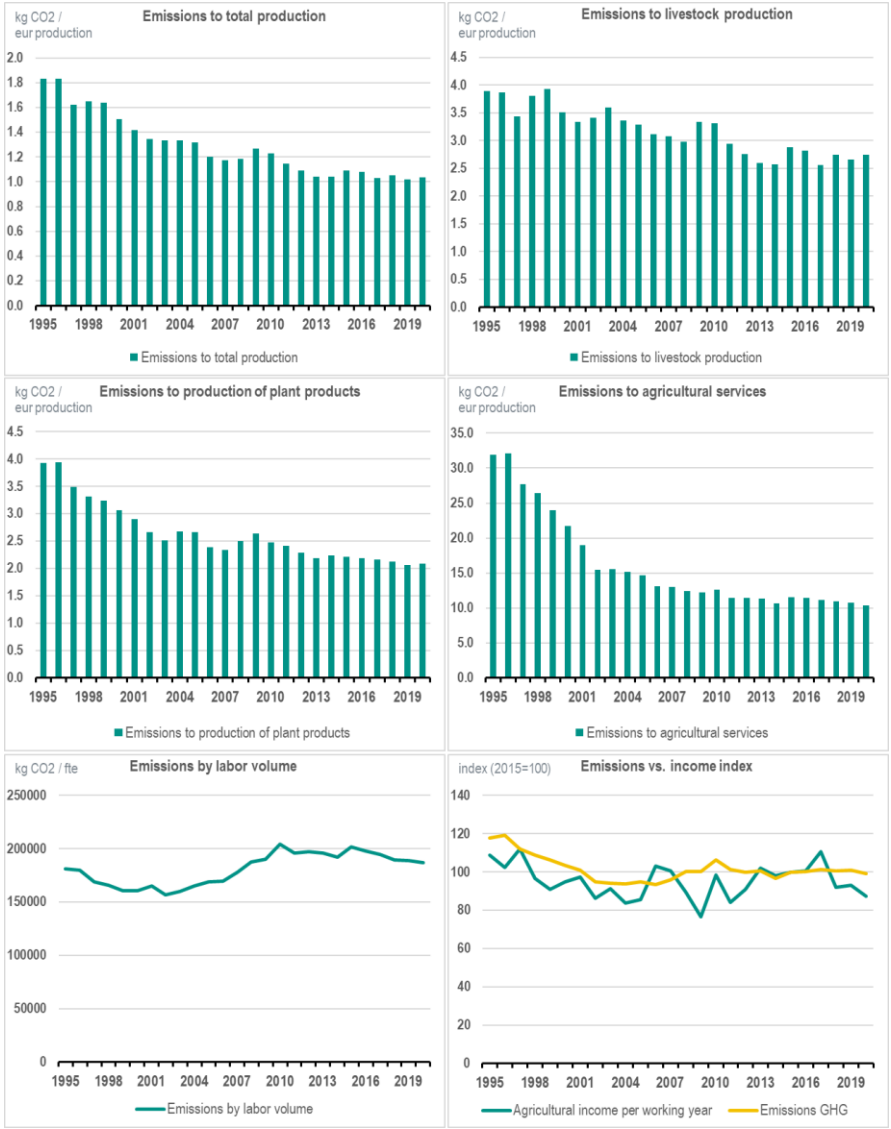
1. Change in consumer preferences
2. Better land management practices
3. Cooperation in value chain
4. Soil management
5. Low-carbon agri-technologies
6. Food waste & waste management
7. Renewable energy generation
8. Feed additives for livestock

The uniqueness of the agricultural sector in relation to climate change is its ability to be able to remove excess carbon from the atmosphere coming from other sectors on the one hand and also reduce its own greenhouse gas emissions on the other. Therefore, many believe it is an important link in the 2050 route towards net-zero emissions. The EU argues that the agricultural sector will eventually become carbon-negative, that is, the sector absorbs more than it emits in greenhouse gases. But agriculture is also one of the sectors most exposed to climate change and directly affected. This primary production sector is highly dependent on the natural environment with many existing agricultural activities. Changes in average temperature and precipitation patterns, as well as more intense and extreme weather events, pose a major challenge to the sector.

There is a difference in greenhouse gas emissions in the agricultural sector compared to other sectors. In fact, emissions from the agricultural sector are not only caused by energy use. Because methane emissions through livestock and land use - and also changes in them - have a major impact on the sector's total emissions. This is because the land used could also have had a forest on it, and this negative CO_2 uptake is attributed to the sector. Thus, soil is the second largest carbon reservoir or sink, just after the oceans. Then, in order to preserve soil fertility and fight climate change, it is important that soil health gets a lot of attention. In this context, one should then think, for example, of minimising tillage, continuous soil cover and intensified tree planting.

The greenhouse gas intensity of the agricultural sector is relatively high. This means a high number of greenhouse gas equivalents per euro of value added. It is related to the relatively high non-energy related greenhouse gases from land use. The decrease in emission intensity from 1990 to 2010 is due to the steady decline in total final energy consumption in the sector. After 2010, intensity stabilises somewhat or is slightly decreasing on many indicators. In addition to reducing CO_2, the sector remains committed to increasing public support for sustainable, safe and healthy food, constantly improving animal health and welfare, increasing biodiversity and reducing pressure on the environment.

Emissions agriculture, forestry & fishing and indicators:



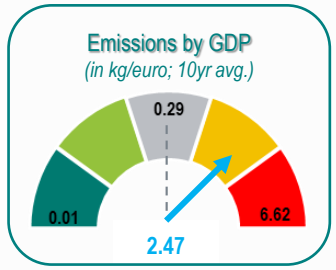
Source: CBS, CE Delft, ABN AMRO Group Economics

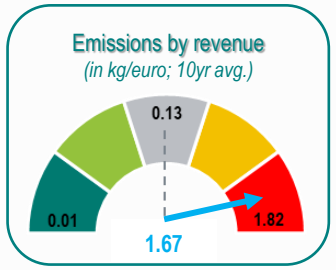
Emissions sector: Agriculture, forestry & fishing

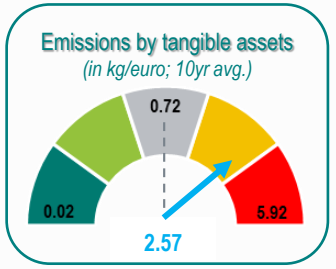
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector - also sometimes referred to as the agricultural sector - includes companies active in the exploitation of natural plant and animal resources, i.e. arable farming, animal husbandry and the production of other plants and animals on an agricultural farm or in the natural habitat; i.e. forestry, timber growing and hunting; i.e. specific contracting services related to the production process agriculture, hunting and forestry are also classified in this section; i.e. fishery: the catching or farming of fish, crustaceans and molluscs.

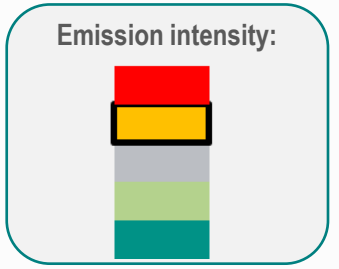
Emission indicators & intensity:

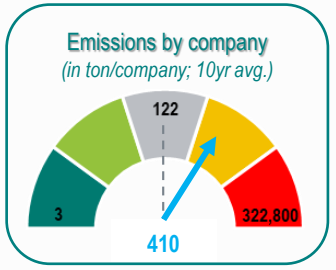
(grey dotted line = average NL score; blue arrow = sector score)

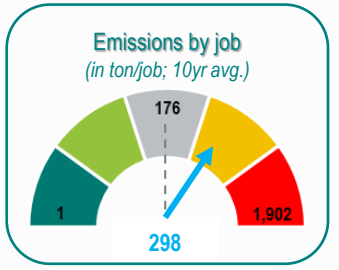




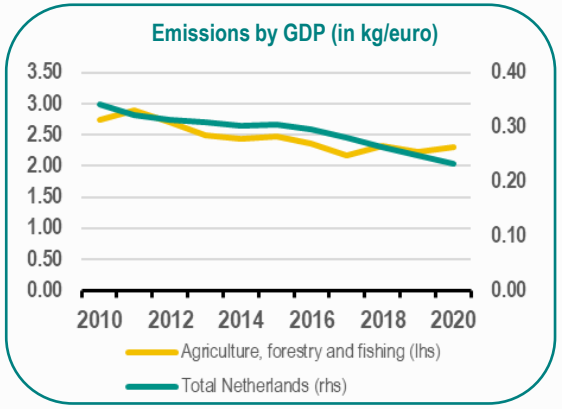


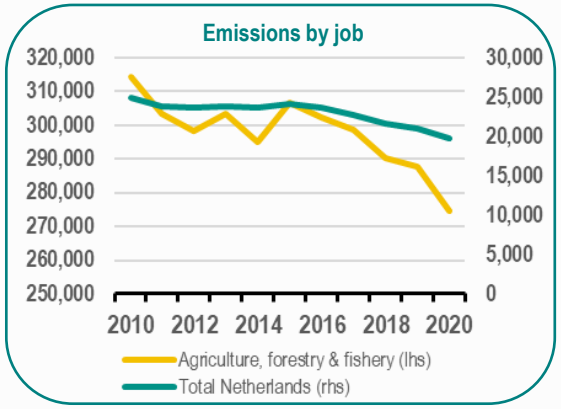


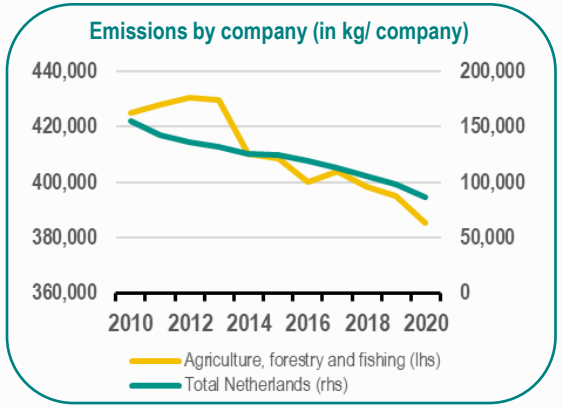


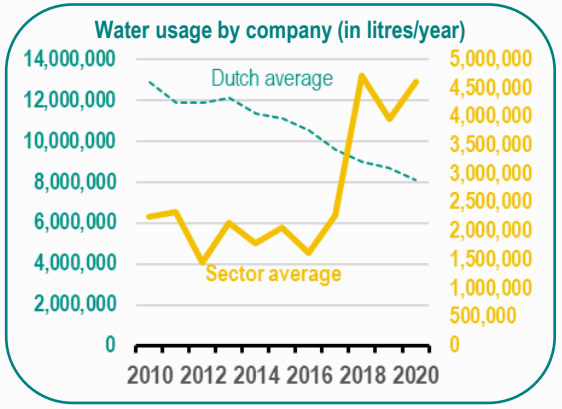


Trend in emission indicators:









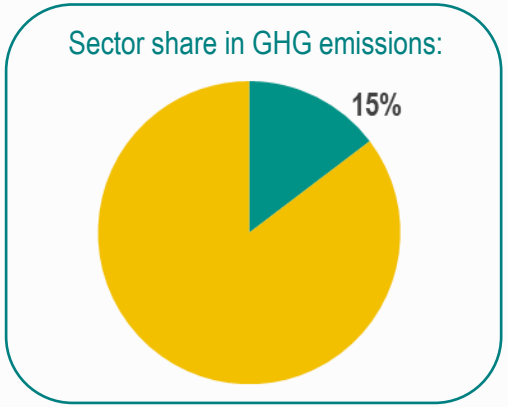
Other indicators:

Energy costs vs. revenue:
(10yr average)
- not available -

Share in total water consumption:
2.4%

Energy costs vs. result:
(10yr average)
- not available -

Water usage by company per year:
(in litres)
2,659,930



Agriculture, forestry & fishing as a whole scores poorly on almost all emission indicators. The contribution to GHG emissions varies greatly by subsector. For instance, dairy farming emits relatively high amounts of methane and in greenhouse horticulture it is gas use that causes high CO_2 emissions. Methane emissions through livestock and land use - and also changes in them - have a major impact on the sector's total emissions. For more depth on these differences by subsector and the path to 2030/50, please read the ABN AMRO Sector Expertise publication 'The agricultural sector on the road to 'Paris Proof''.

Emissions in agriculture, forestry & fishing are strongly influenced by energy consumption, changes in livestock, but also by the use of e.g. fertilisers. In addition, mitigating the impact of climate change is going to mean major changes for farms and their farming techniques. Emissions to GDP are significantly higher in this sector compared to the national average. As a primary producer, the sector by definition has lower value added and the international context with trade agreements plays a prominent role. The decrease in emissions by firm has a stronger relationship with the decrease in the number of firms, than with the decrease in GHG emissions. For emissions by job, the indicator is high because there are relatively few jobs in the sector due to the many partnerships and sole proprietorships. Water use in the sector has increased more sharply since 2016. This is related to climate change and longer droughts, especially during spring.

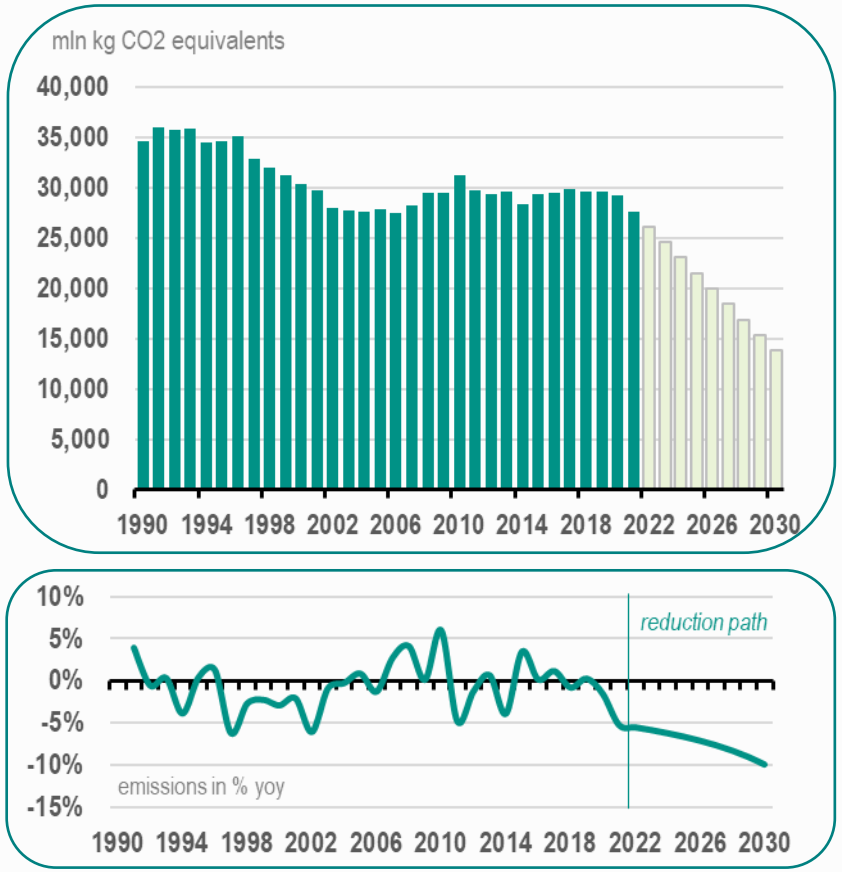
At 2.4%, the sector has a relatively high share in terms of water use. This mainly concerns groundwater and surface water. An average of 2.6 million litres of water is used per farm annually. According to CBS figures, the agricultural sector is responsible for 26 Mt of CO_2 equivalents in 2020 and this is equivalent to about 15% of the annual greenhouse gas emissions in the Netherlands.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Agriculture, forestry & fishing

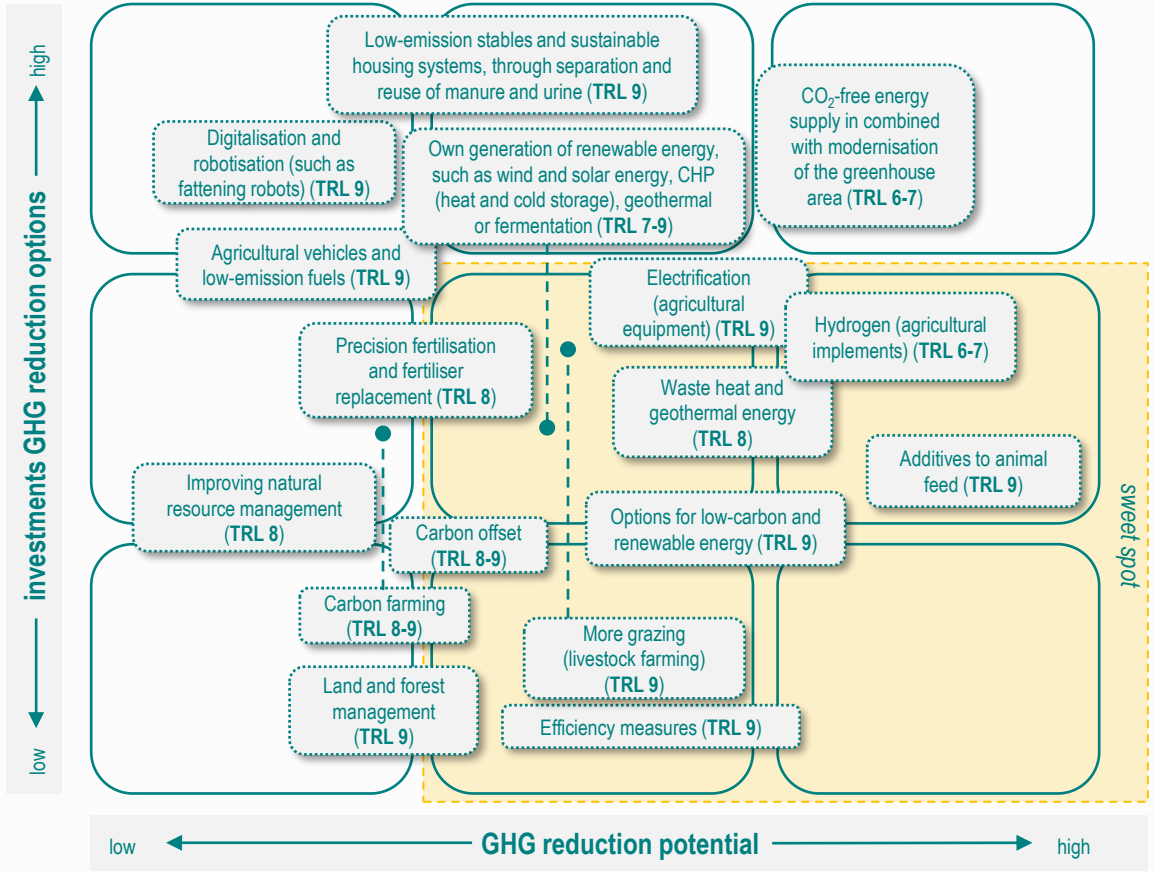
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Based on 60% of 1990 levels, the sector still needs to reduce some 15 Mt CO_2-eq -about 53%- to reach the 2030 emission reduction target. This will be anything but an easy task. Between 1990 and 2005, the sector reduced almost 22% of greenhouse gases. It shows that the sector certainly has the capacity to make greenhouse gas reduction work. But in the post-2006 period, this picture tilts. From 2006 to 2020, greenhouse gas emissions increase again by almost 5%. However, the sector leads the way in terms of sustainable energy production such as solar panels, geothermal energy, biomass plants, windmills, residual heat utilisation and manure digesters on a larger scale. This transformation is continuing.

GHG reduction options: investment & effectiveness



Achieving the emission reduction targets towards 2030 and 2050 requires continuous innovation. This is not only important for the target towards 2030, but is also necessary to have the greenhouse gas reduction towards 2050 clear. To keep up the pace in reducing greenhouse gases, the agricultural sector currently has several options. Broadly speaking, these include contributing to changes in consumer behaviour, combating food waste, land and forest management, more efficient land use, collaboration in the chain, deployment of low-carbon technologies and additives to animal feed. Despite improved energy efficiency over the past few years, it remains important to reduce energy consumption and thus greenhouse gas emissions. Furthermore, in the transition to net-zero emissions, electrification will increase and the importance of fossil fuels will be further reduced.

Emission reduction target:

Minimum emission reduction through 2030:
15,359
(in mln kg CO_2 eq.)

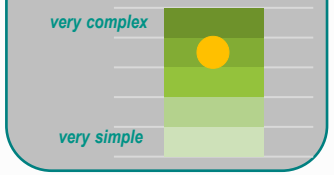
Minimum emission reduction through 2030 per year:
1,707
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-53%

Minimum % annually in emissions through 2030:
-5.8%

Average % annual change in emissions over last 20 years:
-0.5%

Feasibility of emission target:

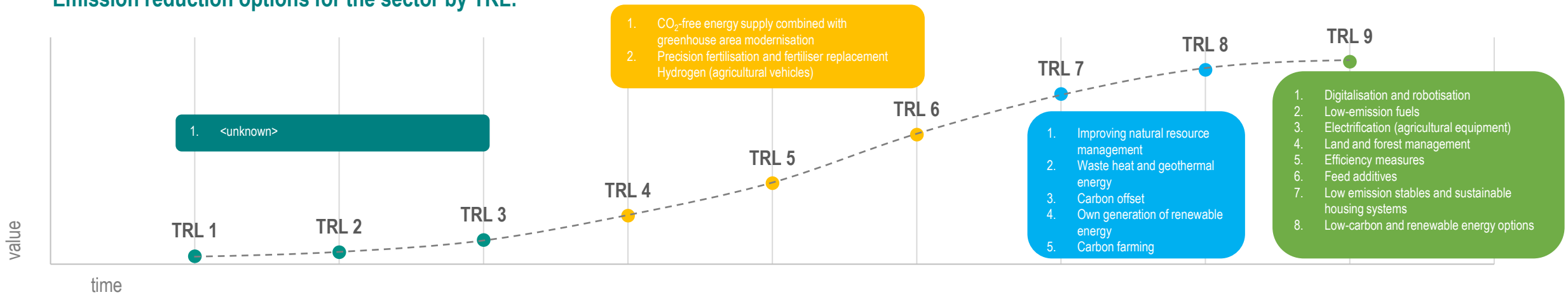


Source: CBS, AEI, EU Observer, McKinsey, CE Delft, ABN AMRO Group Economics

GHG emission reduction options explained: Agriculture, forestry & fishing

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The agriculture and horticulture sector has been making efforts to reduce emissions for years and with success. Best practices are now well established in the sector. There are still relatively few new techniques in the concept phase - but also in the test and prototype phase - as far as we know. Nevertheless, innovation is not standing still here either. Innovation is good, of course, but new methods and techniques should not put much pressure on the already thin margins in the sector. A condition is thus that any new innovation remains within (financial) reach for companies in the sector to achieve the desired transition.
Farmers and market gardeners can use precision agriculture to reduce the use of chemicals. This does not yet include CO_2 storage in the soil as a measure. Its potential is estimated at 1 Mt CO_2 per year.

Techniques in test and prototype phase:

The ambition is a climate-neutral greenhouse horticulture sector in 2040. Among other things, this is to be achieved with the realisation of CO_2-free energy supply and a modernisation of the greenhouse horticulture area. The latter focuses on sustainable production, circular design, more biodiversity and availability of energy and heat, clean water and other production factors. For the flower bulb and mushroom sectors, climate neutrality should be achieved by 2030. Precision fertilisation is about fertilising crops as optimally as possible, with the right amount of fertiliser application at the right time. This increases efficiency and ultimately lowers the carbon footprint. Fertiliser substitution - such as through mineral concentrates - increases yields per hectare and reduces costs and environmental burden.
Innovation in this area is gaining momentum and with the relatively high prices of fertilisers, demand for substitutes is increasing.
Hydrogen can be used as a clean fuel for tractors, forklifts and trucks. High purchase cost, uncertain residual value, few refuelling stations and fuel cell life are thresholds. Hydrogen can also be substituted for propane gas used to dry potatoes, onions and carrots and for heating houses.

Techniques in pre-commercial phase:

Sustainable management of natural resources (such as land, water and minerals) ensures that we can provide for our food production in the long term. It brings biodiversity loss and an increase in greenhouse gas emissions. The theme also partly ties in with land and forest management. It is about not polluting the environment (soil, air, water), not depleting natural resources and not disturbing the ecosystem and biodiversity. Much can also be achieved in this context by encouraging recycling and reducing waste streams.
Connecting companies to a heat network helps to meet the needs of companies that use a lot of heat (such as greenhouse horticulture). On a heat network, it is also possible to combine both industrial residual heat and heat from geothermal sources.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

More sustainable agriculture comes about by producing products that have few harmful effects on nature, the environment and the climate. Waste streams should be maximised and fertiliser use reduced. Agricultural farms are also ideally suited to installations that generate low-carbon and renewable energy. Many farms have large roofs or sufficient land where panels can be installed relatively easily.
Agricultural vehicles powered by fuels with lower emissions than fossil fuels can reduce the carbon footprint. Think of fuels such as bio-CNG (biogas) or bioethanol and biodiesel from waste and residues. Electric agricultural equipment also boosts energy efficiency and reduces energy needs. Feed additives (such as enzymes and vitamins) help to effectively inhibit methane formation in livestock help significantly to reduce environmental damage. Low-emission stables also contribute to reduced emissions. For instance, manure robots immediately water spray the floor grates to keep manure free and stop ammonia. Finally, it is also important to increase consumer knowledge about the origin of food to reduce waste.

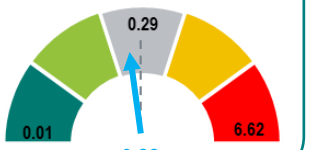
Source: Greenports Nederland, CBS, LTO, ABN AMRO Group Economics

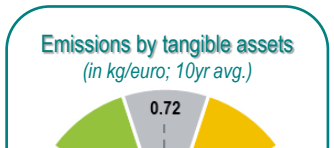
Emissions sector: Mining & quarrying

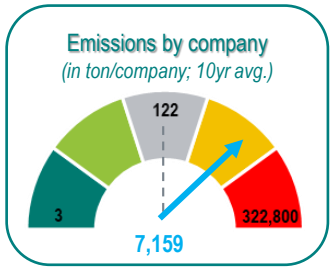
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes the extraction of naturally occurring minerals in solid form (coal, peat and ore), in liquid form (petroleum) or in the form of a gas (natural gas). Extraction takes place through underground mining, opencast mining or drilling.

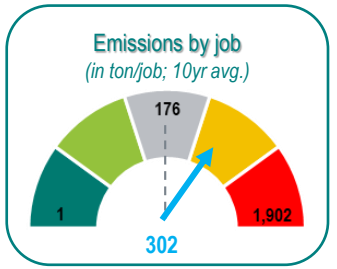
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

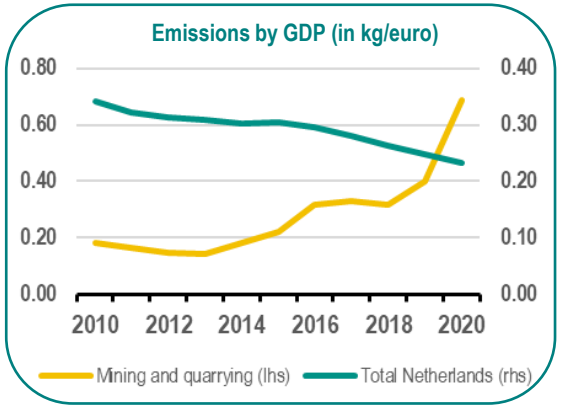


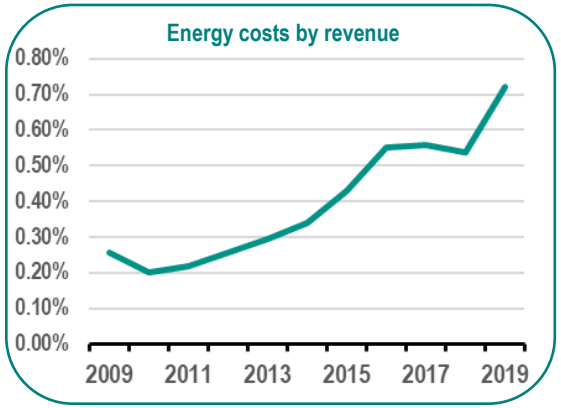


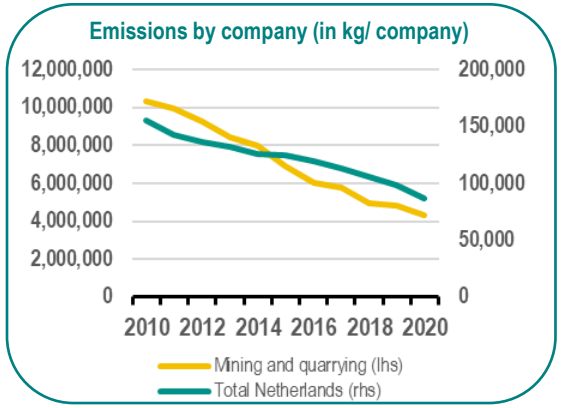


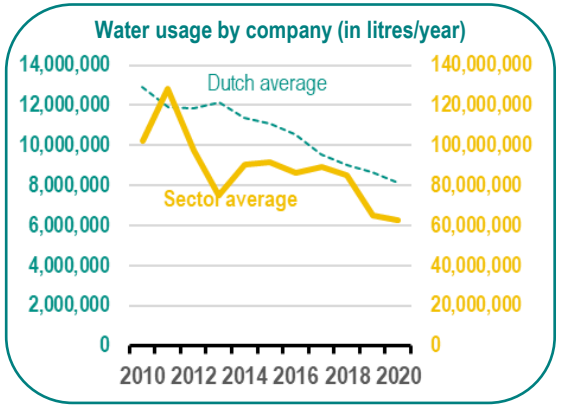


Trend in emission indicators:









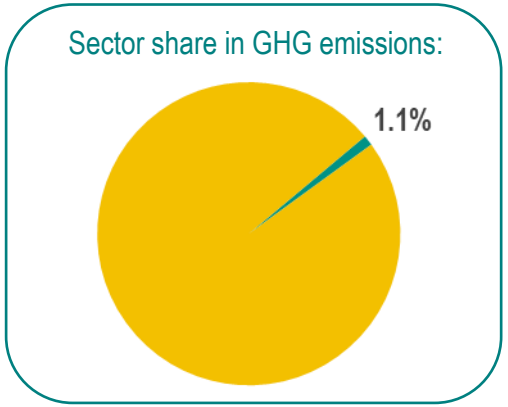
Other indicators:

Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
0.2%

Energy costs vs. result:
(10yr average)
2.7%

Water usage by company per year:
(in litres)
88,515,605



Mineral extraction in the Netherlands is a relatively small sector. The sector has a 0.4% share in GDP and only 0.1% share in the total number of jobs in the Netherlands. Moreover, according to CBS, the sector has 565 companies, or 0.7% of the total. However, the sector's share in total greenhouse gas (GHG) emissions is relatively high at 1.1%. It helps ensure that emissions by GDP, by persons employed, by job and by company score average to above average. Emissions by tangible assets and by turnover score relatively low.

GHG emissions have declined by over 30% in 10 years. As value added in the sector has decreased much more sharply by over 80% over the same period, emissions to GDP in this sector show an upward trend in the period 2010-2020. The sharp decline in added value is strongly related to the sharp reduction in gas extraction in Groningen. On average, emissions to company are almost 60x higher in the sector than the national average. However, the trend in this indicator for the sector has paralleled the national average since 2010. However, the decrease in emissions by company in the sector over the period 2010-2020 has been stronger than the national average (-58% versus -44%). As turnover halved over the 2010-2020 period and energy costs rose by two-thirds, the indicator is on an upward trend. More companies have consumed the same amount of water since 2010. Water efficiency has thus increased over the past 10 years.

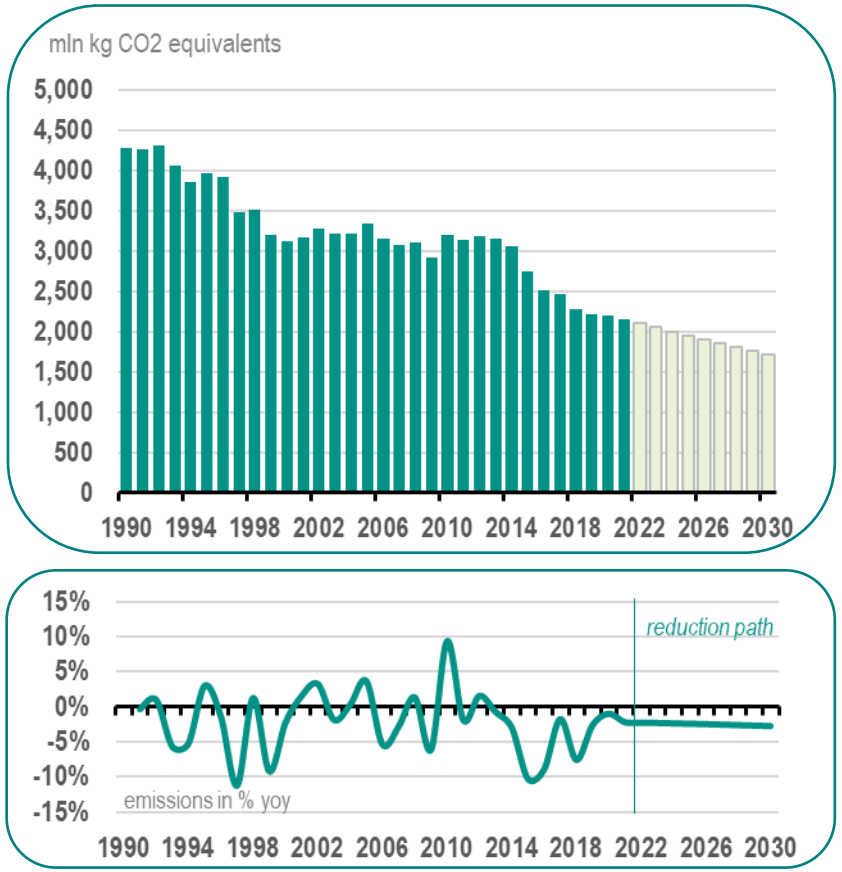
Energy costs by turnover are marginal at an average of 0.4% over the past 10 years. The sector's share of total water use appears to be relatively low at 0.2%. With this share, however, the sector still just makes the top 10 major users of water. On average, over 88 million litres of water are used per company annually.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Mining & quarrying

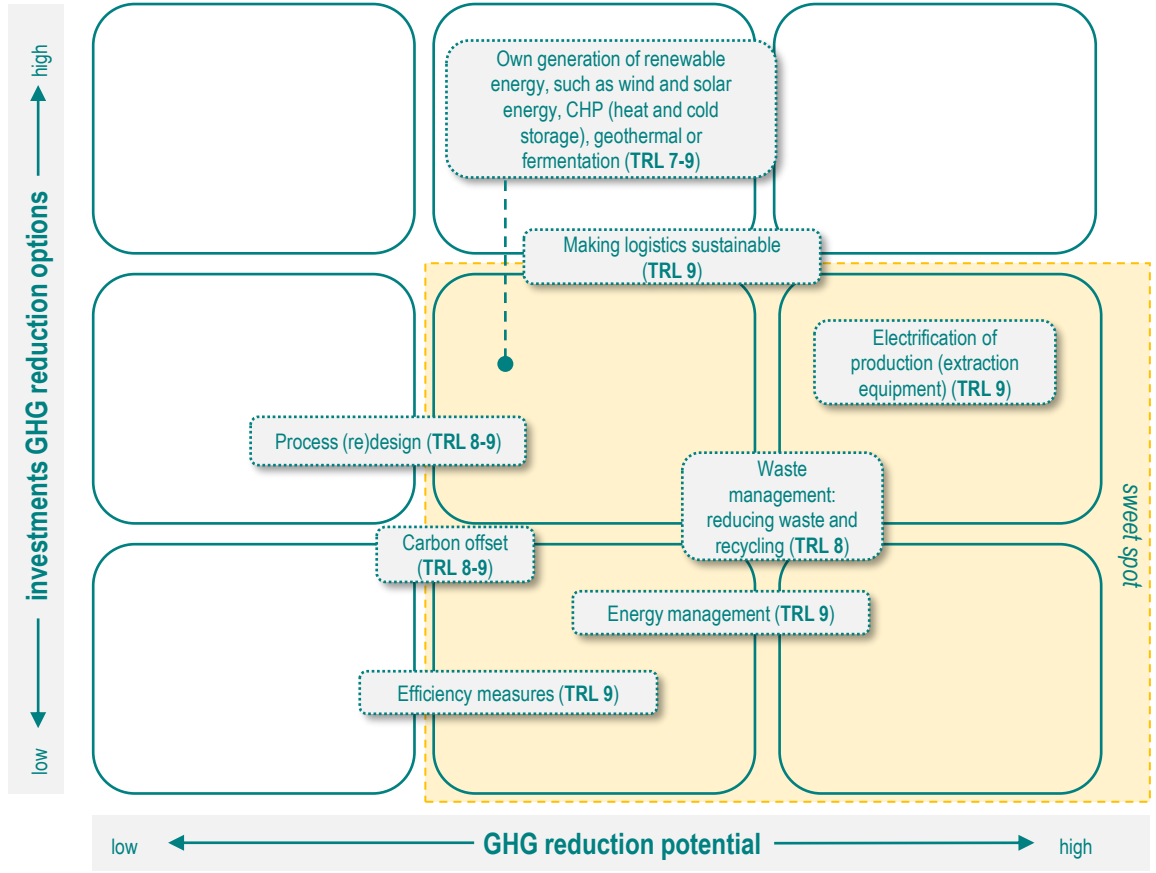
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Greenhouse gas (GHG) emissions have been on a downward trend since 1990 and have fallen sharply. Over the past 30 years, GHG emissions have fallen by 49%. A minimum GHG reduction of 2.4% per year is needed to reduce 54 million kg of CO_2. Over the past 20 years, the sector has achieved an average annual 2.1% GHG emissions reduction. At this rate of GHG reduction, the 2030 target is within reach for the sector.

GHG reduction options: investment & effectiveness



In the Netherlands, mineral extraction is mainly responsible for building materials such as gravel, sand, clay and lime that are extracted as surface minerals. Over the years, imports of raw minerals have increased. By moving the extraction site abroad, additional CO_2 is emitted per tonne of gravel, sand, clay or lime. The increase in imports is partly because it is difficult to get a mineral extraction permit in the Netherlands. The industry is under increasing pressure from various stakeholders to reduce emissions and address climate risks. Mining companies typically have several decarbonisation solutions available, such as commitment to renewable energy sources, purchasing agreements with energy suppliers, electrification, carbon offsetting and ensuring data integrity in environmental, social and governance (ESG) reporting. Companies in this sector are under a magnifying glass and need to maintain their licence to operate. This requires close links with direct stakeholders.

Emission reduction target:

Minimum emission reduction through 2030:
484
(in mln kg CO_2 eq.)

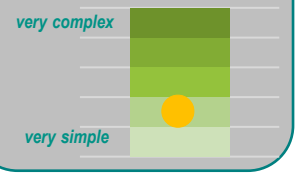
Minimum emission reduction through 2030 per year:
54
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-22%

Minimum % annually in emissions through 2030:
-2.4%

Average % annual change in emissions over last 20 years:
-2.1%

Feasibility of emission target:

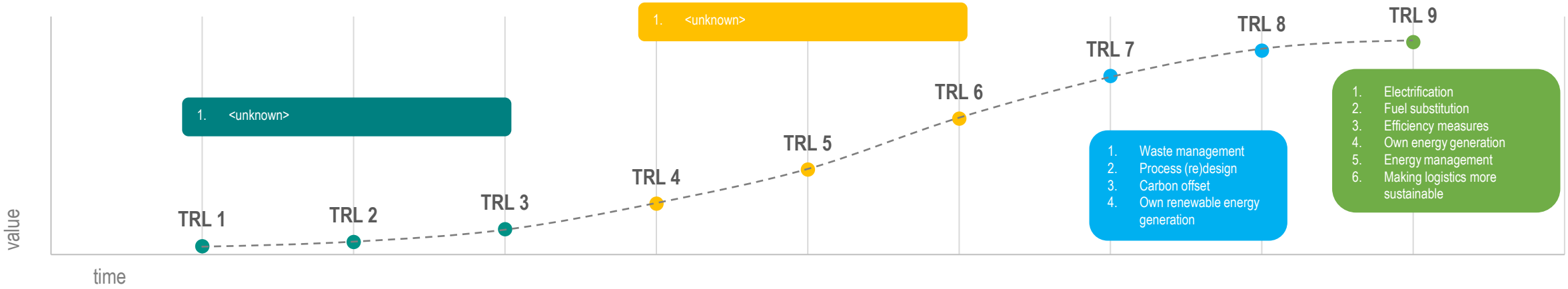


Source: KPMG, CBS, Cascade, CE Delft, ABN AMRO Group Economics

GHG emission reduction options explained: Mining & quarrying

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Although the speed of new decarbonisation initiatives varies by sector and also company, the sector as a whole has invested heavily in renewable energy and electrification.
There are still relatively few new technologies in the concept phase - as well as in the test and prototype phase - to our knowledge. Best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Wise use and deployment of scarce raw materials is an important social task. Extraction has negative impacts on the environment. Therefore, waste management is a way to reduce environmental impact. One example is the optimal use of residual flows.
Another example is switching to other, more sustainable production processes. One example is that electrification of extraction equipment requires fewer materials on balance, such as oil filters.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.
With their own (floating) solar or wind farms, surface minerals miners meet their own energy demand in a sustainable way and can sometimes already operate in a CO_2-neutral way. An additional advantage is that, in some cases, the generated energy can also be used by companies or residents in the area.

Techniques commercial deployment phase:

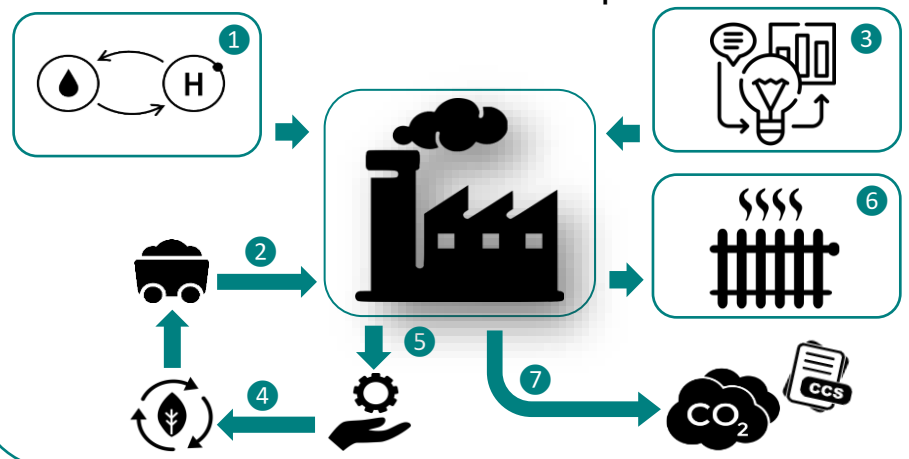
The production of raw materials requires a lot of energy. With the use of all kinds of new technologies, a lot of energy can be saved. Electrification of production (wineries) reduces greenhouse gas emissions. This can be combined with the replacement of fossil fuels with, for instance, green electricity.
Extraction tools can include sand and gravel classifiers and suction dredgers. The challenges are great to electrify such implements, but the option is widely applicable in the sector. Electrification leads to lower emissions, less maintenance, a flexible production process and less noise pollution for the immediate surroundings.
Raw materials such as sand and gravel are transported in bulk via waterways or road transport. The carbon footprint is largely determined by the number of transport kilometres. A conscious choice for less environmentally damaging transport and electrification helps to reduce the carbon footprint. Sand extraction is often also water-related. The disposal of sand and gravel then takes place via waterways and thus roads in the local area are less burdened by truck traffic.

Source: Cascade, CBS, CE Delft, ABN AMRO Group Economics

GHG emissions: Industry (total)

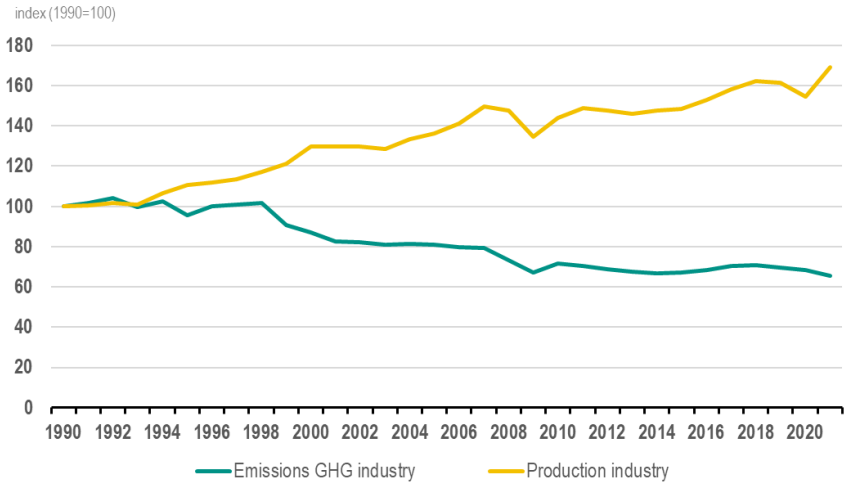
With a 12% share of gross domestic product (GDP), Dutch industry is an indispensable economic link. However, it is also the link that causes a lot of greenhouse gas emissions. In terms of greenhouse gas equivalents, the sector has a 23% share in the Netherlands' total greenhouse gas emissions in 2020 - according to CBS National Accounts.

Mainstream decarbonisation options



1. Fuel substitution
2. Substitution raw materials
3. Process design (efficiency)
4. Recycling
5. Product design (efficiency)
6. Use of residual heat
7. CO_2 capture & storage (CCS)

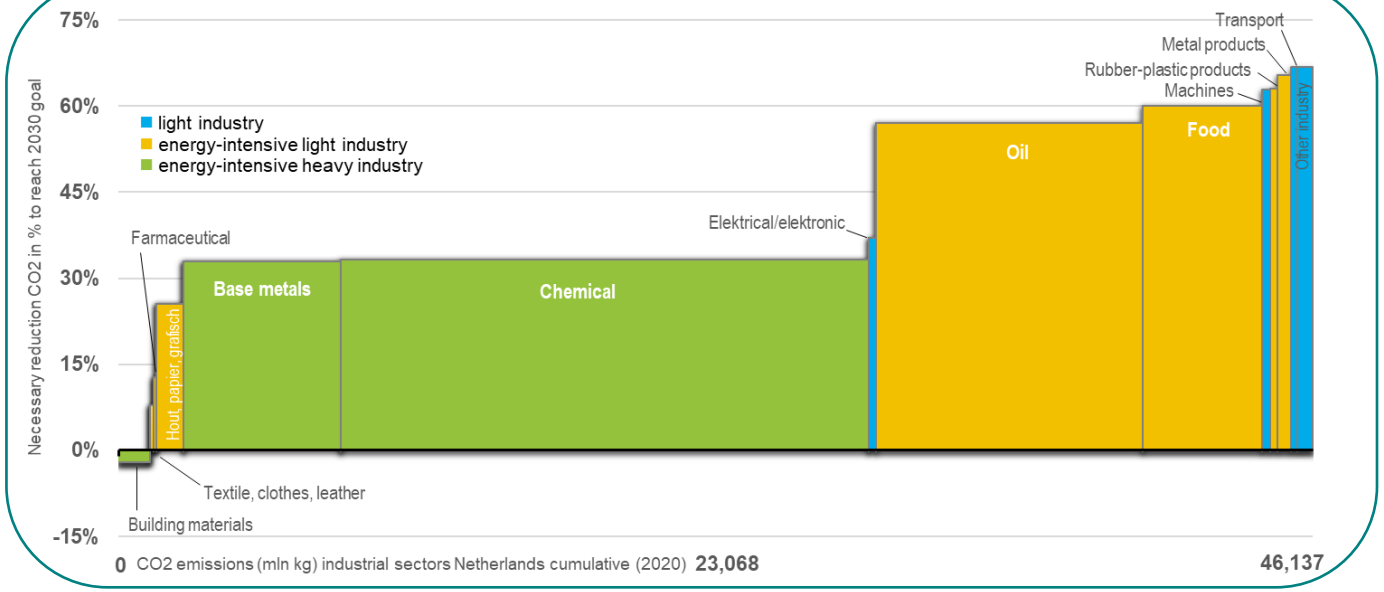
Emissions versus production in industry:



The European Commission (EC) indicated that construction of roadmaps in terms of emission reductions had to take place within the sector itself. In this, European industry associations are taking the lead. Within these roadmaps, great importance is attached to carbon capture and storage (CCS), electrification, fuel substitution and improving energy efficiency. But despite the fact that sectors have a multitude of techniques to make emission reduction work, the search for the breakthrough technologies remains an absolute must. These breakthrough technologies should guarantee that the path between 2030 and 2050 will also become a viable option. In addition, this sector is rich in companies covered by the Emission Trading System (ETS), and thus more or less forced to make emission reduction work.

More economic activity in industry has not increased greenhouse gas emissions over the years. Manufacturing output increased by 69% over the period 1990-2020, or about 2.3% per year on average. However, greenhouse gas emissions decreased by 35% over the past 30 years, or about 1.2% per year. Increased efficiency measures and investments in lower-carbon machinery, plants and processes have ensured lower emission intensity over the years, see figure above right.

The decarbonisation curve for industrial sectors (see figure bottom right) shows where most industrial greenhouse gas emissions come from. The horizontal axis shows the cumulative emissions of the whole industry. In this way, the width of each column in the figure represents the amount of emissions by subsector. Four subsectors stand out in this context: the base metal industry, the chemical industry, the petroleum industry and the food and beverage industry. Together, these four subsectors account for almost 90 per cent of total industrial emissions. The vertical axis shows the percentage gap of emissions in 2020 compared to the 2030 target (60% reduction from 1990 levels). The more a sector is on the right side of the figure, the bigger the task is to reduce greenhouse gas emissions.



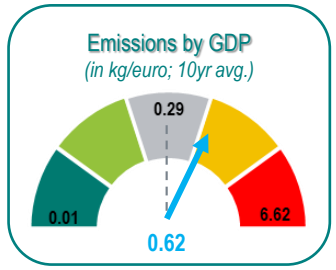
Source: CBS, PBL/TNO, ABN AMRO Group Economics

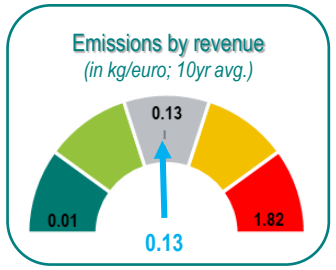
Emissions sector: Industry (total)

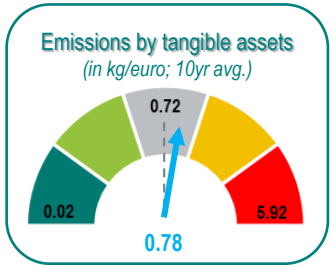
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes the mechanical, physical or chemical processing of materials, substances or parts into new products. The materials, substances or parts processed are raw materials from agriculture, forestry, fishing and mining, as well as (semi-)manufactured goods from industry; the repair and installation of machinery, equipment and other supplies for businesses (not consumer goods).

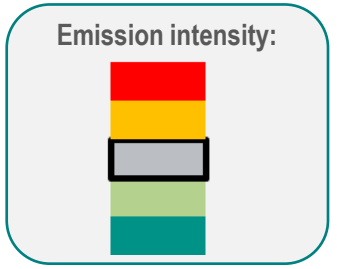
Emission indicators & intensity:

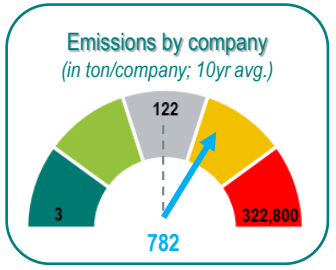
(grey dotted line = average NL score; blue arrow = sector score)

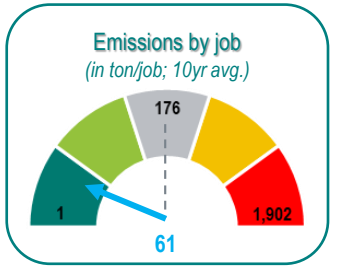




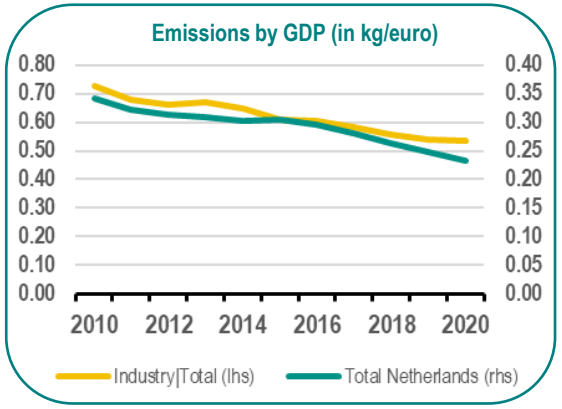


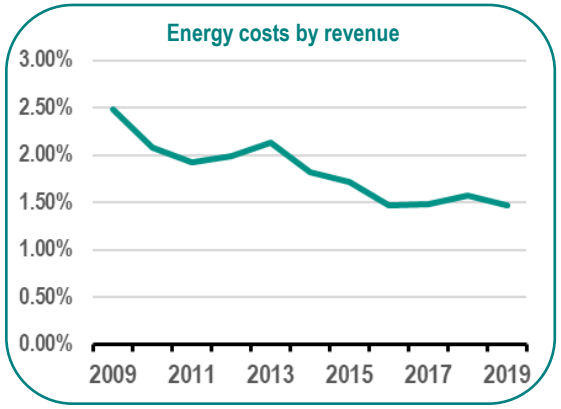


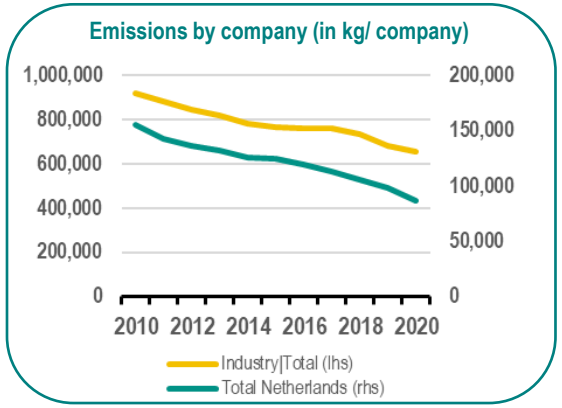


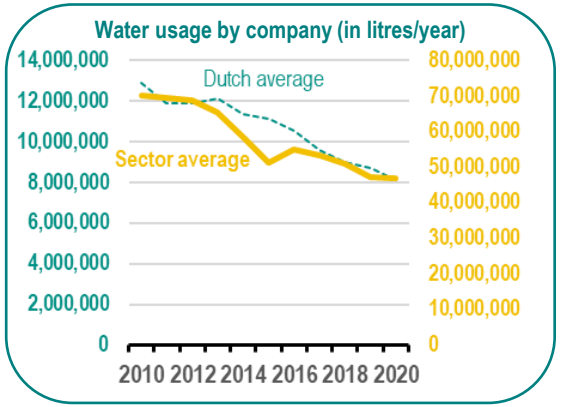


Trend in emission indicators:









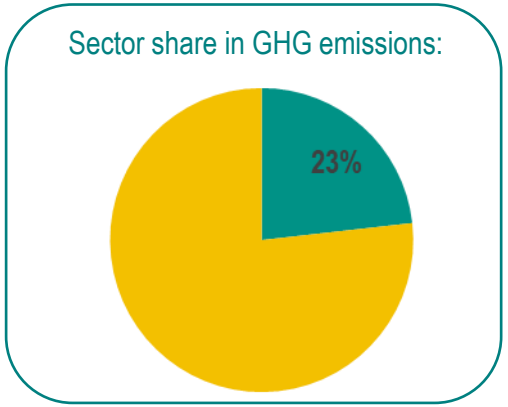
Other indicators:

Energy costs vs. revenue:
(10yr average)
1.8%

Share in total water consumption:
21.3%

Energy costs vs. result:
(10yr average)
32.3%

Water usage by company per year:
(in litres)
57,888,409



The emissions to value added ratio of industry as a whole is higher than the economy average. Within industry, some subsectors, such as the petroleum industry and the chemical industry, score strongly negative on many emission indicators. Together with the Energy Supply sector, these three sectors are the outliers on almost all the above ratios. Emissions to job are relatively low in the industry. Emissions have decreased in recent years, while the number of jobs has grown. Emissions by tangible assets (capital goods) is around average.

With a 12% share of gross domestic product (GDP), Dutch industry is an indispensable economic link. Besides this substantial earning power for the Netherlands, the sector also has an indispensable role in another perspective. This is because, at the same time, this sector is also going to be the one making the low-carbon new technologies that are supposed to reduce greenhouse gases in many other sectors. The indicator emissions to GDP for the industry sector runs parallel to the trend for the total economy. The same is true for emissions by company. The only difference is that the ratios are at different levels. For emissions by company in particular, the difference with the total economy is significant. Energy costs by turnover and water use by company have been at lower levels since 2020 compared to 2010 levels. Energy costs by turnover have decreased by 1 percentage point over 10 years, while water use per company has decreased by a third over the same period.

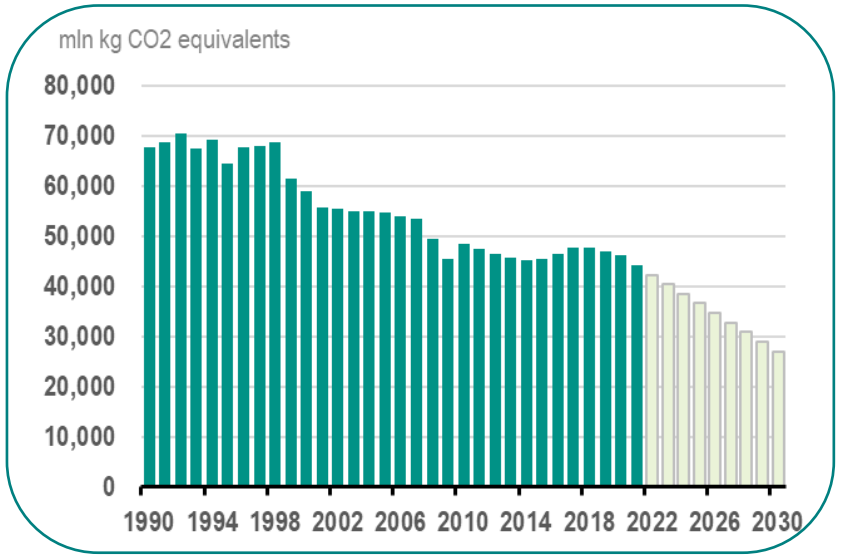
Industry as a whole accounts for 23% of the Netherlands' total greenhouse gas emissions. This makes it the biggest polluter in our country. Industry is also a major consumer of water. Some 80-90% of water use in industry is used for cooling. This mainly involves surface water and groundwater. Its share in total water use is 21.3%.

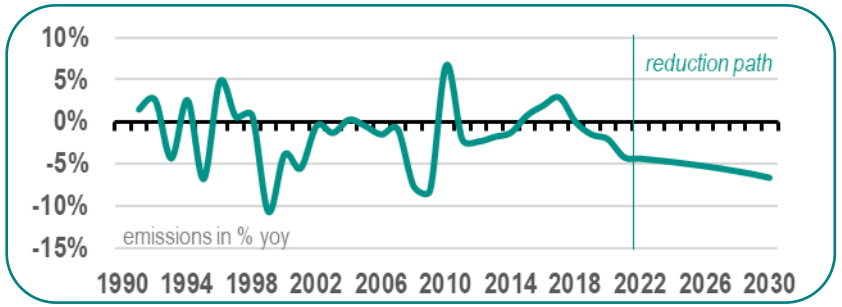
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Industry (total)

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

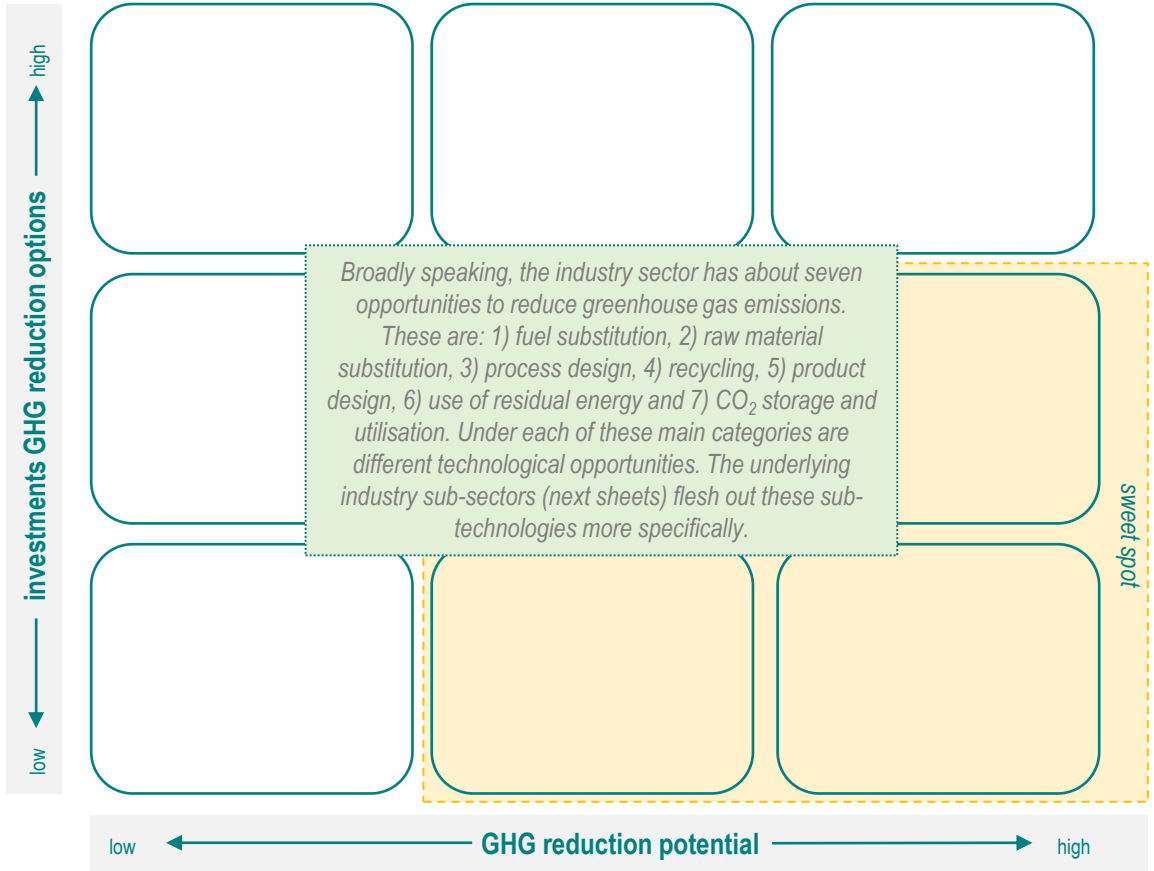
Emission pathway & projection:





In terms of GHG equivalents, the sector accounts for 23% of total GHG emissions in 2020. This makes it the biggest polluter in our country. In this, energy-intensive heavy industry - such as steel, base metal, chemical and the building materials industry - has a large share. Since the mid-1990s, the downward trend in emissions has started in overall industry. This is mainly due to various energy efficiency measures and fuel substitution in various subsectors. But the sector needs much more low-carbon technological advances than just energy efficiency and fuel replacement. Innovation remains a prerequisite for success to meet the reduction targets towards 2030.

GHG reduction options: investment & effectiveness



The incentives to reduce emissions in industrial sectors are there. Indeed, energy costs in many of the sectors in industry are relatively high - especially in heavy industry - and then companies automatically already have an incentive to keep costs low or reduce them further. However, supportive and incentive policies from the government are an indispensable tool for investing in low-carbon technologies and meeting emission reduction targets in industry. It is also important for many industrial sectors operating in the international context to ensure a level playing field so as not to compromise on competitiveness. Furthermore, great importance is also attached to carbon capture and storage (CCS), electrification, fuel substitution and improving energy efficiency. The Scheme Stimulating Sustainable Energy Production and Climate Transition (SDE++) is a subsidy for industrial entrepreneurs, among others, and focuses on roll-out of techniques that reduce carbon dioxide (CO_2) emissions.

Emission reduction target:

Minimum emission reduction through 2030:
19,078
(in mln kg CO_2 eq.)

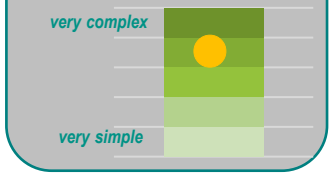
Minimum emission reduction through 2030 per year:
2,120
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-41%

Minimum % annually in emissions through 2030:
-4.6%

Average % annual change in emissions over last 20 years:
-1.2%

Feasibility of emission target:



Source: CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

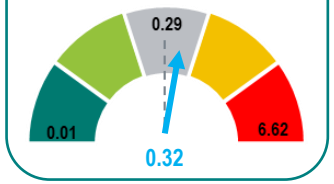
Emissions sector: Food & beverage industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes the manufacture of food, beverages and tobacco products. This category is an aggregation of categories: manufacture of food, manufacture of beverages, manufacture of tobacco products.

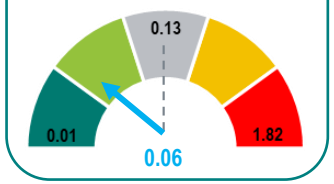
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

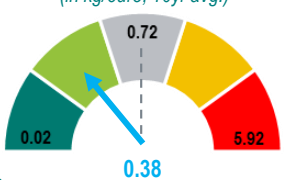
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

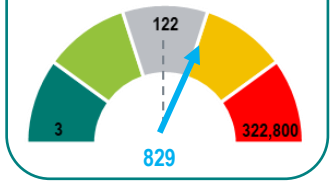


Emissions by tangible assets
(in kg/euro; 10yr avg.)

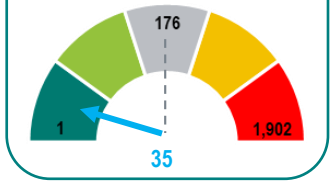


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



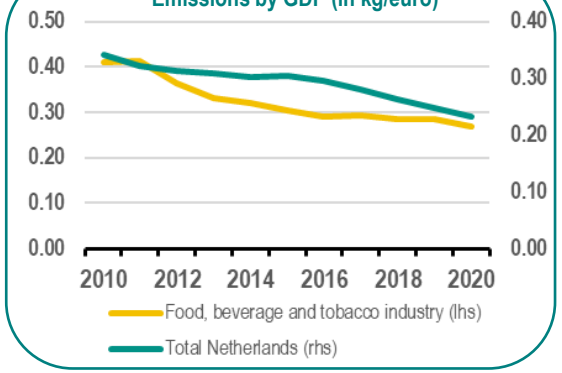
Emissions by job
(in ton/job; 10yr avg.)



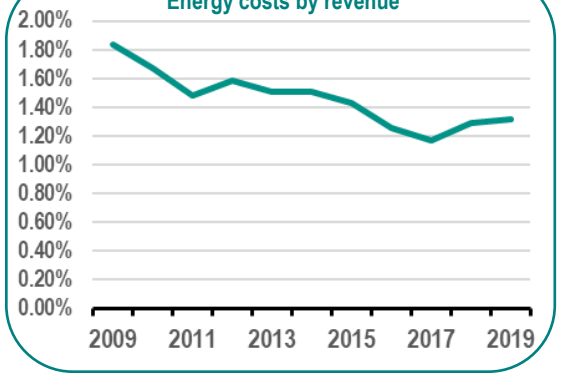
The food and beverage industry scores relatively high on the indicators emissions to GDP and emissions to company. Per euro of added value, 0.32 kg of CO_2 is emitted and per company in the sector about 829,000 kg. On the other indicators, the score is much lower and well below the national average. This ensures that, on balance, the sector receives an average score on emission intensity.

Trend in emission indicators:

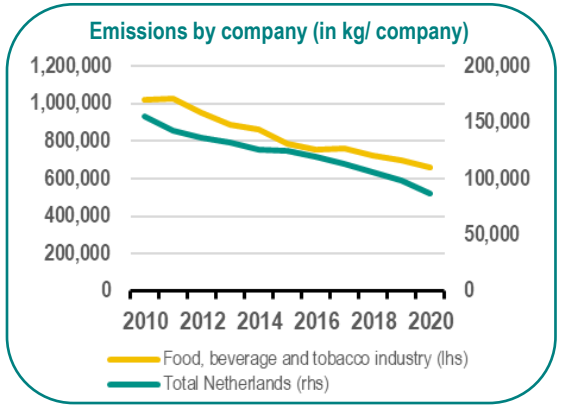
Emissions by GDP (in kg/euro)



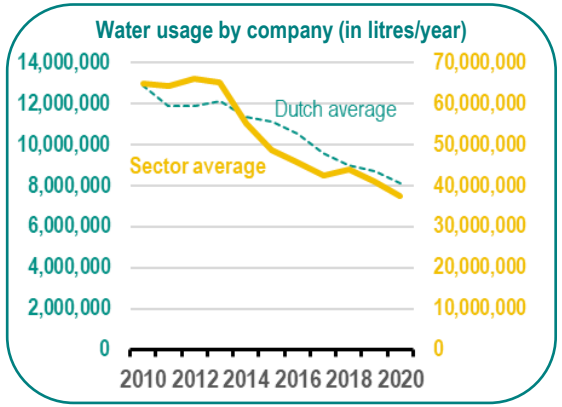
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions to GDP are at a similar level compared to the national average. The decrease in the level of the indicator between 2010-2020 is almost identical. However, emissions by company are significantly higher on average in the sector by a factor of 7. Here, too, there is a clear parallel in the trend from 2010 onwards. The indicator energy costs by turnover is average compared to other sectors. It fluctuates between 1.8% and 1.2% between 2010 and 2020. Over 10 years, energy costs show an erratic pattern, while turnover has steadily increased over those years. Water is an important resource for this sector, but its share in total water consumption is relatively low. The sector uses a lot of tap water, but also depends on surface water and groundwater. The quality of this must be good. The downward trend is because the sector's total water consumption fell by 13% between 2010 and 2020, while the number of active companies increased sharply by 67% over the same period.

Other indicators:

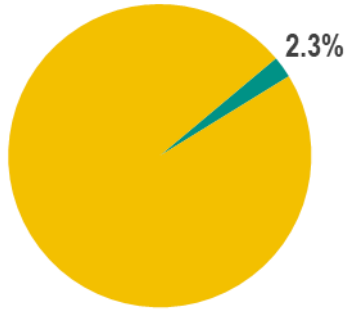
Energy costs vs. revenue:
(10yr average)
1.5%

Share in total water consumption:
0.2%

Energy costs vs. result:
(10yr average)
26.7%

Water usage by company per year:
(in litres)
52,275,323

Sector share in GHG emissions:



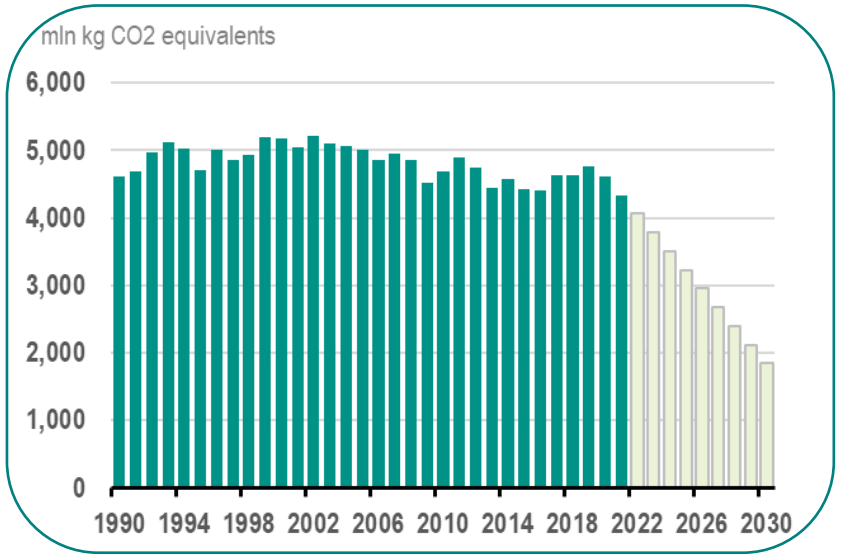
The sector has a high share of 2.3% of total emissions. It seems relatively low, but this share puts the sector in the top 10 biggest polluters. Energy costs by results are relatively high at 26.7%. This is partly because margins in this sector are relatively low. The average annual water consumption is over 52 million litres of water per company.

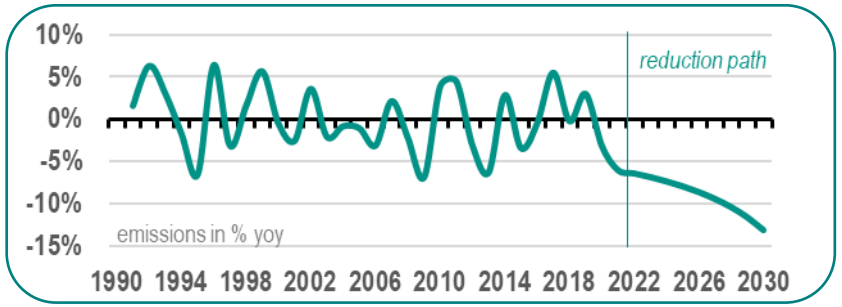
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Food & beverage industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

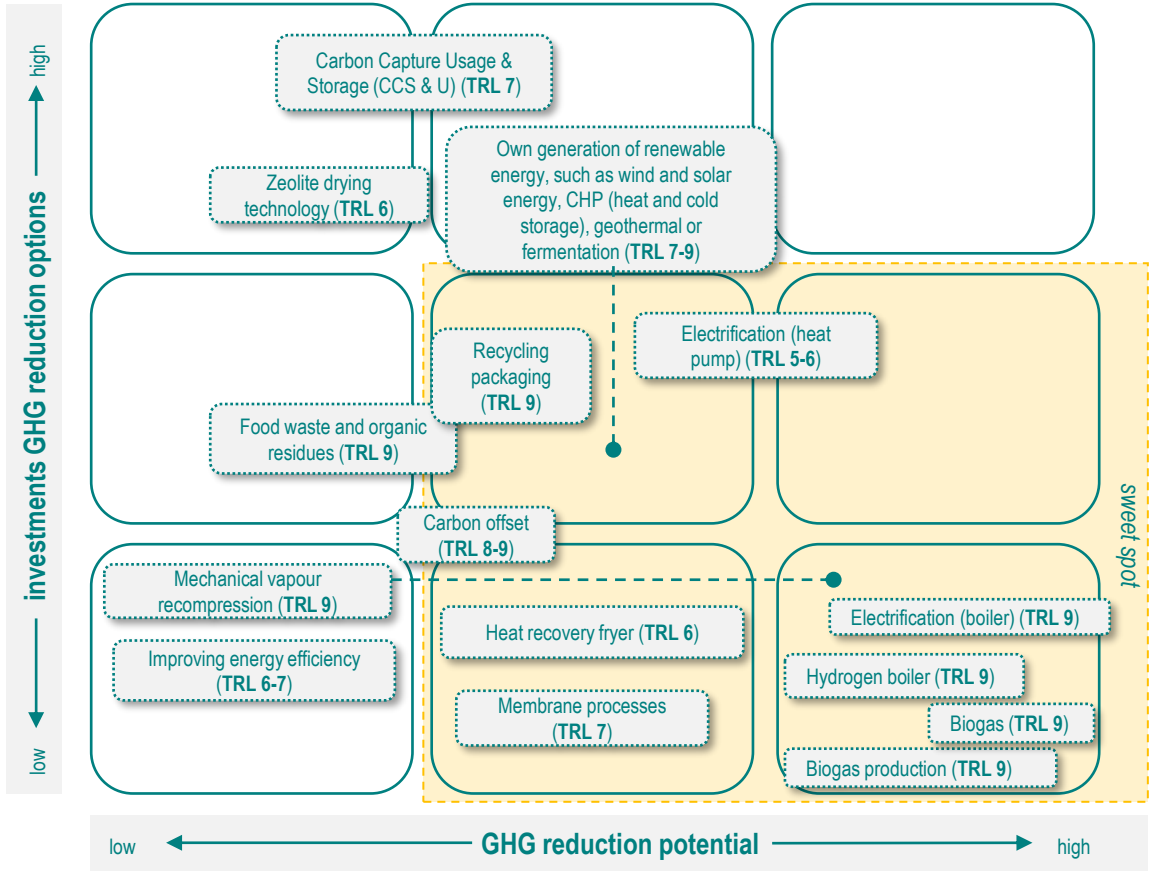
Emission pathway & projection:





The sector shows a stable trend in greenhouse gas emissions between 1990 and 2020, obviously with some volatility. The level of emissions in 1990 and 2020 is almost the same. Historically, the sector has added an average of 0.1% of greenhouse gases to the atmosphere every year. And that while from today, an annual reduction in these emissions of 6.7% is needed. So the sector still has to bridge about 60% of the emissions it emits until 2030. Despite the fact that the feasibility of the 2030 target seems challenging, the sector is active with sustainability. From consumers, supermarket chains, government and NGOs, pressure is growing on the sector to further reduce GHG emissions.

GHG reduction options: investment & effectiveness



The food & beverage industry has several industries, which have a wide range of low-carbon options. In many sectors, there are roughly three ways to accelerate decarbonisation: energy efficiency, efficiency in the use of materials or fuel substitution. In many subsectors, steam and fuel are mainly needed for heating. Fuel substitution and process design are often good options. In addition, a lot of electricity is needed for cooling, freezing and the necessary machinery and equipment. Efficiency in the use of materials is mainly about reducing waste streams. Biogas from residual waste (such as potatoes) can be achieved through simple and commercially available technologies. Replacing fuels delivers the most in terms of CO_2 reduction. Furthermore, biogas, green gas, hydrogen or carbon-free electricity can be to provide heat and steam to the processing process. For mechanical vapour recompression, the GHG reduction potential varies by subsector (dairy = low, potato = high). The variation is also visible in electrification with heat pumps.

Emission reduction target:

Minimum emission reduction through 2030:
2,770
(in mln kg CO_2 eq.)

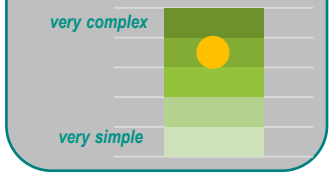
Minimum emission reduction through 2030 per year:
308
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-60%

Minimum % annually in emissions through 2030:
-6.7%

Average % annual change in emissions over last 20 years:
0.1%

Feasibility of emission target:

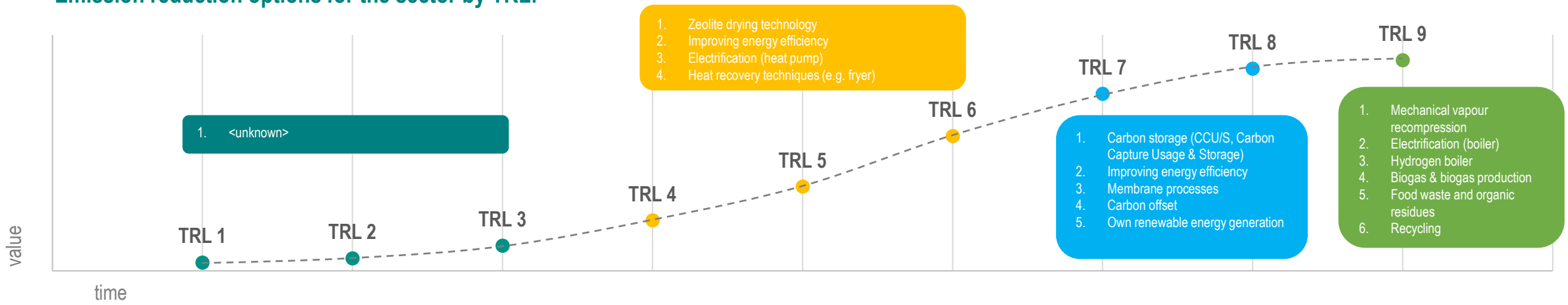


Source: FNLI, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Food & beverage industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The sector has some key sustainable spearheads, where innovation remains important. These include innovations in the areas of energy saving and reduction of CO_2 emissions, raw material availability and efficiency, valorisation of waste streams, international corporate social responsibility (ICSR), sustainable packaging and circular economy.
In the concept and validation phase, the sector has few if any new decarbonisation options ready to be developed further. But that does not take away from the fact that in this sector, innovation towards emission reduction technologies will continue in the coming years. At the time of writing this analysis, however, innovations in this area were still relatively scarce.

Techniques in test and prototype phase:

Zeolite drying technology uses special zeolite granules. Water heats the granules and the heat from this is further used in drying processes.
Heat pumps are a suitable option for low-temperature heating options (up to 200 degrees Celsius).
Improving energy efficiency is a relatively simple option to reduce greenhouse gas emissions. Options include use of waste heat - also benefiting other companies in the vicinity - and improved monitoring of energy information. Larger-scale use of heat pumps can also increase energy efficiency. Overall, within the sector as a whole, this option gets a TRL of 6-7. However, for many subsectors, implementing energy efficiency measures is relatively straightforward. The scale of subsequent reduction is relatively low.

Techniques in pre-commercial phase:

Carbon recycling and storage (CCU/S) is an effective technique to reduce greenhouse gas emissions. But the technique is not always readily applicable in every subsector. Location and size of production facilities play a relevant role here. This often makes this technique a less economically viable option. The possibility and feasibility of combining CO_2 streams from other local or regional industries with the availability of local CCS storage capacity requires further research.
Membrane processes are separation techniques with relatively low energy requirements. It can be applied in the field of drinking and process water preparation. A membrane then acts as a filter to separate pollutants in the production process.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

In mechanical vapour recompression, the exhaust of steam from the evaporator is reused. This significantly reduces steam consumption, but at the same time is also very operation-dependent. Installation of larger machines or devices sometimes also requires conversion.
With material efficiency, many positive results can be achieved in the short term. This mainly involves reducing waste streams. Because of the often large amounts of waste heat from processing facilities, heat pumps can be used to use all waste streams more efficiently. Valorisation (or turning waste streams into value) can be done through biogas production. Biogas can meet energy needs and also reduces CO_2 emissions. Biogas from waste can be done through simple and commercially available technologies. To produce steam - an important secondary energy carrier for some subsectors - alternative methods can also be used, such as electric boilers, biogas- or green gas-fuelled boilers, heat pumps or geothermal energy.
A hydrogen-based boiler replaces those that operate on gas. However, hydrogen is not yet widely available. But biogas can also serve as a good substitute.

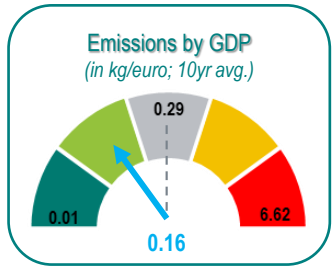
Source: FNLI, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

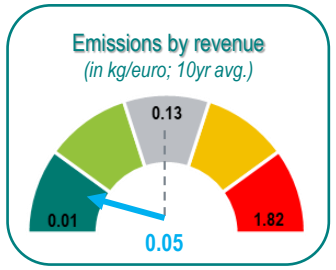
Emissions sector: Textile, clothing & leather industry

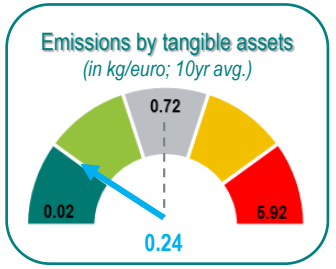
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes the manufacture of textiles, clothing and leather goods. This category is an aggregation of categories: manufacture of textiles, manufacture of clothing, manufacture of leather, leather goods and shoes.

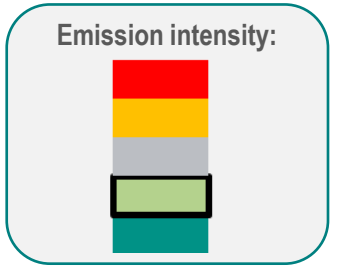
Emission indicators & intensity:

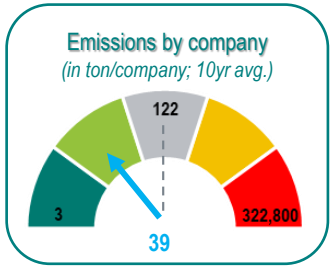
(grey dotted line = average NL score; blue arrow = sector score)

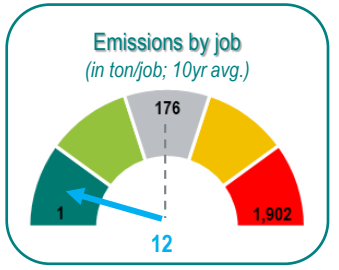




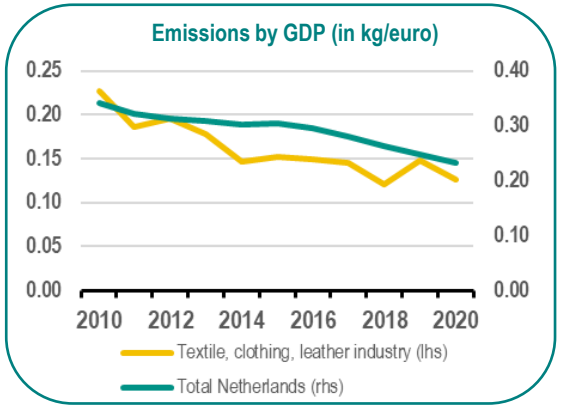


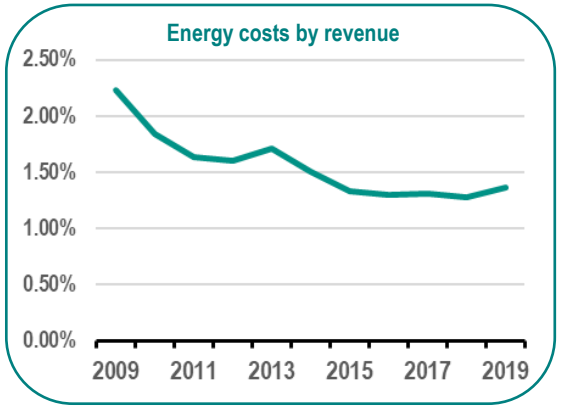


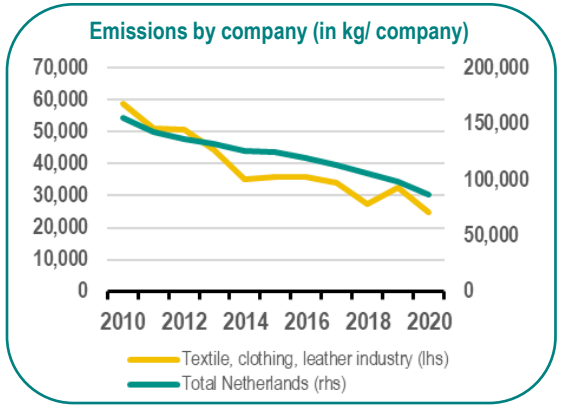


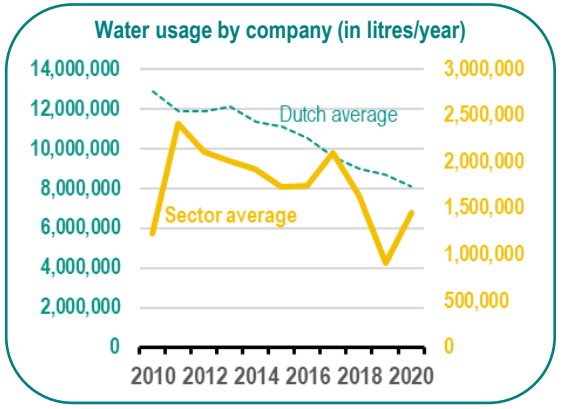


Trend in emission indicators:









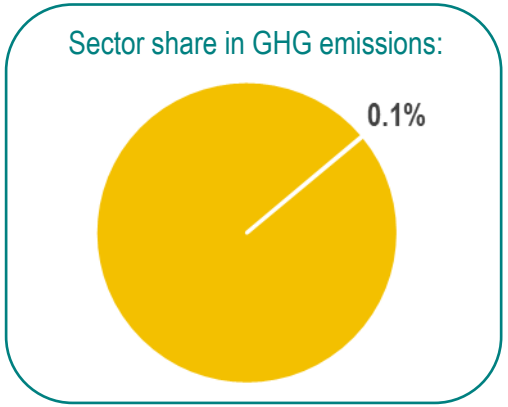
Other indicators:

Energy costs vs. revenue:
(10yr average)
1.6%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
18.2%

Water usage by company per year:
(in litres)
1,751,984



Emission indicators in this sector are relatively low. Thus, the emissions intensity in the Netherlands is limited. It is only on the indicators emissions to GDP and emissions to company that the sector scores higher. Per euro of added value generated in the sector, some 0.16 kg of CO_2 is added to the atmosphere on average annually. And per company, some 39,000 kg of CO_2 is emitted on average annually. But if these indicators also take scope 3 emissions into account, the picture tilts. Then the sector scores high in terms of emission intensity.

Emissions to GDP in the sector are about half the national average. The two track each other closely and have declined at the same rate over the past decade. This is also broadly true for emissions to company. In the textile industry, groundwater is mainly used for rinsing and cleaning. Energy costs fluctuate in a range of 2.3% and 1.4% over the period from 2010 to 2020, but have declined over these years. Energy costs decreased slightly, while turnover in the sector increased. Water consumption shows an erratic pattern over the past decade. The level of water consumption in 2020 is slightly higher than in 2010. The textile sector uses and consumes a lot of groundwater in the production process in particular. However, this water must be of good quality and meet certain specifications. This is important against staining the fabric and the impact it has on the dyeing process.

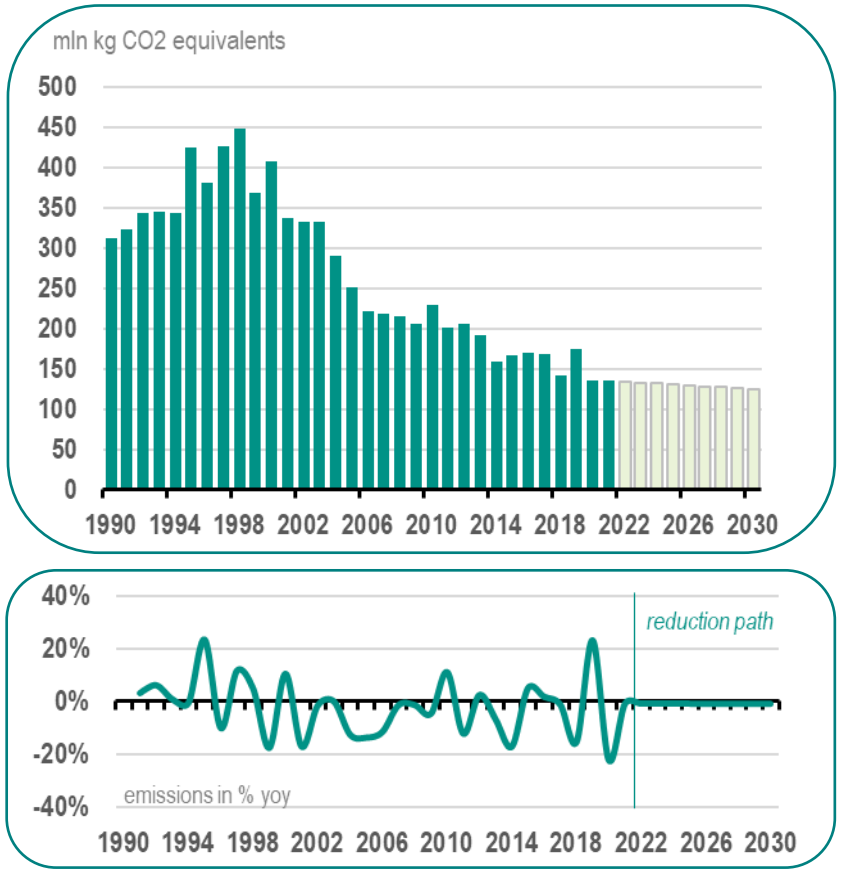
Other indicators also show that the emissions intensity of the sector is low. The share in total emissions of companies in economic sectors is marginal. The overall share in water consumption is relatively low, although this is an important component for the production process. Some 1.7 million litres of water are consumed per company annually.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Textile, clothing & leather industry

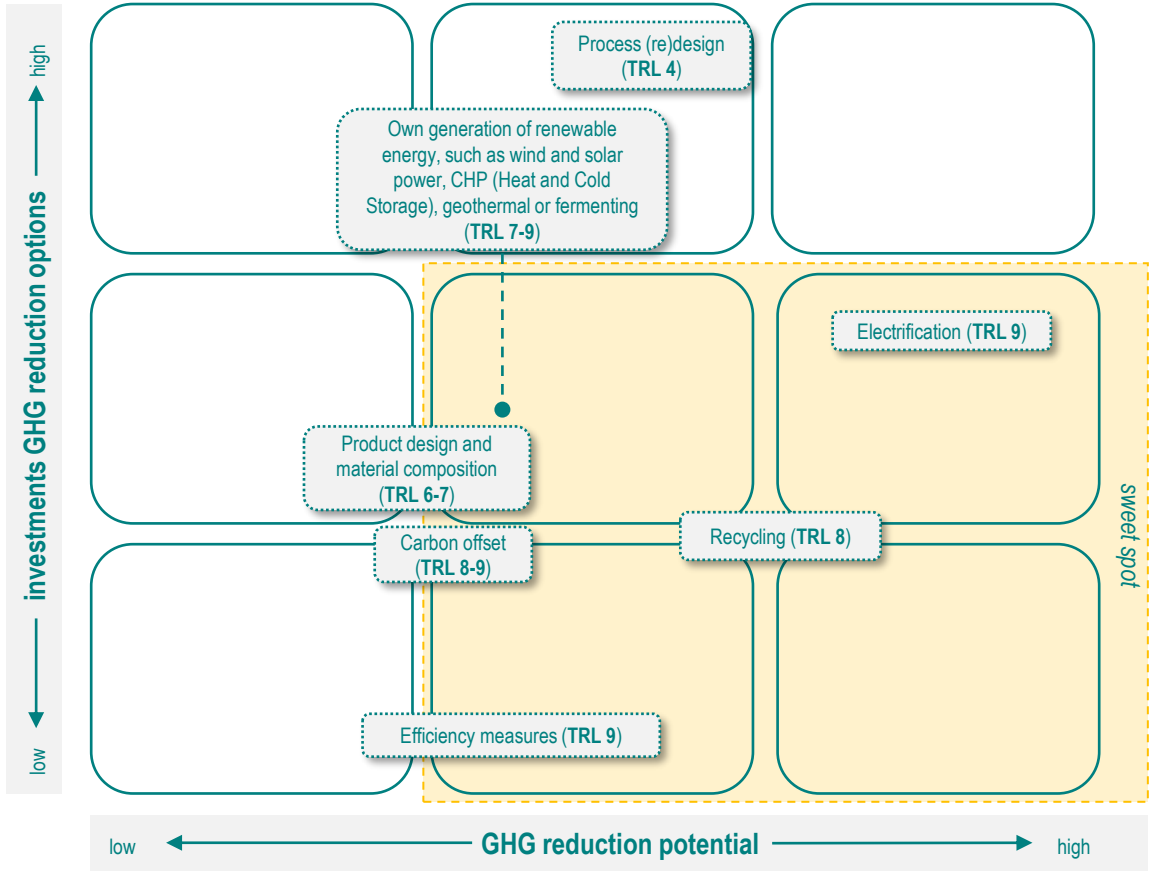
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Greenhouse gas emissions increased almost every year from 1990 until the peak in CO_2 emissions in 1998. After that, emissions are steadily decreasing and the sector is on the right track towards the 2030 target. The sector only needs to bridge less than 8% until 2030, which is just under 1% per year. With decreases in emissions over the past 20 years averaging 2.1% per year, this is good for the sector in the Netherlands. However, the sector's emissions do not include scope 3 emissions. The entire garment chain is known worldwide as a highly polluting sector, with a lot of water at the beginning of the chain (cotton), use of agricultural land and harmful pesticides.

GHG reduction options: investment & effectiveness



The ecological footprint of the textile and clothing industry is large. Despite the sector's low share of greenhouse gas emissions in the Netherlands, its global impact remains significant. The textile chain is a strongly global chain, partly also because most production takes place outside the Netherlands. International chain cooperation is therefore an important prerequisite for reducing the sector's environmental impact. Incidentally, it is not only CO_2 emissions that are of concern either; waste and water consumption also deserve attention. As consumers increasingly demand more sustainable products instead of synthetic fabrics and animal materials, the textile industry is constantly looking for innovation. As a result, vegan shoe lines and garments are becoming more fashionable. Material innovation resulting in a lower carbon footprint has obviously become more important in this sector.

Emission reduction target:

Minimum emission reduction through 2030:
11
(in mln kg CO_2 eq.)

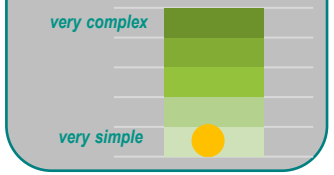
Minimum emission reduction through 2030 per year:
1
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-8%

Minimum % annually in emissions through 2030:
-0.9%

Average % annual change in emissions over last 20 years:
-2.1%

Feasibility of emission target:

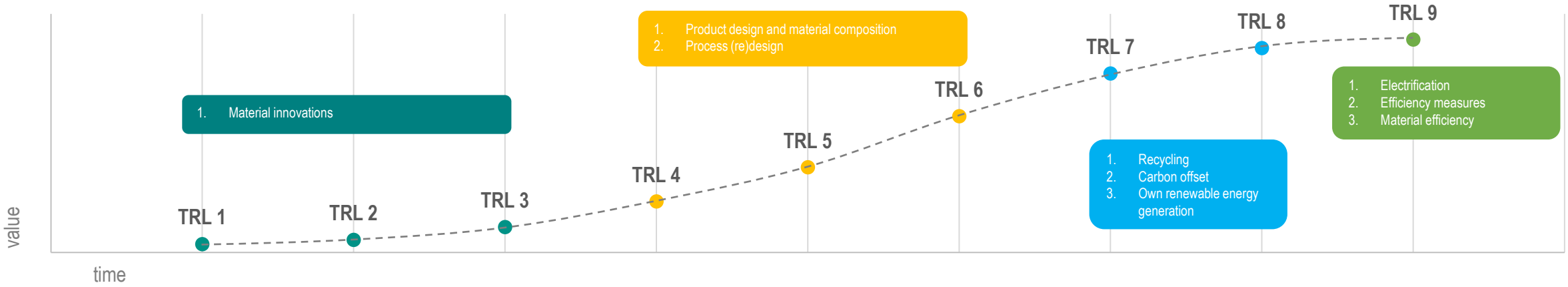


Source: Consultancy.nl, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Textile, clothing & leather industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The sector is under a magnifying glass when it comes to working conditions, animal welfare and the environment. So innovation remains key for the textile industry. Because the sector still has to deal with relatively high water consumption per company and the use of chemicals. But also overproduction and the inability to deal with residues means that more environmental awareness is still high on the agenda. Therefore, pioneering innovations continue to take place, especially in the field of raw material savings and material innovation (such as the versatile hemp, lotus and nettle fibres). But also with apples, pineapples, mushrooms, coffee, bananas, kapok, kelp and squid, the sector has now demonstrated its innovativeness. In any case, the innovations are numerous and this shows that the sector is not sitting still when it comes to making products and processes more sustainable. For instance, researchers have shown that by using a special fibre in clothing, energy can also be generated by body movement.

Techniques in test and prototype phase:

Product design can take much account of preservations and product composition. In some cases, however, this requires larger interventions in the production process. Consider, for example, options such as extracting the plastics needed from recycled products. And if plastics are needed that are not easily recyclable, they should at least be biodegradable. But the products can also comply with 'made to be remade' principles in advance, which simplifies the recovery process.
With high competitive pressure and continuous tension in the garment and textile sector, the required change to new revenue models is a very important but a very difficult path to achieve. However, the industry realises that non-sustainable practices can lead to risks to business continuity.

Techniques in pre-commercial phase:

Recycling in the sector is important to reduce the carbon footprint, but is often still complex. This is mainly because products often consist of mixed fabrics or materials, making recycling difficult. Innovative sorting techniques, as well as mechanical and chemical recycling processes, can bring textile waste back to raw material levels.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

The sector's high share of global CO_2 emissions is mainly due to the process of dyeing and finishing fabrics. The energy consumption of these dyeing processes is high because large amounts of water have to be heated. Besides the energy-intensive processes, many textiles are thrown away and burnt, which is also a major contributor to higher CO_2 emissions. Emission reductions can also be significantly reduced with more efficient handling of these flows.
Electrification has several advantages. For instance, electrically powered plant and equipment tend to be more energy-efficient than the conventional option. Moreover, both maintenance and investment costs are usually lower. Trade association Modint has an online tool for its members to map the carbon footprint and also offers all kinds of tools for entrepreneurs around energy saving.

Source: Modint, VGT, INretail, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

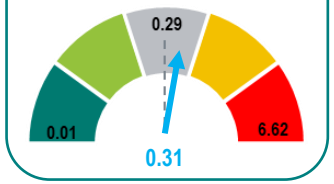
Emissions sector: Woodworking industry

Emissions are greenhouse gas (GHG) emissions, scope 1. This sector includes primary woodworking and manufacture of articles of wood, cork, wicker and wickerwork (not furniture)

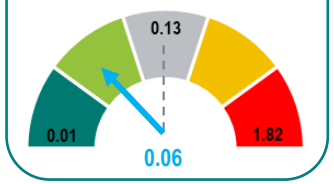
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

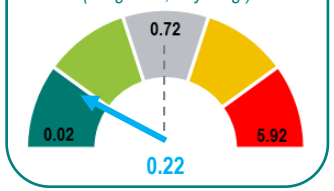
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

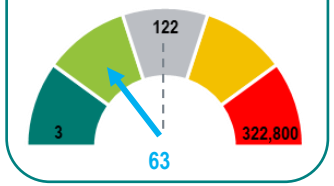


Emissions by tangible assets
(in kg/euro; 10yr avg.)

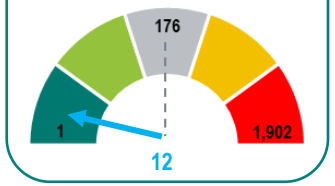


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



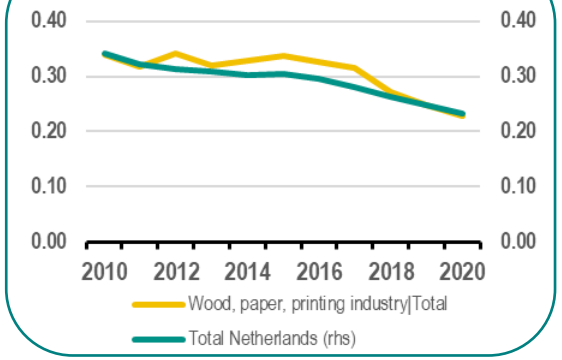
Emissions by job
(in ton/job; 10yr avg.)



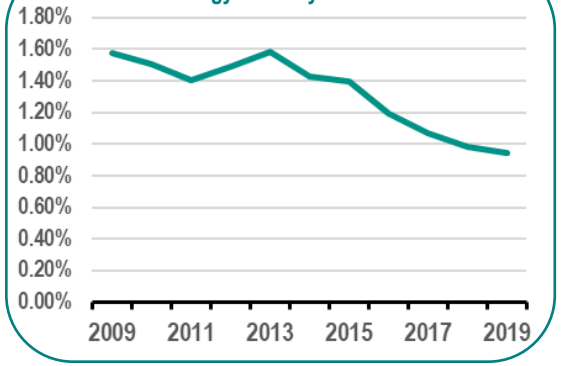
On average, the wood industry scores relatively low on many emission indicators, but shows increased scores on emissions to GDP, emissions to turnover and emissions to company. On emissions to GDP, the score is just above the national average. However, this indicator is based on a combination of three subsectors: wood, paper and printing industries. The paper industry influences the indicator more than the other two subsectors.

Trend in emission indicators:

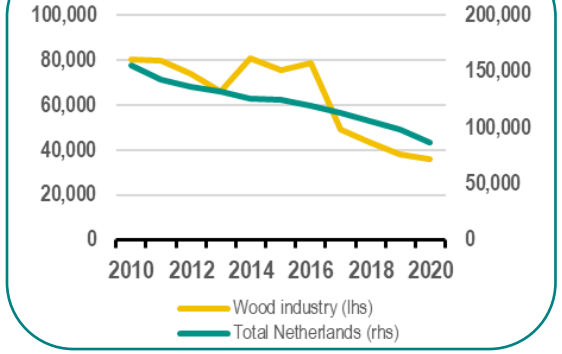
Emissions by GDP (in kg/euro)



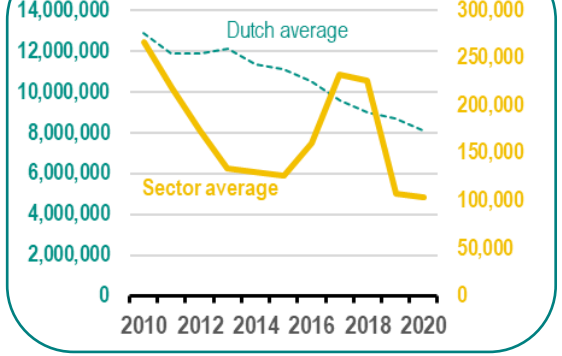
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The emissions to GDP for the sector in the figure above refer to a combination of three subsectors: wood, paper and printing industry. The trend in this indicator broadly follows the trend in the national average. For emissions by company, the relationship between the sector and the national average deviates slightly and the sector average is lower. The decrease in emissions by company is 55% over the past ten years. For the national average, it is 44%. Energy costs by turnover have an average level compared to the other sectors. Energy costs have declined only slightly in the sector since 2010, while turnover has increased much faster. Thus, the sector has become slightly more efficient, causing a downward trend in the indicator. Water consumption in the sector declined over 10 years per company over the period 2010-2020 by over 60%, with a substantial recovery between 2016 and 2018. The increase in the number of companies was 37% over the same period.

Other indicators:

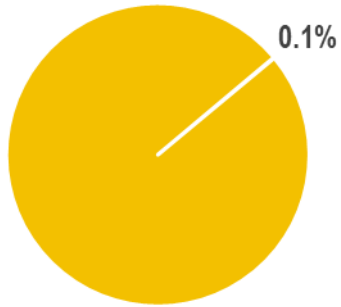
Energy costs vs. revenue:
(10yr average)
1.3%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
21.6%

Water usage by company per year:
(in litres)
171,040

Sector share in GHG emissions:



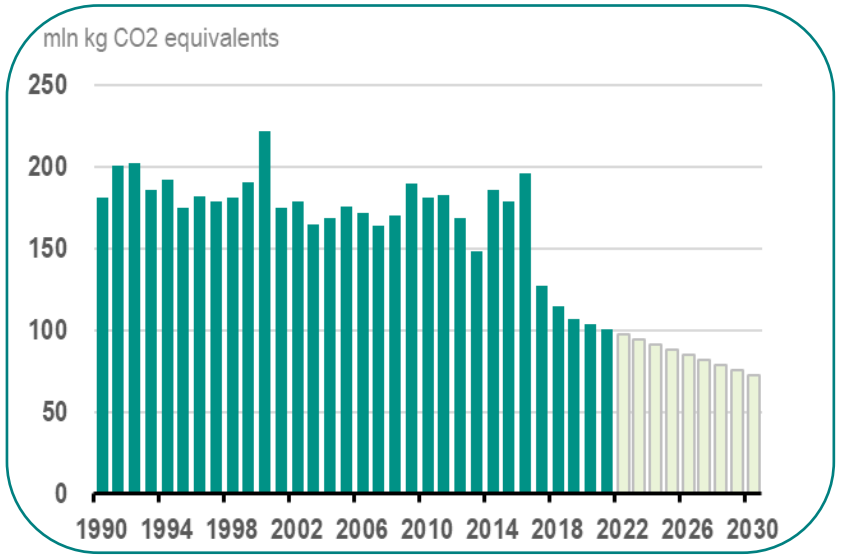
Over the past decade, the sector has consumed or used an average of about 171,000 litres of water per company annually. This is relatively little compared to other sectors and its overall share in total water consumption is almost zero. The sector also has a very small share in total emissions from companies in economic sectors.

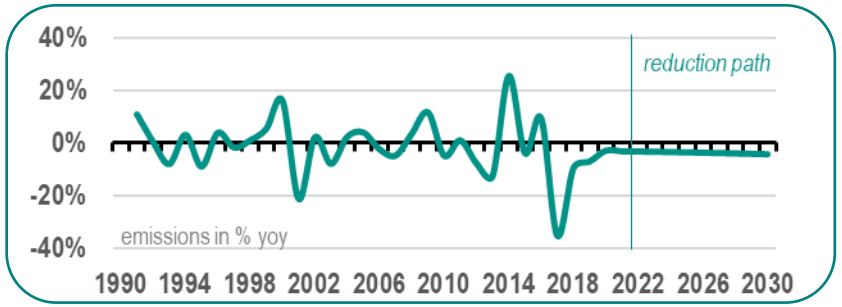
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Woodworking industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

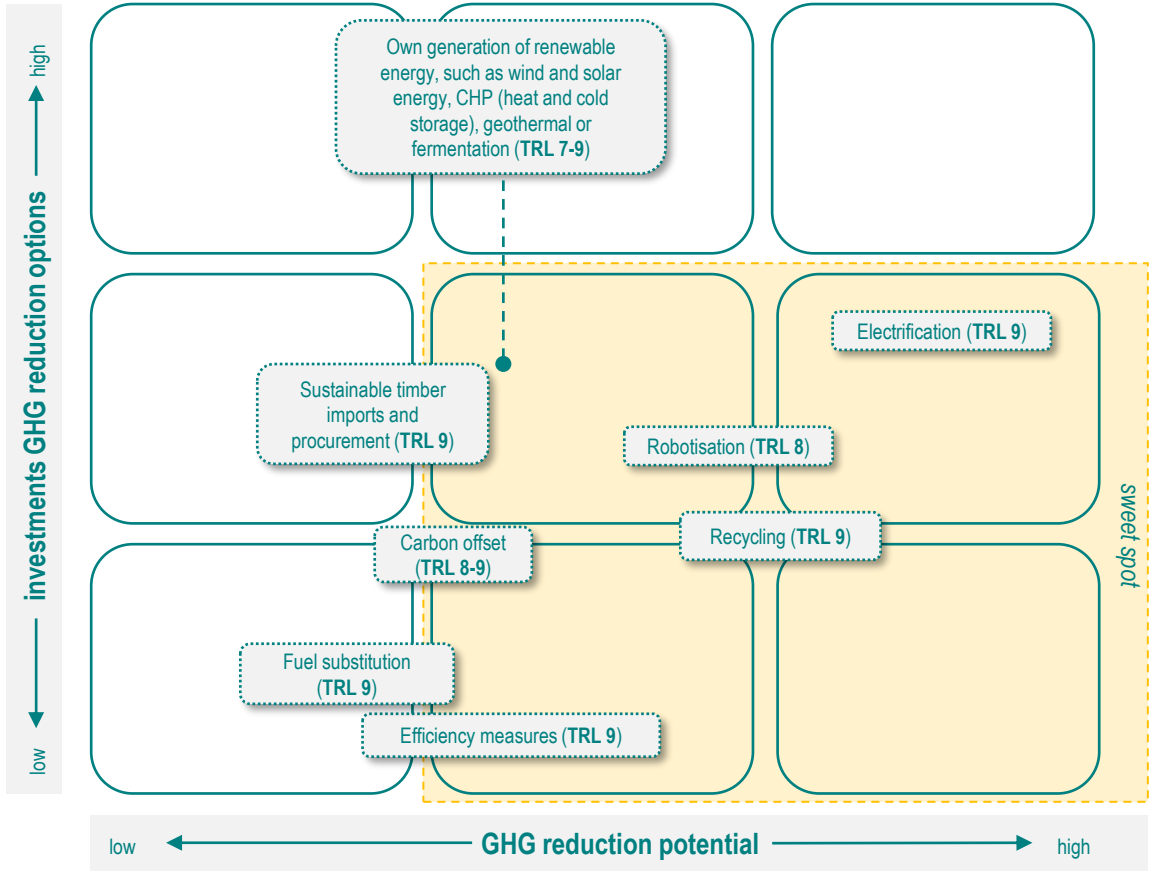
Emission pathway & projection:





In the emission path since 1990, the sector shows strong upward and downward outliers. The peak in emissions is in the year 2000, before following a slow downward trend. Eventually, emissions in 2020 are more than 43% lower than the 1990 emission level. That the sector has been able to work towards emission reduction over the years is advantageous for the feasibility of the 2030 emission target. To reach this target, the sector needs to reduce emissions by at least about 3.4% per year, and this is a relatively low level compared to other industry subsectors. The historical reduction path has averaged 1.2% per year. Thus, a continuation of that pace would not be sufficient to meet the 2030 target.

GHG reduction options: investment & effectiveness



The wood industry makes products for construction, furniture, packaging, transport and leisure. Many machining operations take place in the wood industry. In woodworking, planing benches, band saws, automatic cross-cut saws and sawing machines are used. The drying process is often computer-controlled. A vacuum dryer is also sometimes used in drying, which speeds up the process. However, this requires a relatively large amount of energy. Automatic spray lines then give the dried wood a coating (primer or lacquer-finish). Circular working is now well established in the sector. This takes place through, for example, processing and material efficiency, circular strategies for reuse and recycling. Due to increased resource and energy efficiency in the wood industry over the years, relatively little waste is produced during the life cycle.

Emission reduction target:

Minimum emission reduction through 2030:
32
(in mln kg CO_2 eq.)

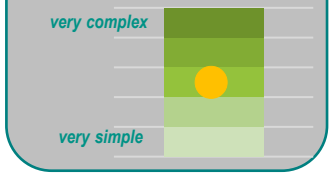
Minimum emission reduction through 2030 per year:
4
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-30%

Minimum % annually in emissions through 2030:
-3.4%

Average % annual change in emissions over last 20 years:
-1.2%

Feasibility of emission target:

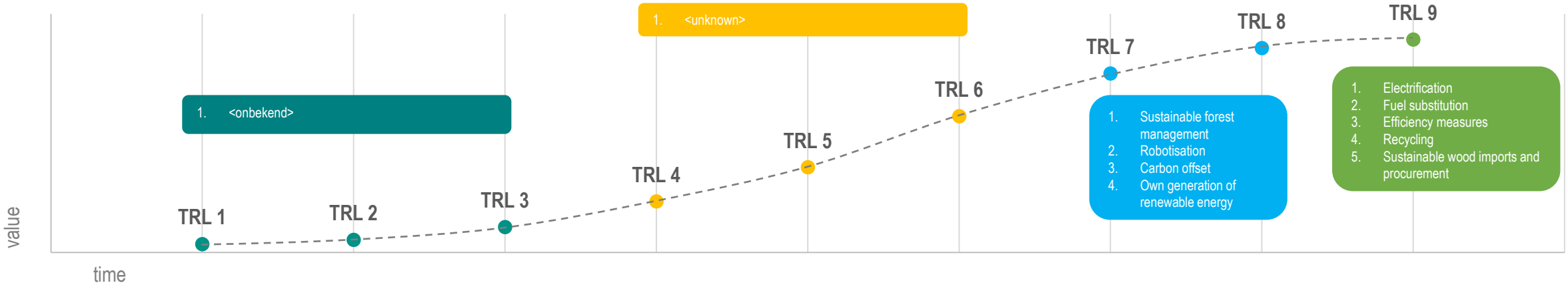


Source: VVNH, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Woodworking industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Economic and technical innovations towards new ways to be more energy efficient continue. Today's timber industry has now moved significantly with the times with well-automated and partly robotised plants where energy efficiency has been a key driver. Another focus is the digitisation of process chains in the forest and wood industry and innovations in sawmill technology. Exact details on innovations to reduce the carbon footprint were not known at the time of writing.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

The manufacture of wood products requires less fossil fuel than alternative non-wood building materials such as concrete, metals or plastics. Wood is naturally composed of carbon captured from the atmosphere during tree growth. Sustainable forest management and legal requirements for reforestation remain relevant for the sector. Bio-based products such as naturally grown wood naturally have a lower carbon footprint. Emissions arise only when the wood is extracted or harvested, during wood processing and transport. Bioenergy produced from the residues, such as tree bark and sawdust, can be used to generate energy for the production process.
Robots can be used to optimise production processes, reduce production costs and robotise repetitive handling. Robots are becoming increasingly efficient in terms of energy consumption and are used in many different applications. The most common application is for moving an object. But they can also be drilling, cutting and sawing operations.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein

Techniques commercial deployment phase:

Electrification is the most impactful measure to reduce greenhouse gas emissions. Purchasing green electricity (solar power, biomass) also helps reduce the carbon footprint.
Wood products have low greenhouse gas emissions because they are grown using renewable solar energy, use little fossil fuel during production and have many end-of-life options (reuse, recycling, energy recovery). Besides the decreasing carbon intensity of electricity, energy efficiency is a key benefit of electrification that reduces carbon emissions. Electric motors are three times more energy-efficient than conventional internal combustion engines. Moreover, an engine powered by electricity contains far fewer components, which are estimated by the 40% to require less maintenance.

Source: Houtwereld, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

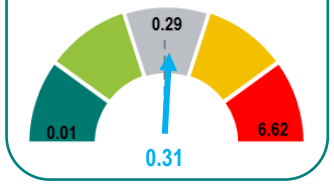
Emissions sector: Paper industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of paper, cardboard and paper and cardboard products.

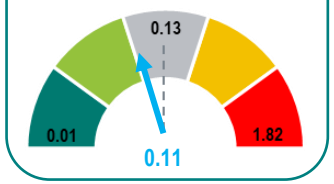
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

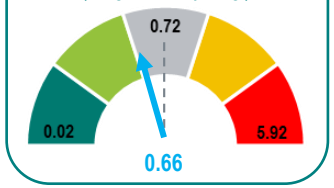
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

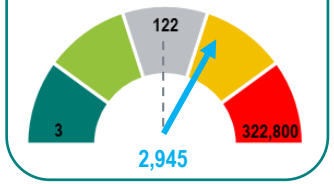


Emissions by tangible assets
(in kg/euro; 10yr avg.)

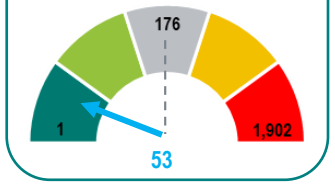


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



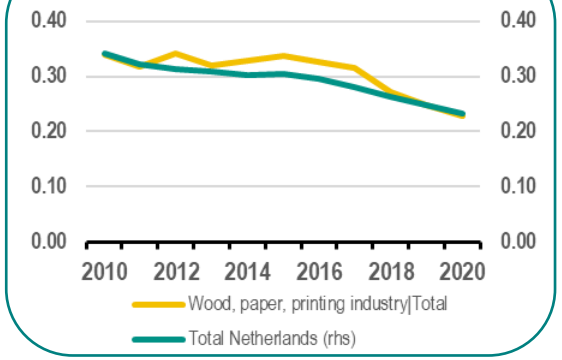
Emissions by job
(in ton/job; 10yr avg.)



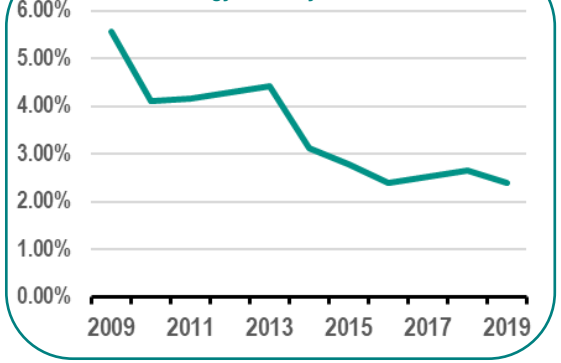
The paper industry shows average scores on many relevant indicators. This is especially evident in the ratios emissions to GDP, to turnover and to tangible assets. Emissions to GDP relate to a combination of three subsectors: wood, paper and printing industry. Emissions by business are slightly increased compared to the average for the total economy.

Trend in emission indicators:

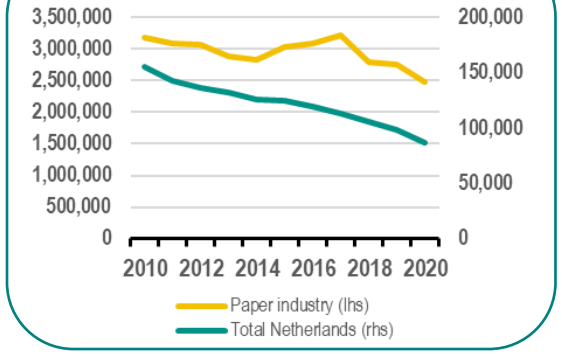
Emissions by GDP (in kg/euro)



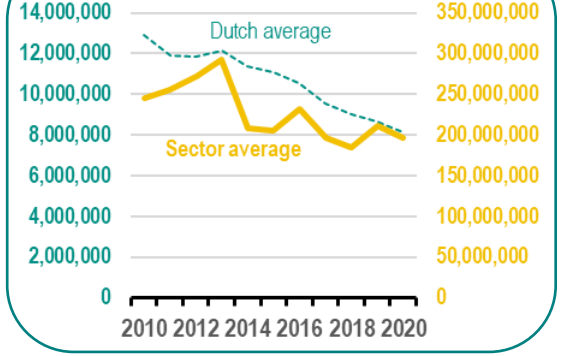
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The paper industry shows a clear downward trend in almost all relevant emission indicators and thus follows the line of the emission indicators applicable to the Netherlands as a whole. However, emissions by company are on average much higher in the paper industry compared to the Netherlands as a whole. Indeed, the paper industry is the fifth most energy-intensive industry in Europe. About 70% of the energy used in the paper industry relates to the drying phase, and this requires a lot of high-temperature heat. Energy costs have fallen year-on-year in the industry since 2009, and turnover has grown. This results in a downward trend in the ratio of energy costs vs turnover. Total water use has decreased by 20% in the paper industry since 2010. The production of recycled paper requires 10-15 litres of water per kilo of paper. For new paper, it is 25 litres. Paper production has been on an upward trend since 2015.

Other indicators:

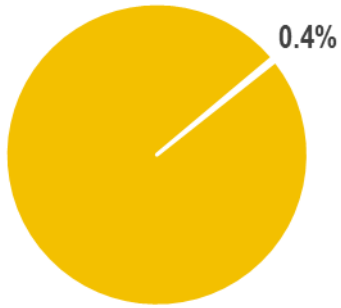
Energy costs vs. revenue:
(10yr average)
3.5%

Share in total water consumption:
0.5%

Energy costs vs. result:
(10yr average)
70.3%

Water usage by company per year:
(in litres)
227,428,138

Sector share in GHG emissions:



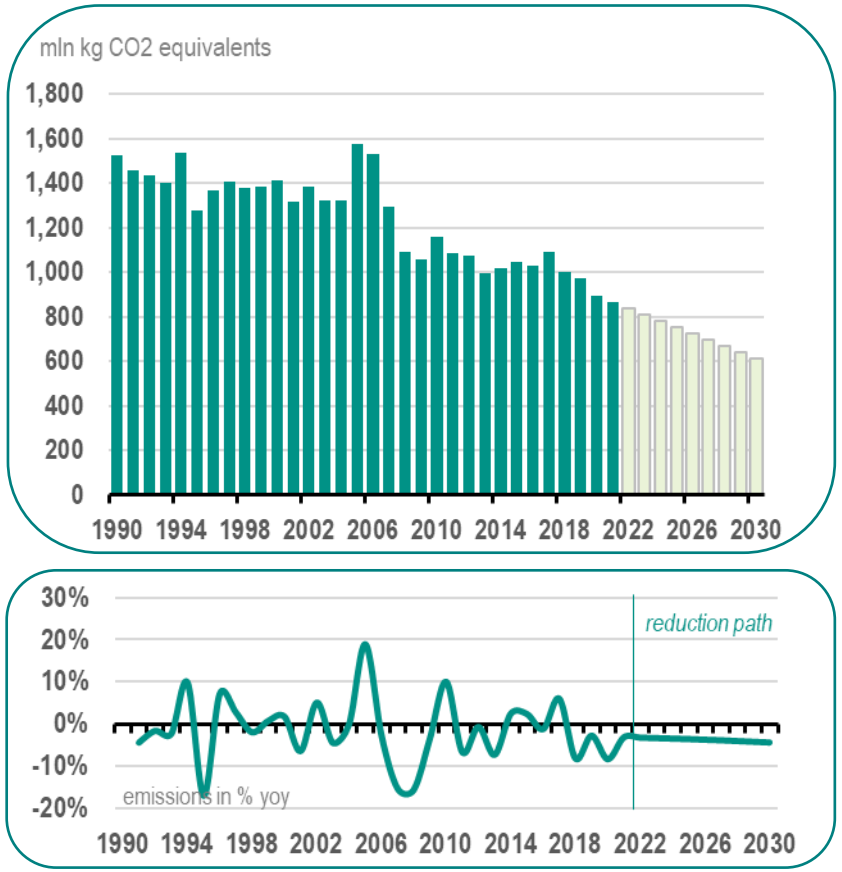
The paper industry is an energy-intensive and also a water-intensive sector. The ratio of energy costs to turnover and water use per company are relatively high. The paper industry is also a heat-intensive industry. The paper industry depends mainly on natural gas in its total energy needs. However, the sector's share of total GHG emissions is relatively low.

Source: CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options: Paper industry

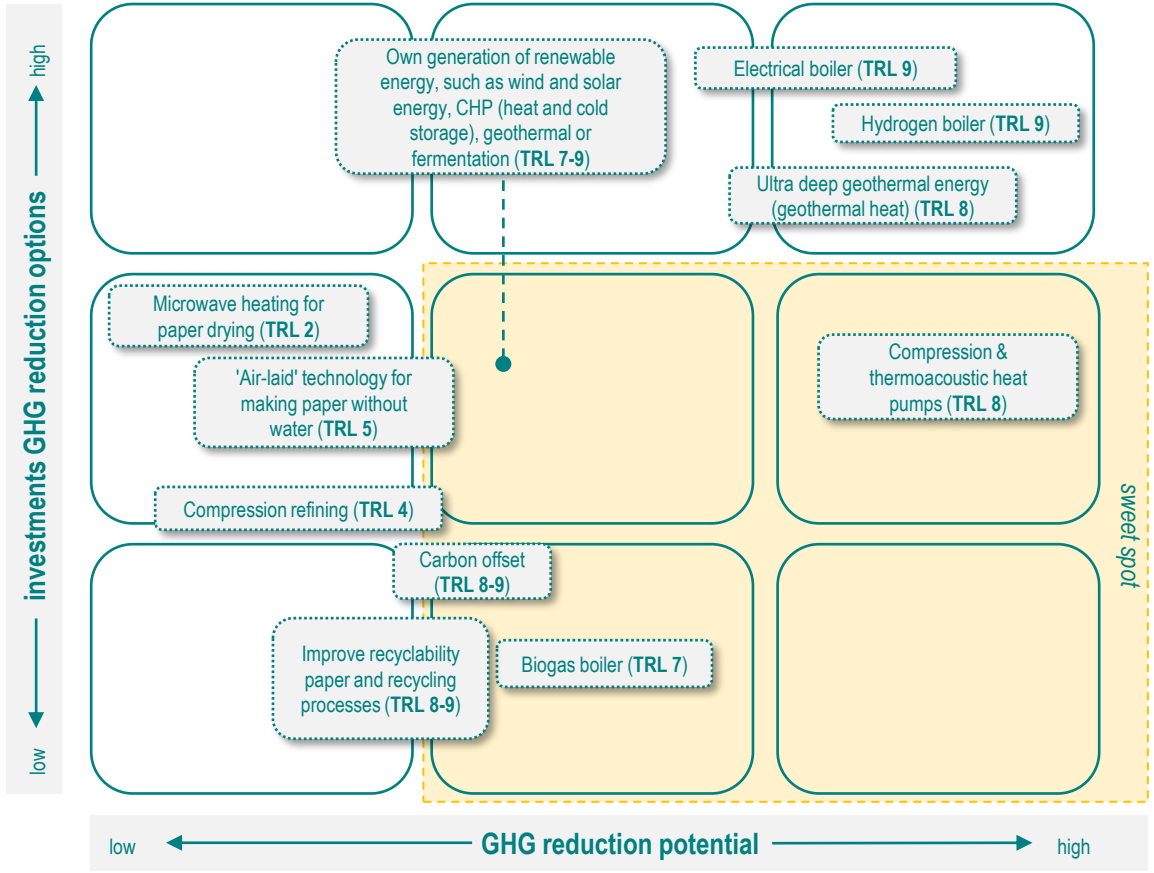
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



The paper industry shows a faster trajectory in greenhouse gas (GHG) reductions than the reduction trend in the overall industry. Over the years, the paper industry has implemented numerous emission reduction options and these have contributed to the gradual decline in emissions since the 1990s. However, the rise of digital alternatives also had a disruptive effect on the industry. A minimum annual reduction of 3.5% in GHG emissions is necessary to reach the 2030 target. However, the sector has achieved an average GHG reduction of 1.5% over the past 20 years. Thus, the feasibility of the 2030 reduction target still seems challenging, but relative to other sectors, the final target is less distant.

GHG reduction options: investment & effectiveness



The industry has about four decarbonisation options available that have both a high TRL and a relatively high reduction potential. The paper industry sees the biobased economy as a way to extract more value from its residual streams and to secure long-term raw material security (source: CE Delft). A win-win situation, because in addition to the environmental benefit, it is also the basis for competitive advantage over countries where primary raw materials and energy are relatively cheap. Some further efficiency measures are also possible, which cannot be directly plotted in the matrix above. An energy management system, such as monitoring of steam, electricity and gas consumption lines, can improve regulation of energy flow throughout the system and measurement of energy efficiency. Also, regular maintenance, especially on electrical equipment (such as pumps, motors, fans, drying systems) can improve energy efficiency and reduce emissions.

Emission reduction target:

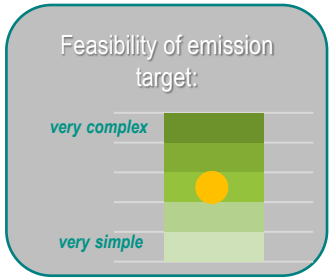
Minimum emission reduction through 2030:
283
(in mln kg CO_2 eq.)

Minimum emission reduction through 2030 per year:
31
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-32%

Minimum % annually in emissions through 2030:
-3.5%

Average % annual change in emissions over last 20 years:
-1.5%

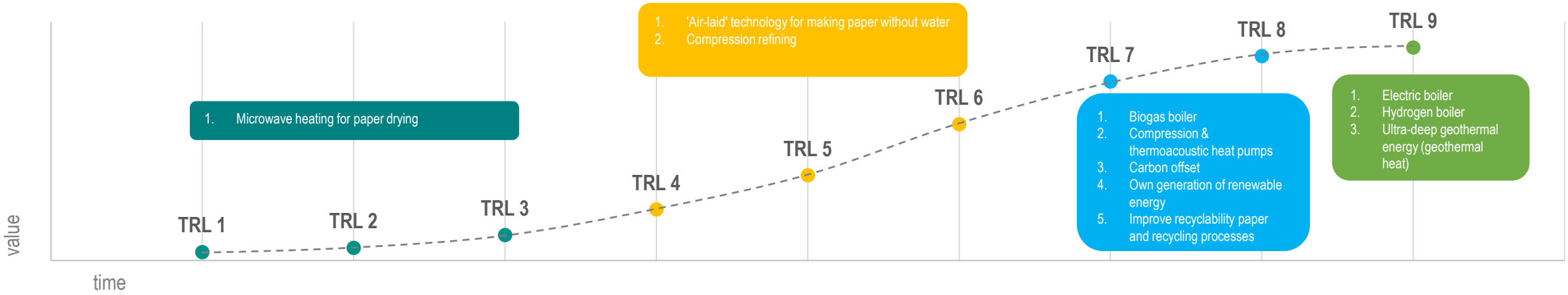


Source: CBS, VNP, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Paper industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

In microwave heating (or: microwave drying), paper is dried by exposure to microwave radiation. This technology increases drying speed and reduces overall energy consumption. But the reduction is relatively low on balance. The technology has advantages not only with regard to energy efficiency, but also with regard to paper properties, such as tensile strength and bending strength. These properties can be improved through microwave drying, leading to a better product. Microwave heating is also used in the food industry (for baking or drying), but is also used for wood treatments.

Techniques in test and prototype phase:

The most energy-intensive part of paper production is the removal of water. With 'air laid' technology, paper can be produced without the use of water. Currently, the paper strength achieved through this process is quite low, making it less suitable for cardboard with packaging purposes. However, it can be used well in the production of sanitary paper or graphic paper. The refining step is very energy-intensive and responsible for a significant proportion of electricity consumption in paper production. The energy required for refining can be reduced by about 20% with compression refining because of its higher efficiency compared to normal refining (95% to 25% respectively).

Techniques in pre-commercial phase:

CO_2 reduction can be achieved by using biogas instead of natural gas to fire the boilers. This is also possible if only a small amount of biogas is mixed with the natural gas used for combustion. For higher biogas ratios, however, higher maintenance costs are to be expected, as unwanted elements can clog the boilers and chimneys (source: PBL/TNO).The use of heat pumps offers many advantages. It allows low-temperature waste heat to be converted into high-temperature heat. However, modifications to the production process are necessary and this entails costs. The use of biogas is also a technique that can be deployed in the relatively short term, but the local availability of biomass is sometimes still an obstacle. Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

The advantage of electric boilers is that their implementation is relatively easy as it does not require a complete redesign of primary processes. Incidentally, this option can only count as an emission reduction option if the electricity comes from a renewable source. Although electric boilers are commercially readily available, there are some challenges related to electricity infrastructure and additional costs for connection.
Hydrogen can be used as an alternative to natural gas to produce steam in combustion boilers. The availability of affordable hydrogen produced from renewable electricity (green hydrogen) or hydrogen produced from natural gas combined with CCS (blue hydrogen), is currently a limiting factor.
Ultra-deep geothermal is not yet applied in the Netherlands. The main feature of ultra-deep geothermal technology is the depth of the well from which hot water is extracted.

Source: VNP, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

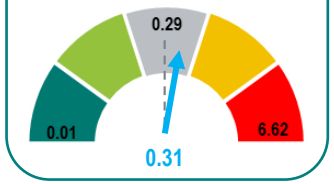
Emissions sector: Printing & publishing industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes printing companies and companies active in reproduction of recorded media.

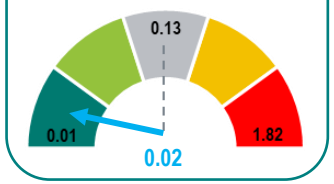
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

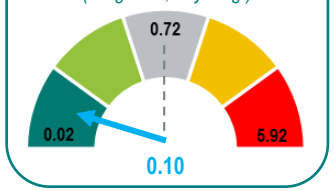
Emissions by GDP
(in kg/euro; 10yr avg.)



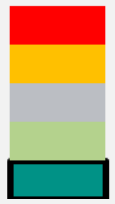
Emissions by revenue
(in kg/euro; 10yr avg.)



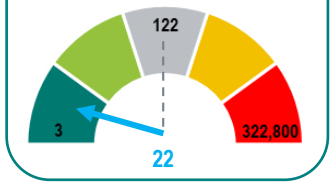
Emissions by tangible assets
(in kg/euro; 10yr avg.)



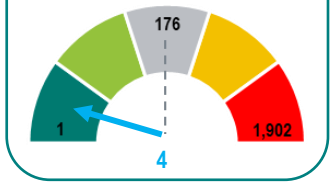
Emission intensity:



Emissions by company
(in ton/company; 10yr avg.)



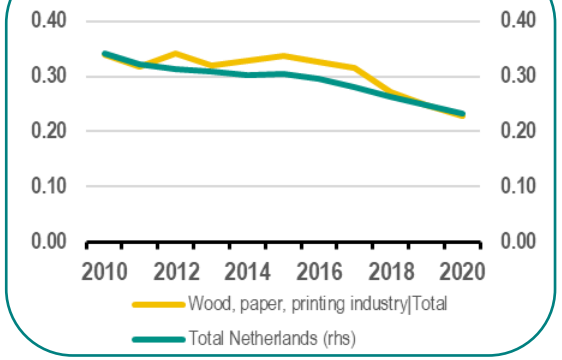
Emissions by job
(in ton/job; 10yr avg.)



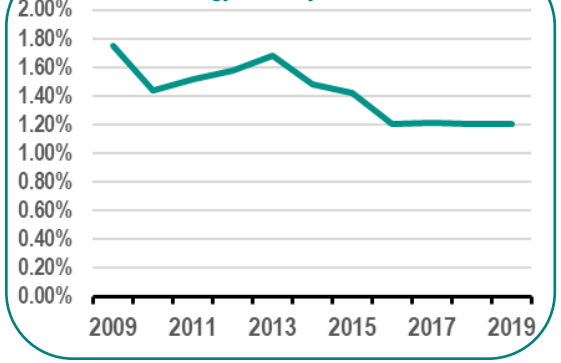
The indicator emissions to GDP reflects the situation for a combination of sectors and sub sectors. This is an indicator for the wood, paper and printing industry subsectors. Here, the paper industry has the largest share of emissions to GDP. The graphics industry's score is relatively low taken into account all other emission indicators shown in the figures shown above,. With this, it can be said that the total emission intensity of the graphics industry as a whole is relatively low.

Trend in emission indicators:

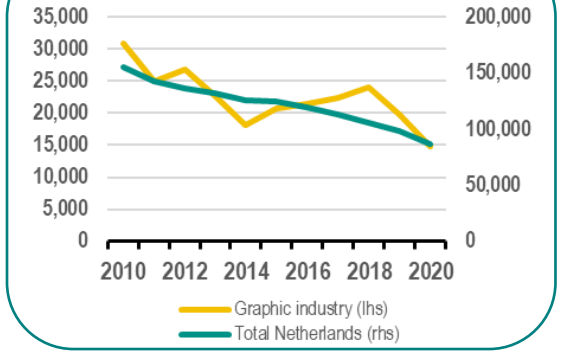
Emissions by GDP (in kg/euro)



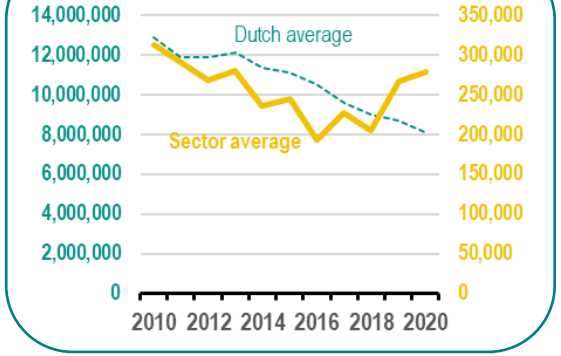
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The emissions to GDP for the sector in the figure above refer to a combination of three subsectors: wood, paper and printing industry. The trend in this indicator broadly follows the trend in the national average. Even though emissions of a company are much lower than the national average by a factor of 5-6, the trend of lower emissions is the same. Since 2010 there has been a reduction of 52%. This has been sharper than the national average (-44%). Energy costs by turnover have fluctuated between 1.8% and 1.2% over the past decade. Initially the indicator was on a downward trend from 2010 on, but since 2016 it has been fairly constant. Total water consumption per company declined by 11% over a decade. In the last few years, however, the sector has showed an increase in consumption again, after a longer period of decline. The number of companies decreases almost every year, while water consumption remained constant. As a result, water efficiency has worsened.

Other indicators:

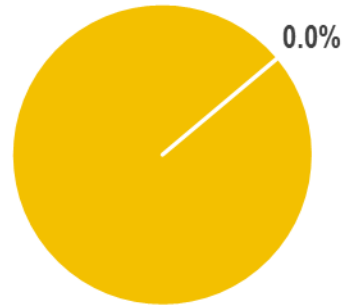
Energy costs vs. revenue:
(10yr average)
1.4%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
28.9%

Water usage by company per year:
(in litres)
254,735

Sector share in GHG emissions:



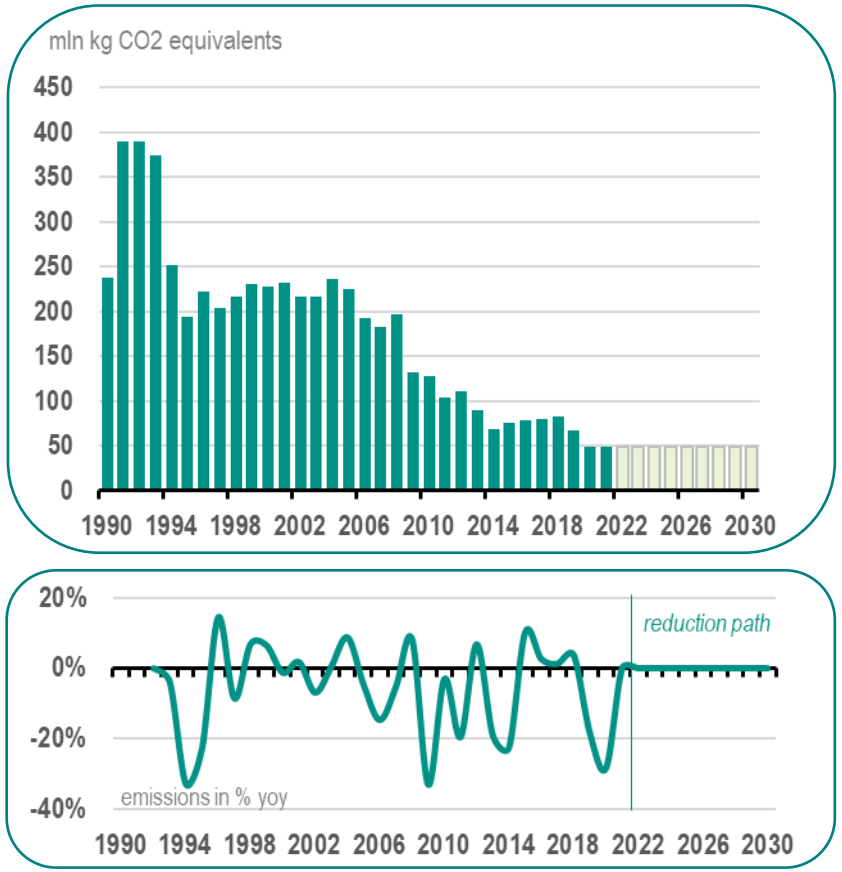
The sector has a very low share in both total water consumption and total greenhouse gas emissions. In both cases, this places the sector low in the rankings. On average, about 250,000 litres of water are consumed per company annually and this average amount puts the sector in 7th position from bottom compared to all other sectors.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Printing & publishing industry

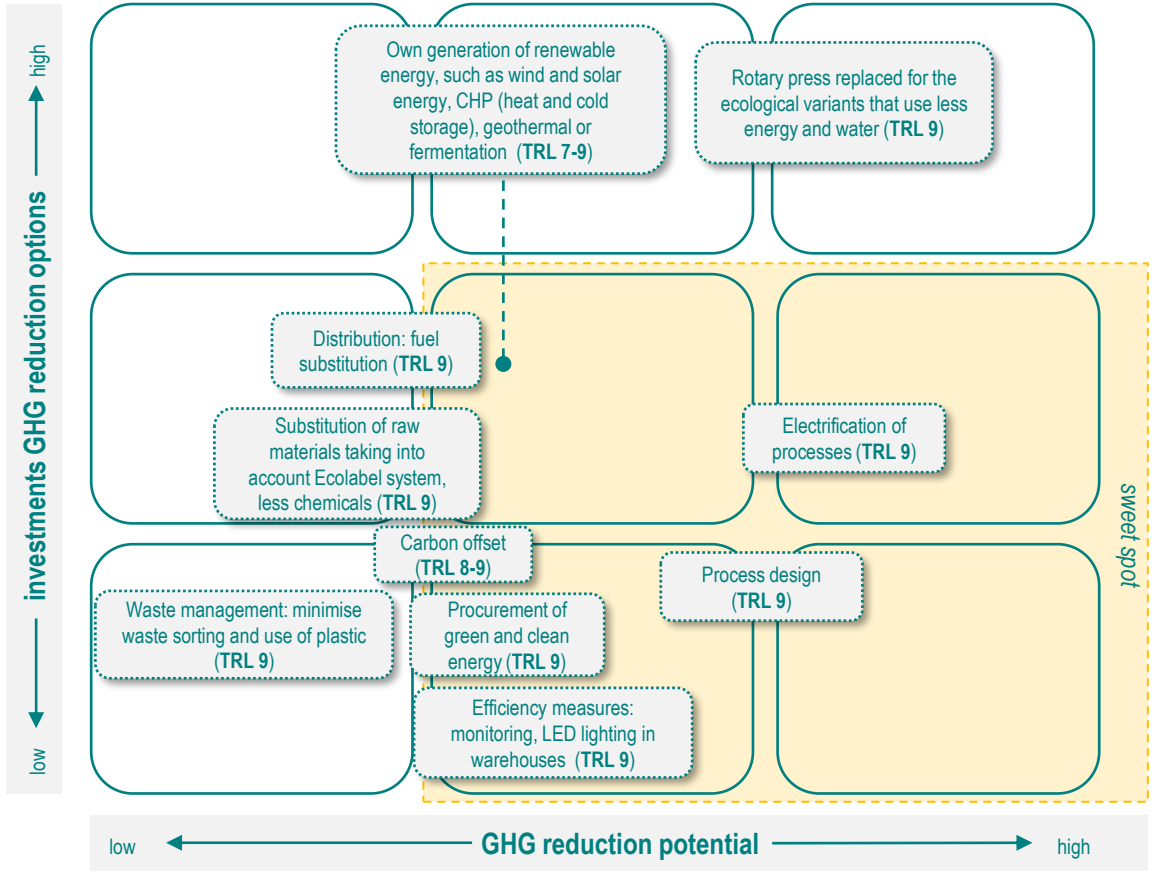
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



In fact, the sector no longer needs to reduce greenhouse gas emissions as the 2030 target has already been reached. The remaining greenhouse gas emissions are relatively easy for the sector to eliminate in the period ahead through 2030. Reducing energy consumption and implementing energy-saving measures will mainly be on the sector's agenda. Also, the sector has a certain amount of volatile organic compounds, which are both hazardous to people but also have negative effects on the environment.

GHG reduction options: investment & effectiveness



Besides more efficiency measures and electrification, the sector has several options to reduce this footprint. In the printing industry, recycling paper is now the norm. Paper is mainly made from recycled material and can be recycled up to six to seven times. The choice of raw materials has become more relevant. Environmentally friendly alternatives - such as adding less alcohol to the offset printing process, printing inks and varnishes based on vegetable oils - are preferred. Continuous evaluation of plant efficiency and environmental impact also help raise awareness and feed into the decarbonisation strategy. In process design, digitalisation and automation play an important role. This can regulate supply needs and help optimise plants for smarter consumption and material use (energy-saving mode).

Emission reduction target:

Minimum emission reduction through 2030:
-47
(in mln kg CO_2 eq.)

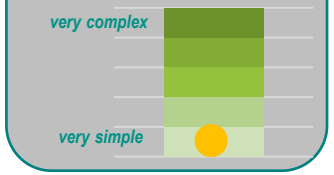
Minimum emission reduction through 2030 per year:
-5
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
- target achieved -

Minimum % annually in emissions through 2030:
- target achieved -

Average % annual change in emissions over last 20 years:
-3.6%

Feasibility of emission target:



Source: KVGO, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

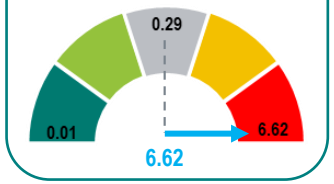
Emissions sector: Petroleum industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of coke oven products and petroleum processing, also known as midstream.

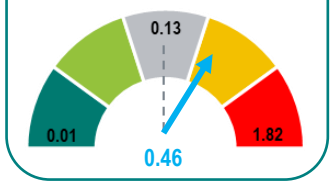
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

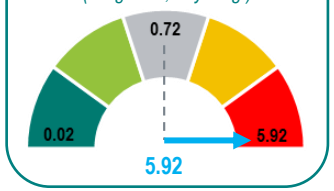
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

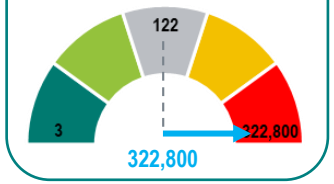


Emissions by tangible assets
(in kg/euro; 10yr avg.)

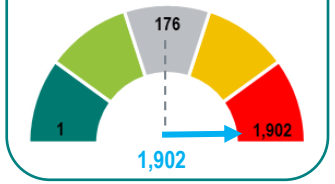


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



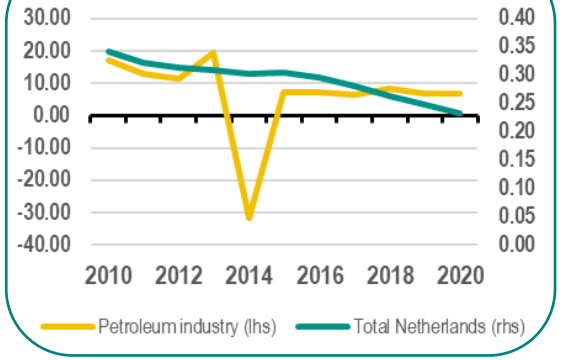
Emissions by job
(in ton/job; 10yr avg.)



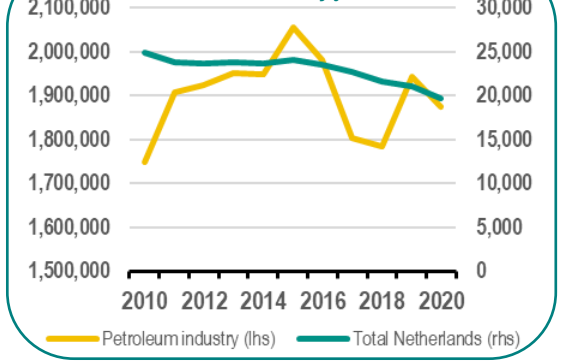
The emission indicators tend to move considerably to the right in the figures above. The sector accounts for the highest possible score compared to all other sectors. This is only not the case for the indicator emissions by turnover. The score here is well above average. It can be said that the petroleum industry is the most emission-intensive sector compared to all other sectors in the Dutch economy.

Trend in emission indicators:

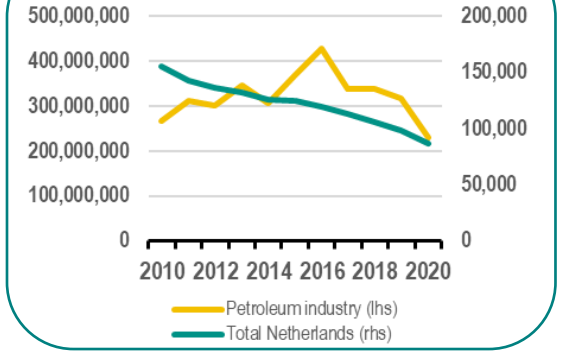
Emissions by GDP (in kg/euro)



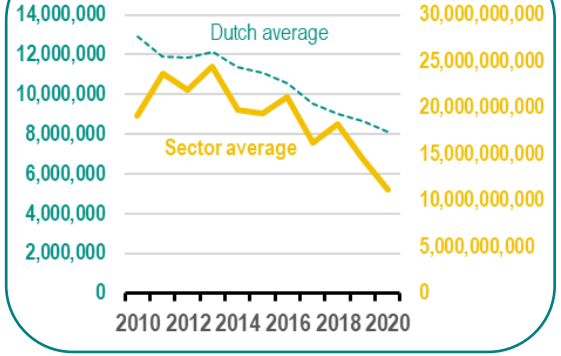
Emissions by job



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



In the trend of emissions to GDP from 2010, the negative value in 2014 is particularly striking. In 2014 the direct value added for the sector reached a negative value. Strong fluctuations in oil prices caused this. Indeed, in 2014, oil prices fell sharply. Crude oil was purchased more expensively than refined products could be sold. Once this shock is removed from the series, a fairly constant downward trend in emissions to GDP emerges, similar to the trend of the national average. Emissions by company are a fraction lower in 2020 than the 2010 level. In the intermediate period, emissions by company increase up to the peak in 2016, before slowly decreasing again. The 2020 level of emissions by job is much higher than the 2010 level, which is due in particular to job losses in this sector. Water consumption per company in the sector decreased by 42% from 2010 to 2020, driven by increased water efficiency.

Other indicators:

Energy costs vs. revenue:
(10yr average)

- not available -

Share in total water consumption:

3,2%

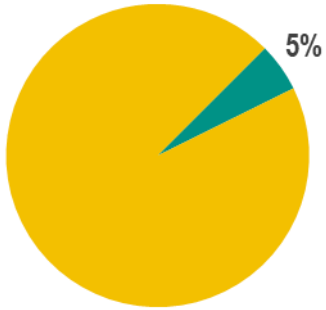
Energy costs vs. result:
(10yr average)

- not available -

Water usage by company per year:
(in litres)

19,040,645,022

Sector share in GHG emissions:



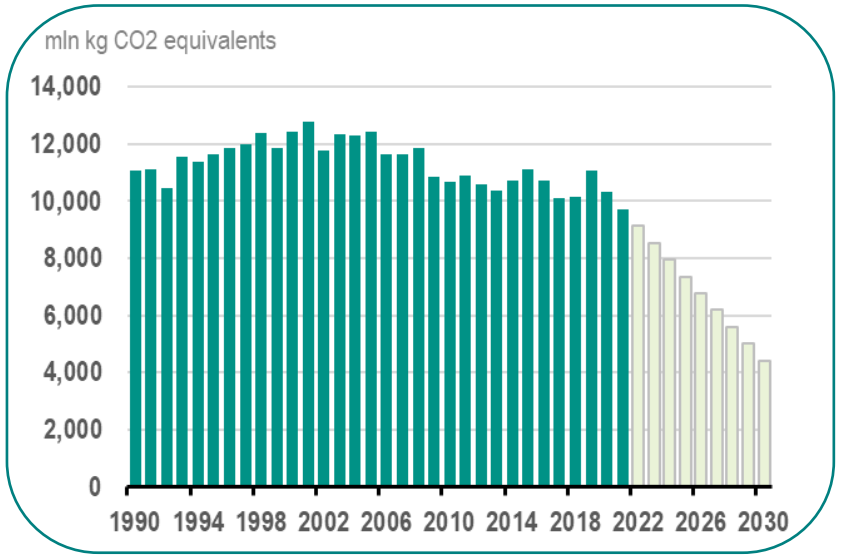
Energy costs are not known to CBS. The sector's share of total water consumption is high at 3.2%, putting it in fourth position among large consumers. However, when it comes to water consumption per company, the sector leads the list. Its water consumption is four times higher than the second largest consuming sector (the chemical industry). Its share in total emissions is also relatively high at 5.2%.

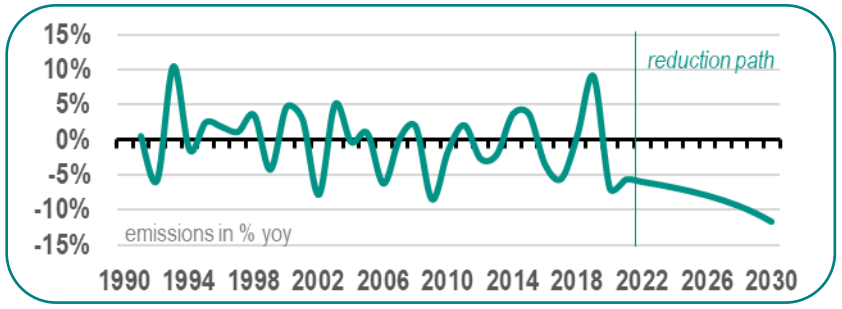
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Petroleum industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

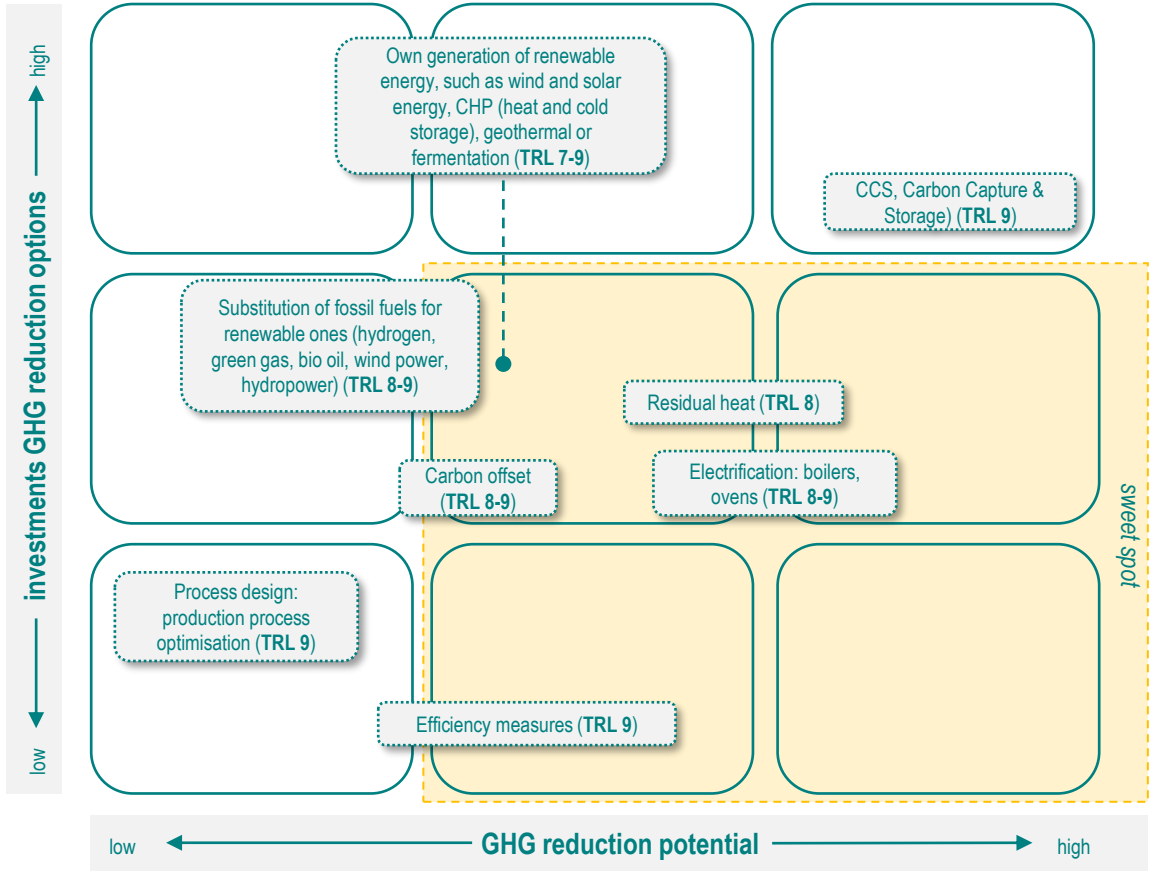
Emission pathway & projection:





Despite the high emission intensity, the sector has been able to reduce emissions to some extent over the past 30 years. However, the reduction has only been modest, with a very erratic path from 1990-2020. It indicates that the sector still has a lot of work to do to reduce emissions in the coming years. The sector will need to reduce about 57% of emissions until 2030 to reach the 2030 target. This means a minimum annual reduction by roughly 6.3%. This falls short of past performance, with only an annual reduction by 0.1%. Many companies in this sector are covered by the ETS trading system and are therefore more or less forced to work towards GHG emission reductions.

GHG reduction options: investment & effectiveness



Two-thirds of refineries are located in the Greater Rotterdam-Rijnmond region. Many other companies within the sector produce lubricating oils and greases, recycle waste oil or produce petroleum products from waste oil. As a result of European emission reduction targets, demand for fossil fuels will decrease in the coming decades. This is going to have a major impact on the refinery sector. This will make new investments in current plants less attractive. But the oil industry also supplies raw materials for the production of basic chemicals. Alternative products for these applications, such as biobased and synthetic hydrocarbons, are currently on a small scale, but this may change in the coming decades (PBL/TNO). In particular, success in external factors such as carbon transport and storage infrastructure, green electricity and hydrogen supply and biomass availability play a major role in the decarbonisation transition strategy of the petroleum industry.

Emission reduction target:

Minimum emission reduction through 2030:
5,881
(in mln kg CO_2 eq.)

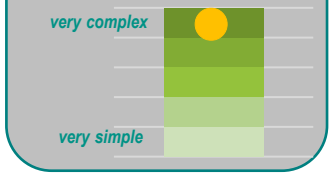
Minimum emission reduction through 2030 per year:
653
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-57%

Minimum % annually in emissions through 2030:
-6.3%

Average % annual change in emissions over last 20 years:
-0.1%

Feasibility of emission target:

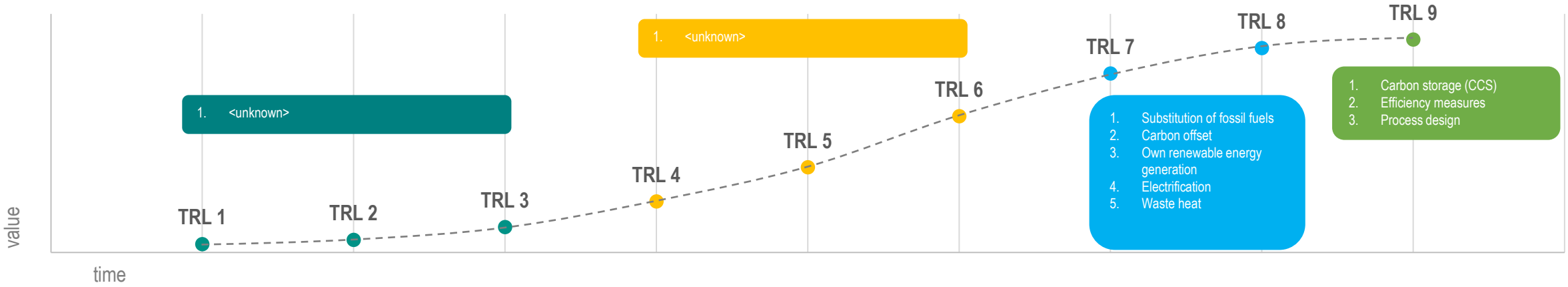


Source: Element NL, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Petroleum industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.
Substitution of fossil fuels can be done by hydrogen, for example, and is potentially applicable to all processes where gas-fired equipment is present (e.g. atmospheric distillation, cracking processes, reforming). This also applies to electric furnaces. Energy supply substitution for electric furnaces and boilers are not yet commercially available. The deployment of hydrogen-based furnaces is highly dependent on the availability of hydrogen.
Excess waste heat can be used relatively easily for internal or external processes (including third parties). However, the challenge here is to establish the infrastructure needed for heat distribution. Technologies such as heat pumps can upgrade low-temperature waste heat.

Techniques commercial deployment phase:

Most CO_2 emissions in the oil industry are related to gas-fired process heaters, on-site utilities for power and steam generation, gas-fired furnaces and for hydrogen production. These processes have different CO_2 concentrations, which are relatively easy to capture and distribute for carbon storage.
Often, the capture equipment does not need to be located close to the combustion systems. And once it is an integrated fuel gas network, the network can also be used to transport hydrogen.
Adapting the process design for the production of LPG, petrol, paraffin and gasoil/diesel helps to reduce the carbon footprint. Consider, for example, a stand-alone plant for biofuel production (via pyrolysis bio-oil upgrading) or biomass gasification. The latter option is a technology that involves high-temperature heating of drier biomass in particular, such as scrap wood and pruning waste. This process produces gas with a high methane content, which can then be upgraded to green gas.

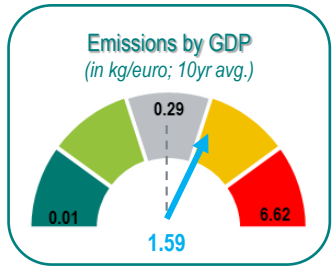
Source: Element NL, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

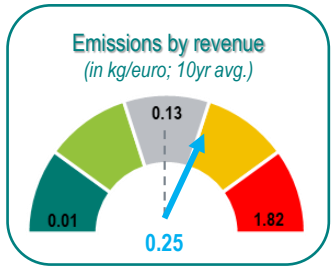
Emissions sector: Chemical industry

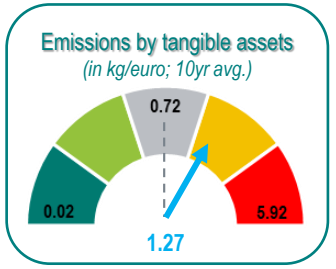
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of chemical products. Within the analysis on the following three sheets, where possible, a distinction is made between the organic chemical industry (such as refining, biofuel production) and the inorganic industry (such as the production of industrial gases and the chlor-alkali industry)

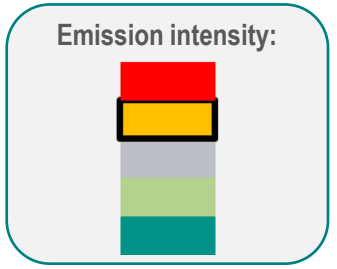
Emission indicators & intensity:

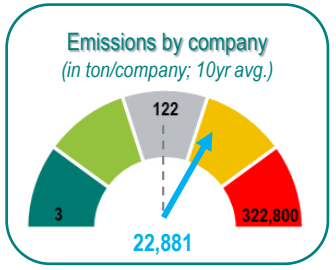
(grey dotted line = average NL score; blue arrow = sector score)

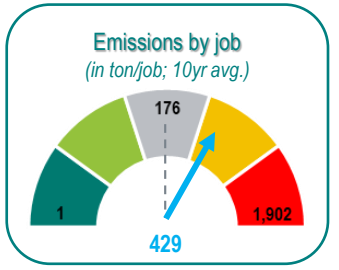




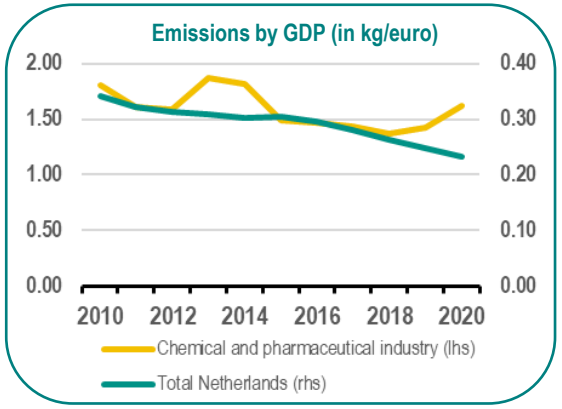


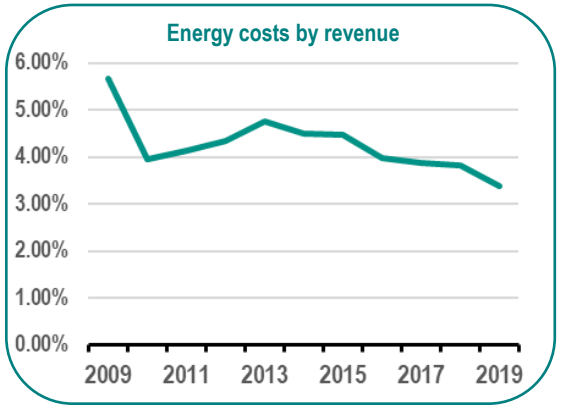


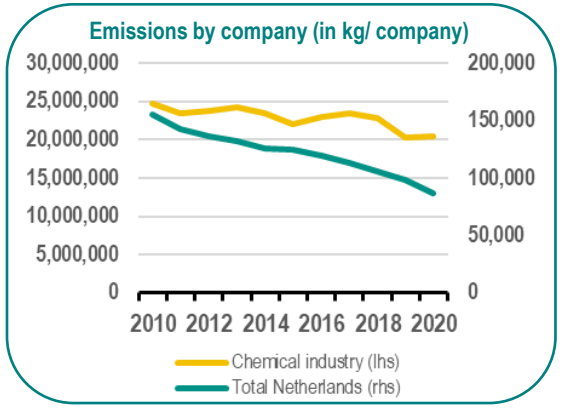


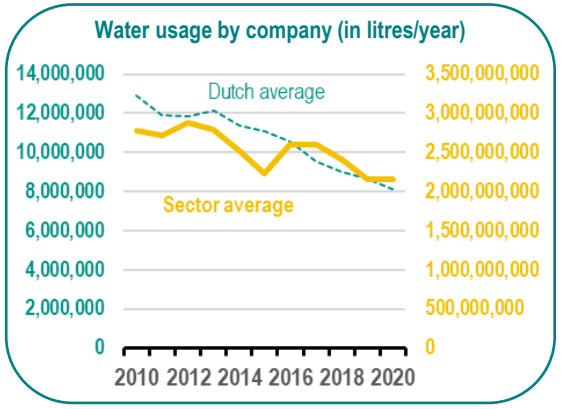


Trend in emission indicators:









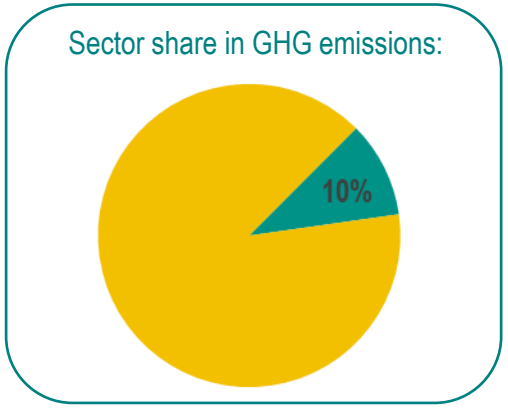
Other indicators:

Energy costs vs. revenue:
(10yr average)
4.3%

Share in total water consumption:
14.0%

Energy costs vs. result:
(10yr average)
72.2%

Water usage by company per year:
(in litres)
2,530,395,921



The chemical industry in the Netherlands is an emission-intensive sector. On all emission indicators shown above, the sector scores well above average. Per euro of added value, some 1.6 kg of CO_2 is added to the atmosphere on average, and each company in the sector accounts for an average of some 23 million kg of CO_2 annually.

GHG intensity has improved slightly in the chemical industry since 2010. The path in emissions to GDP are erratic over the years, but are lower in 2020 compared to 2010. The capriciousness is a lot less in emissions from a company, but here too there is a slight decrease in the period 2010-2020. Emissions in the chemical industry are further reduced by, among other things, more efficient use of raw materials and recycling. The vast majority of water is used to control temperature in production (cooling). Water is also used to make products together with other raw materials. The average water consumption per company has decreased by 22% over the past decade. Water efficiency in the sector can increase further by reusing water streams in the production process.

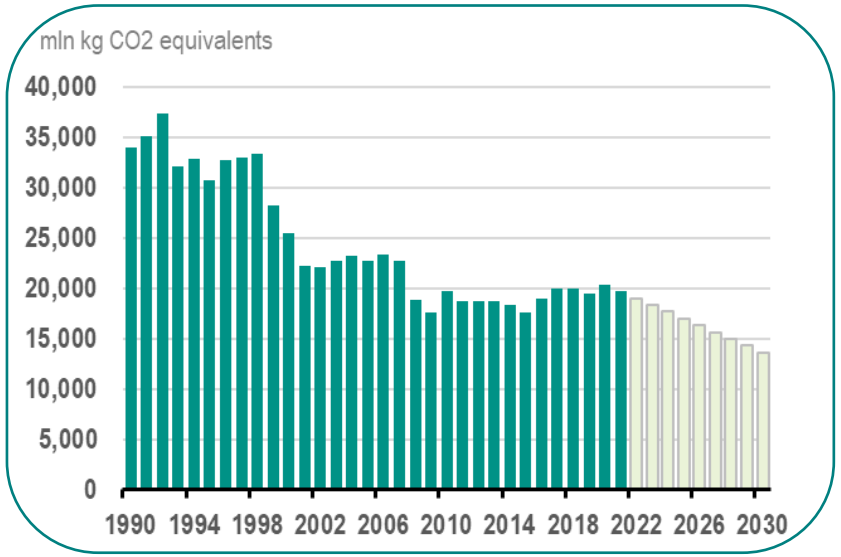
The chemical industry also scores high on other emission indicators. For instance, with a 14% share of the total, the sector is a large water user and energy costs by turnover are relatively high. Over the past 10 years, an average of over 2.5 billion litres of water was consumed per company annually. Its share in total greenhouse gas emissions is around 10%.

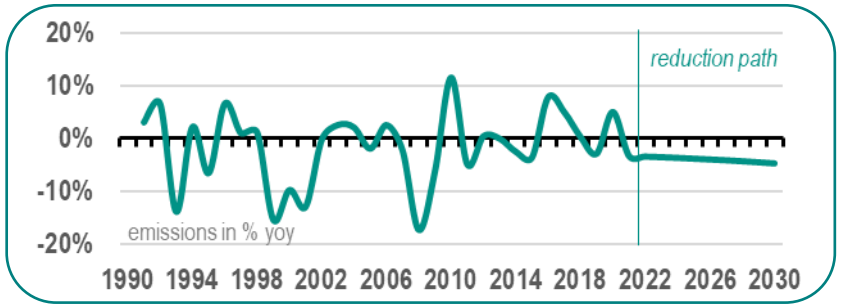
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Chemical industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

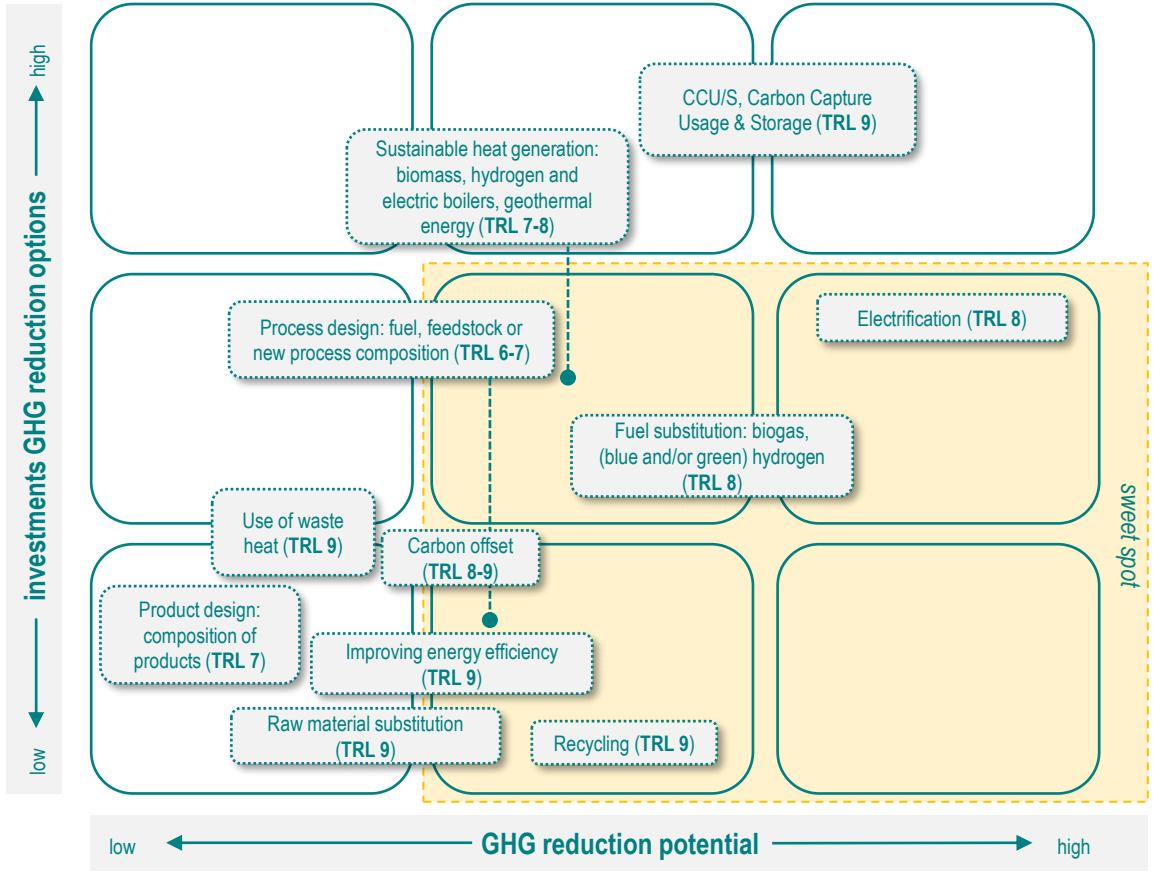
Emission pathway & projection:





Through the Chemical Industry Covenant of the 1990s, the industry has managed to achieve reductions in emissions to air and water, among others. Greenhouse gas emissions have been reduced by 22% over 30 years. The necessary reduction in emissions until 2030 is less than 33%, or about 3.7% per year. Over the past 20 years, the sector has managed to reduce emissions by an average of 1.4% annually. This still falls short of the minimum annual reduction pathway, but at least the sector is well on its way. In any case, the 2030 target is within reach. Thereby, this sector is rich in ETS companies (Europe's CO_2 emissions trading system), which are more or less forced to work on emission reduction.

GHG reduction options: investment & effectiveness



The chemical industry has a multitude of subsectors, which can generally be divided into the organic chemical industry (such as refining and biofuel production) and the inorganic industry (such as industrial gas production and the chlor-alkali industry). There are different decarbonisation techniques for each of the production processes of these subsectors, not all of which may be included in the matrix above. The most relevant decarbonisation options for the chemical industry involve carbon storage, electrification and fuel substitution. On balance, these deliver the most in terms of emission reduction. The CCS pathway involves relatively few modifications in many chemical production processes. However, CCS requires investment in new infrastructure for CO_2 transport and storage. Moreover, public acceptance remains a barrier to large-scale implementation of CCS.

Emission reduction target:

Minimum emission reduction through 2030:
6,775
(in mln kg CO_2 eq.)

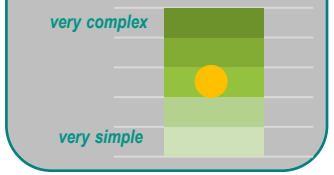
Minimum emission reduction through 2030 per year:
753
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-33%

Minimum % annually in emissions through 2030:
-3.7%

Average % annual change in emissions over last 20 years:
-1.4%

Feasibility of emission target:

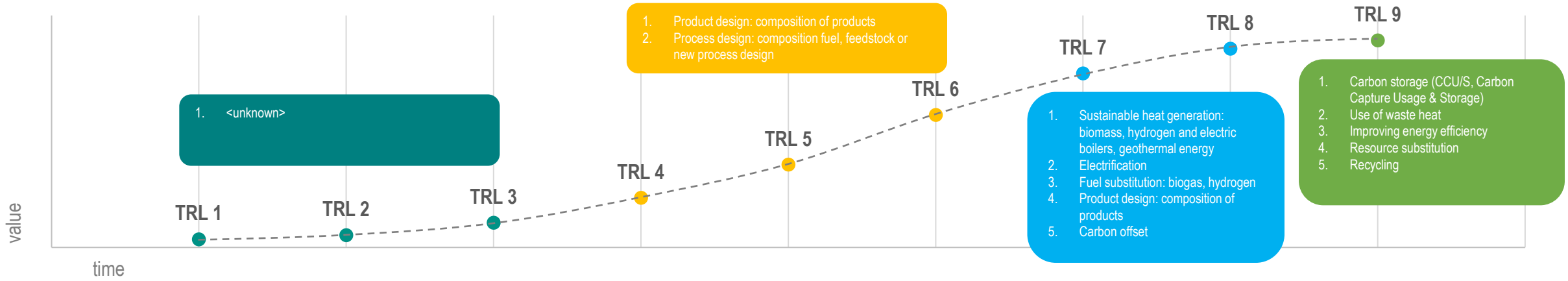


Source: VNCI, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Chemical industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still either.

Techniques in test and prototype phase:

Replacement of the current production process based on a different fuel, feedstock or a completely different process, to create the same product with a reduction in energy/emissions. In the production of industrial gases (inorganic chemical industry), this involves, for example, electrolysis or thermal decomposition of methane. And in the silicon carbide industry (inorganic chemical industry), it involves changes in process design with mechanical activation of feedstock and microwave heating. For some subsectors, this option has a higher technical readiness level or TRL.

Techniques in pre-commercial phase:

Process design changes are modifications to the current industrial process that can lead to improvements in energy efficiency or a less carbon-intensive alternative. Energy efficiency helps to reduce emissions, but it will not lead to complete decarbonisation.
Biomass boilers generate steam by burning wood chips, pellets or other similar organic material. However, the investment cost of installing a biomass boiler is a multiple of that of a fossil-fuel-fired boiler. The capital expenditure for electric boilers is relatively low and once installed, electric boilers can be easily and quickly deployed.
Electrification has great potential in terms of greenhouse gas emission reductions for the chemical industry. It can be deployed relatively easily on many fronts (such as for boilers, furnaces and other processes). A carbon offset is a credit that an organisation can buy to reduce its carbon footprint. When the number of carbon offset credits obtained equals the organisation's carbon footprint, that organisation is carbon neutral.

Techniques commercial deployment phase:

Research (2018) shows that the potential for carbon capture in the Dutch chemical industry is estimated at 14 megatons of CO_2 per year. This technology is based on capturing CO_2 from the gases released by industrial processes. Transport usually involves compression of CO_2 and shipment from the production area to the storage site, via pipelines, ships, or by road or rail. Storage requires the introduction of CO_2 into underground formations at a depth of kilometres and can take place either onshore or offshore.
Energy efficiency can be achieved through relatively simple measures or modifications. Consider regular maintenance, smart planning of maintenance activities and installing more energy-efficient equipment.
An EU study concluded that waste heat recovery has the highest technical energy-saving potential for the chemical sector.

Source: VNCI, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

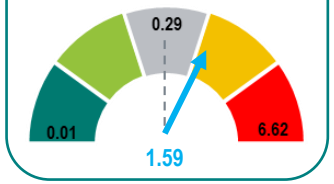
Emissions sector: Pharmaceutical industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of pharmaceutical raw materials and products.

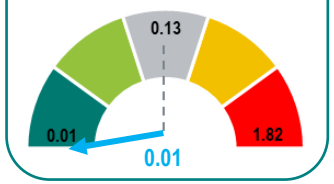
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

Emissions by GDP
(in kg/euro; 10yr avg.)



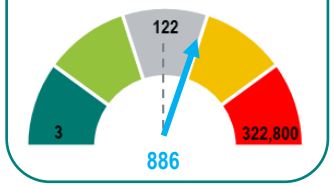
Emissions by revenue
(in kg/euro; 10yr avg.)



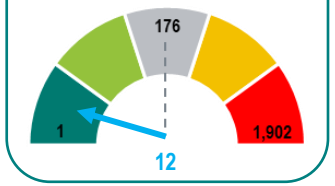
Emissions by tangible assets
(in kg/euro; 10yr avg.)

Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



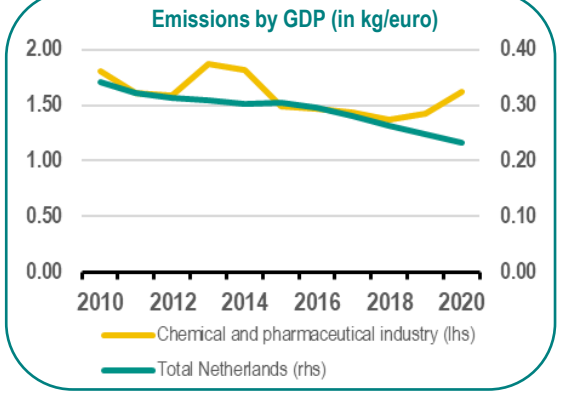
Emissions by job
(in ton/job; 10yr avg.)



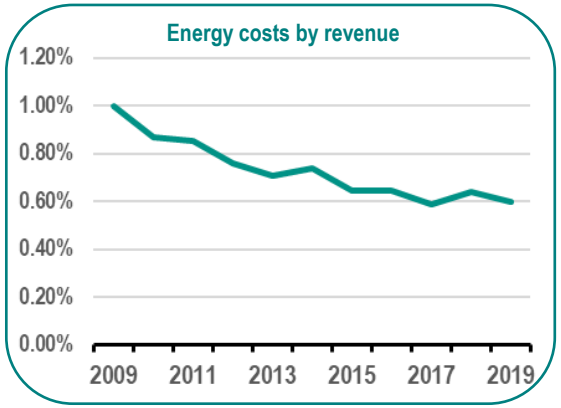
The sector scores relatively high on two emission indicators,. Emissions to GDP are higher than average at 1.6 kg CO_2 per euro of added value, and emissions to company are also high. However, emissions to GDP refer to the combination of chemical and pharmaceutical industries. In this, the chemical industry has a much higher weight. In terms of emissions by turnover, the sector accounts for the lowest possible score compared to all other sectors.

Trend in emission indicators:

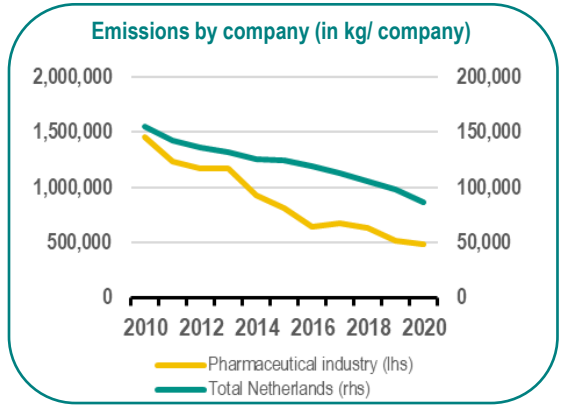
Emissions by GDP (in kg/euro)



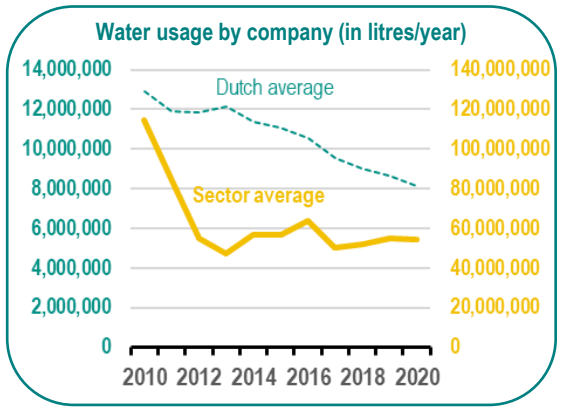
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions by company are about a factor 10 higher in the pharmaceutical industry than the national average. The reduction in the indicator over the past ten years has been stronger than the average for the Netherlands as a whole. In the sector, emissions by company decreased by 67% over the period 2010-2020, compared to a 44% reduction for the Netherlands as a whole. In the sector, the number of companies increased by 27 in 10 years, while greenhouse gas emissions fell by almost 60%. Energy costs by turnover fluctuated between 1% and 0.6% in the years from 2010, showing a more stable trend in recent years. Total water consumption fell sharply from 2010 to 2012, while the number of companies remained stable in those years. Since 2013, water consumption per company has shown an almost stable trend.

Other indicators:

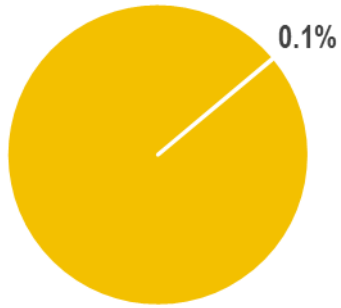
Energy costs vs. revenue:
(10yr average)
0.7%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
4.7%

Water usage by company per year:
(in litres)
62,641,186

Sector share in GHG emissions:



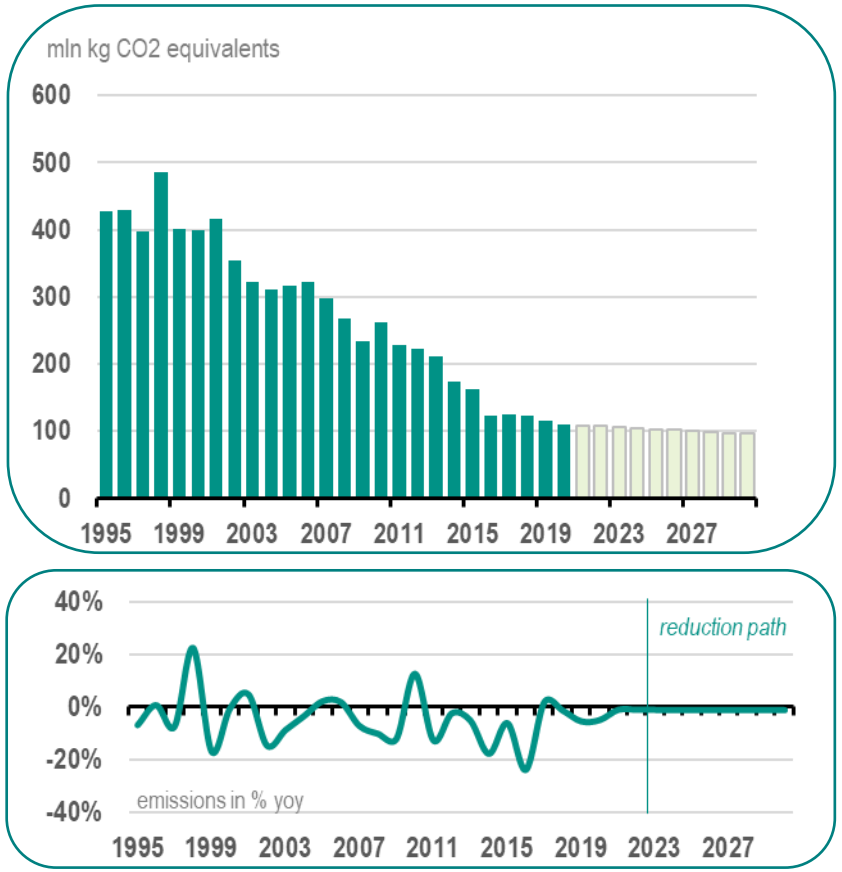
The sector's share of total water consumption is 0.1%. This seems low at first. But an average of over 62 million litres of water is consumed per company annually. This puts the sector in the top ten largest water consumers. The sector's share in total greenhouse gas emissions is relatively low at 0.1%.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Pharmaceutical industry

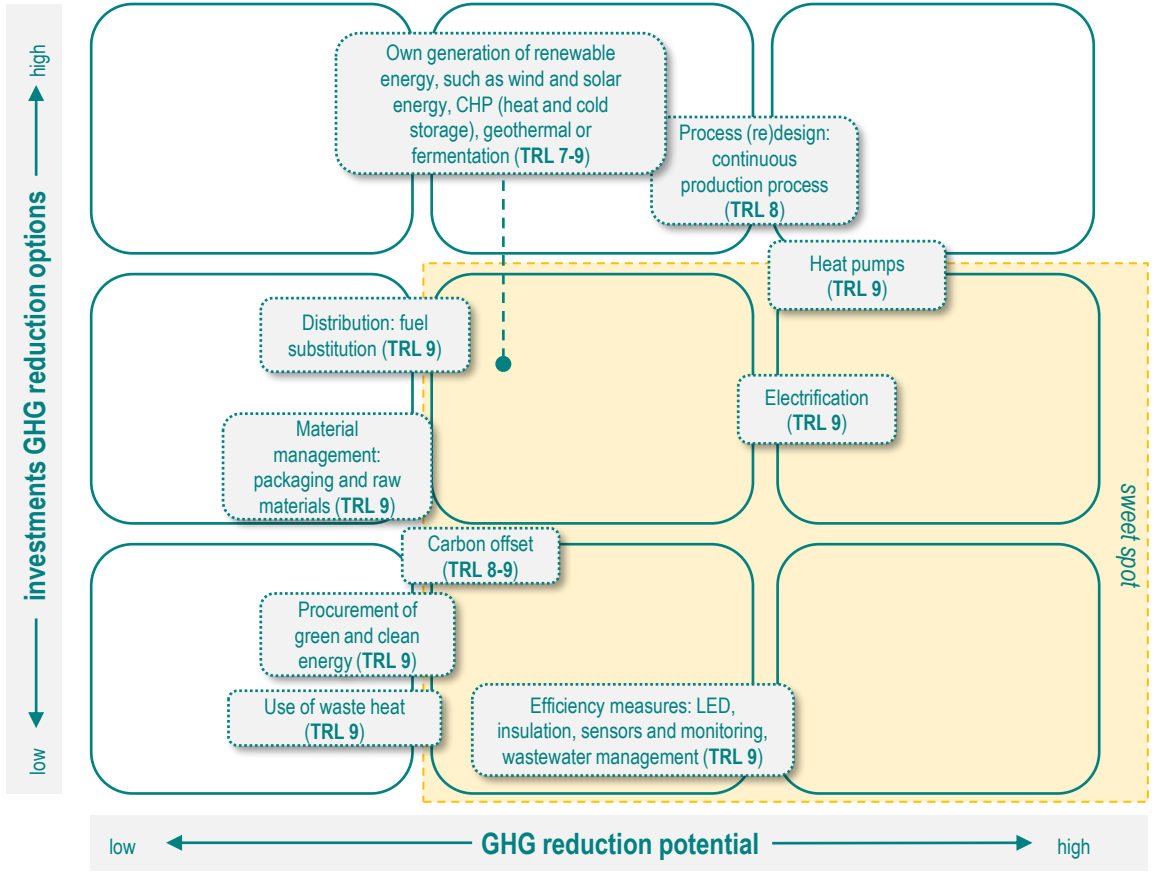
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



In 1993, the pharmaceutical industry reached its peak in greenhouse gas emissions. Since then emissions have decreased at a steady pace. The production of pharmaceuticals releases emissions such as volatile organic compounds (VOC). These are emitted to the air or in waste water. Government regulations regarding the treatment of emissions to air and water are strict. To reach the 2030 target, the sector still needs to reduce about 13% of emissions, or about 1.4% per year. For the sector, this target is within reach as the historical trend in emission reduction shows that the sector is reducing emissions by about 2.5% annually on average.

GHG reduction options: investment & effectiveness



The pharmaceutical industry in the Netherlands has a low greenhouse gas emission share, but further reducing its carbon footprint remains relevant here too. Besides more efficiency measures and electrification, the sector has several options to reduce this footprint. Making the raw materials for medicines - or Active Pharmaceutical Ingredients (APIs) - in so-called small-molecule medicines largely relies on petroleum-derived chemicals. In addition, there are many energy-intensive steps in the chemical synthesis of raw materials. But even getting to the final product - including packaging – this is not without greenhouse gas emissions. Sustainable, biology-based processes are on the rise. In addition, a continuous production line - combining several production phases into a single one - lowers the carbon footprint. Investing in greener fuels and energy sources for transport will also reduce greenhouse gas emissions.

Emission reduction target:

Minimum emission reduction through 2030:
14
(in mln kg CO_2 eq.)

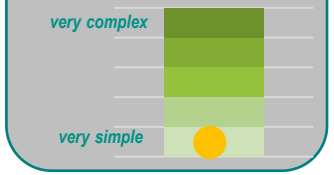
Minimum emission reduction through 2030 per year:
2
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-13%

Minimum % annually in emissions through 2030:
-1.4%

Average % annual change in emissions over last 20 years:
-2.5%

Feasibility of emission target:



Source: KNMP, Green Deal Duurzame Zorg, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

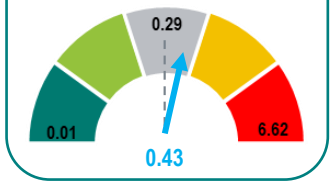
Emissions sector: Rubber & plastic products industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of rubber and plastic products.

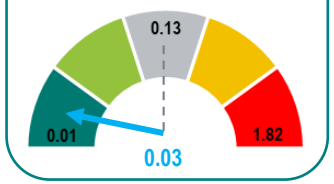
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

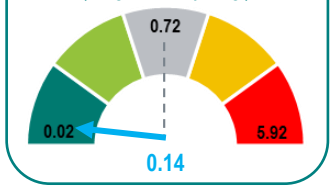
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

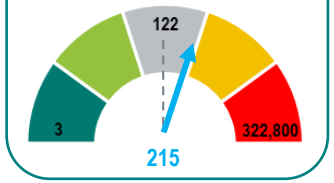


Emissions by tangible assets
(in kg/euro; 10yr avg.)

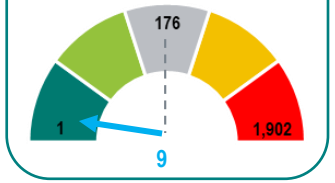


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)

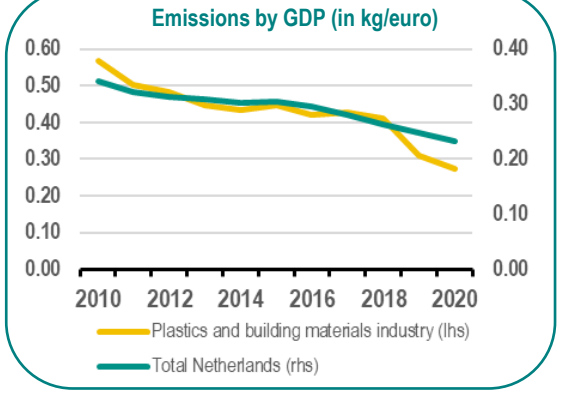


Emissions by job
(in ton/job; 10yr avg.)

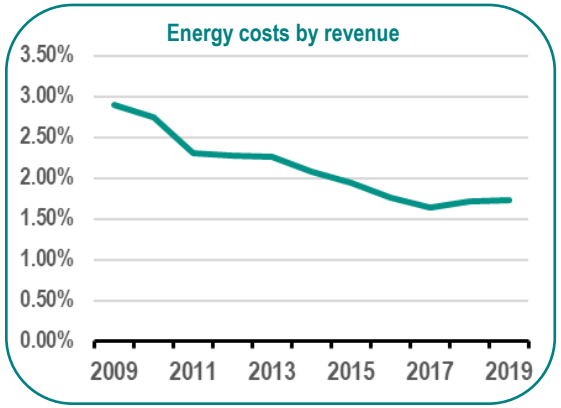


Trend in emission indicators:

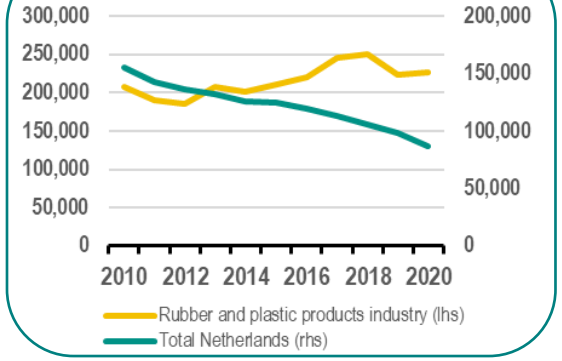
Emissions by GDP (in kg/euro)



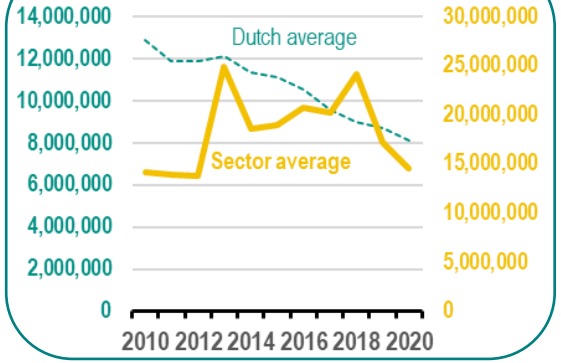
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Other indicators:

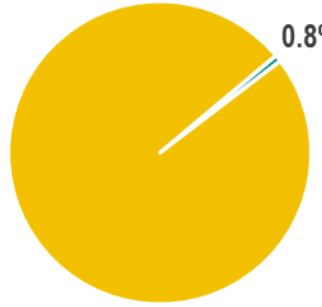
Energy costs vs. revenue:
(10yr average)
2.1%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
29.3%

Water usage by company per year:
(in litres)
18,275,978

Sector share in GHG emissions:



The rubber & plastic product industry shows a varied picture concerning emission indicators and intensities. The sector shows an average score of emissions to GDP,. However, this score is related to both the plastics and construction materials industries, making the score higher. With emissions by turnover and tangible assets, the score is relatively low. Per job, the sector emits about 8,000 to 9,000 kg of greenhouse gases annually on average. Emissions by company are higher than average at around 215,000 kg per company.

The indicator emissions to GDP for the sector consists of a combination of two sectors: the plastics industry and the construction materials industry. As the building materials industry is more emission-intensive, its share of the level and trend is higher. While emissions by company for the entire Dutch economy have been on a continuous downward trend since 2010, emissions per company in the rubber & plastic product industry have increased since 2010. This is because emissions increased by 8% over the period 2010-2020 and the growth rate of the number of companies in the sector was much lower at 4% over the same period. Energy costs have an average share of 2.1% in total turnover, higher than the average in the total Dutch economy (of 1.4%). The ratio of energy costs to turnover is on a downward trend and has stabilised over the past two years. Over the period 2010-2020, turnover increased faster than energy costs increased.

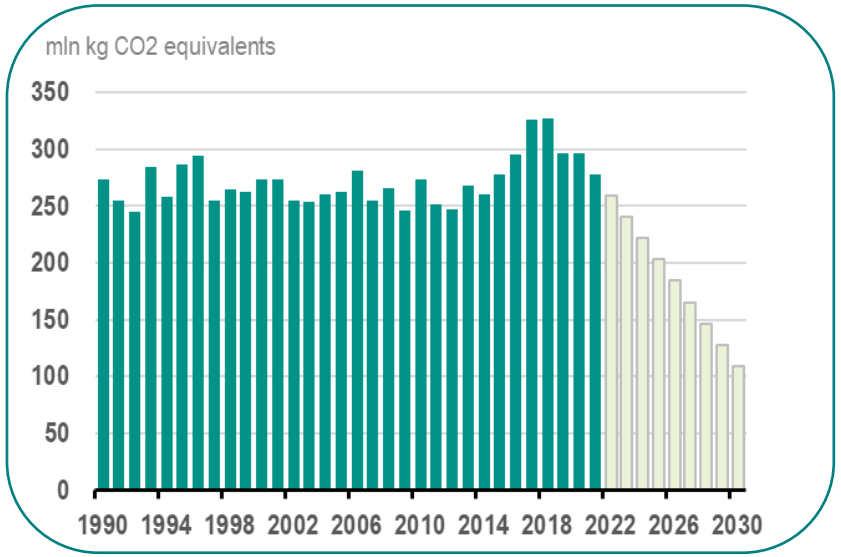
As a whole, the sector has a relatively low share in total greenhouse gas emissions in the Netherlands. However, due to the increase in emissions in this sector in recent years, this share has been on a slight upward trend. Water use in the sector is relatively low. With over 18 million litres of water used per company, water use is around the national average.

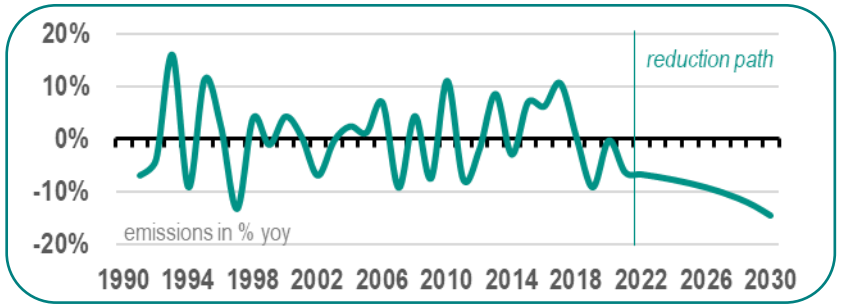
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Rubber & plastic products industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

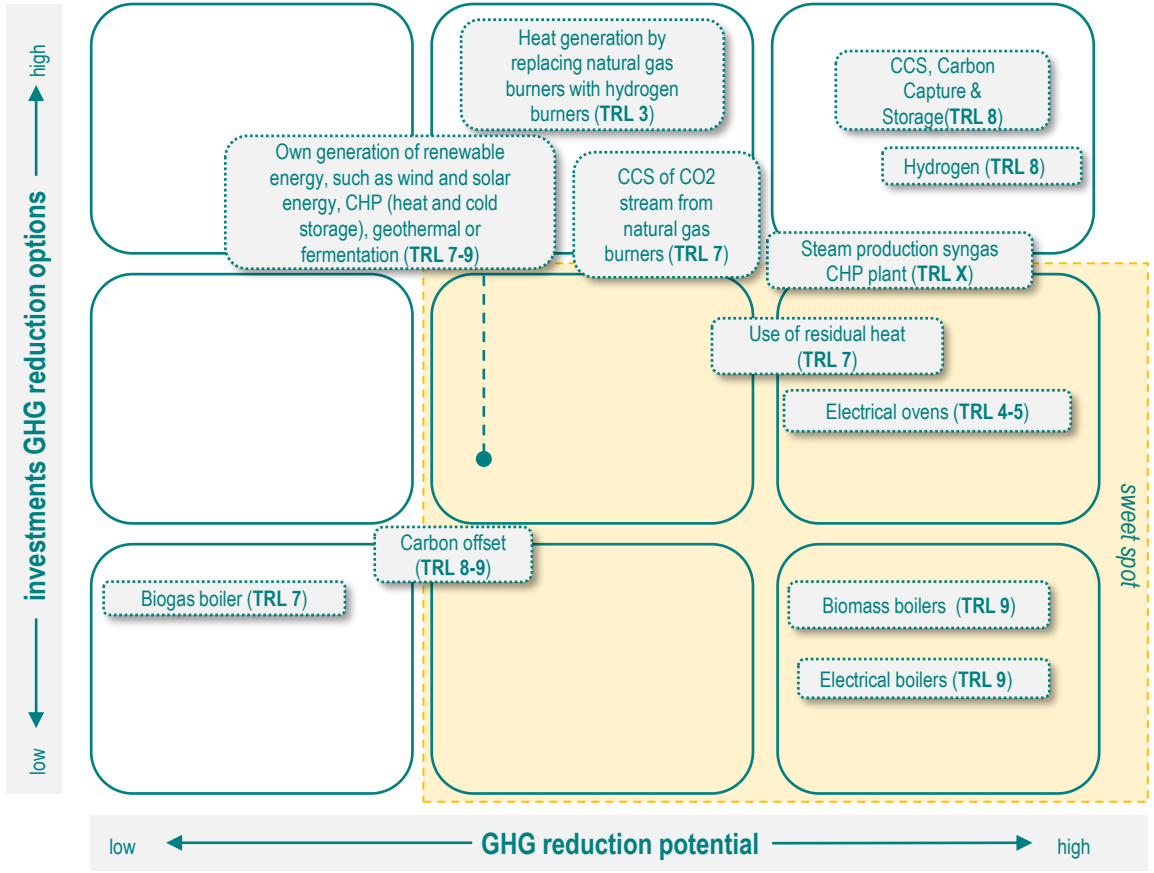
Emission pathway & projection:





Greenhouse gas emissions in the rubber & plastic product industry show a less favourable picture over the years. From 1990 to 2014, emissions annually fluctuated around 250 million kg CO_2 equivalents. After that, emissions increased more sharply. This is partly due to an increase in production and the number of companies active in the sector. Emissions peaked in 2018 and are at a lower level in the two years that followed. Until 2030, the sector needs to reduce about 7% in GHG emissions annually to reach the target. However, over the past 20 years, emissions have increased by an average of 0.5% annually. Therefore reaching the 2030 target for this sector is difficult to achieve.

GHG reduction options: investment & effectiveness



The sector has a number of emission reduction techniques available. However, not all techniques are included in the matrix because the relevant information is missing. These include the use of bio-based feedstock (such as bio-ethylene & ethanol), chemical and mechanical recycling (of e.g. PVC) and heat pumps (with different temperature ranges). Replacing petroleum with biobased feedstock is a good option for decarbonisation. The development of electric furnaces is still in the testing phase and electric furnaces of larger industrial size are not yet available. Electric boilers have already been implemented on a larger scale, especially in small-scale plants. This is mainly due to the relatively low investment and operational costs. The reduction potential is also high, provided that renewable energy sources are used here. CCS is a proven method to capture large amounts of CO_2 from natural gas combustion. However, the cost of CO_2 transport and storage is relatively high.

Emission reduction target:

Minimum emission reduction through 2030:
186
(in mln kg CO_2 eq.)

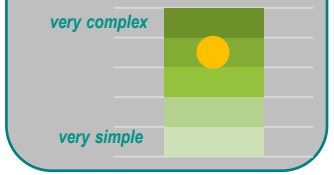
Minimum emission reduction through 2030 per year:
21
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-63%

Minimum % annually in emissions through 2030:
-7.0%

Average % annual change in emissions over last 20 years:
0.5%

Feasibility of emission target:

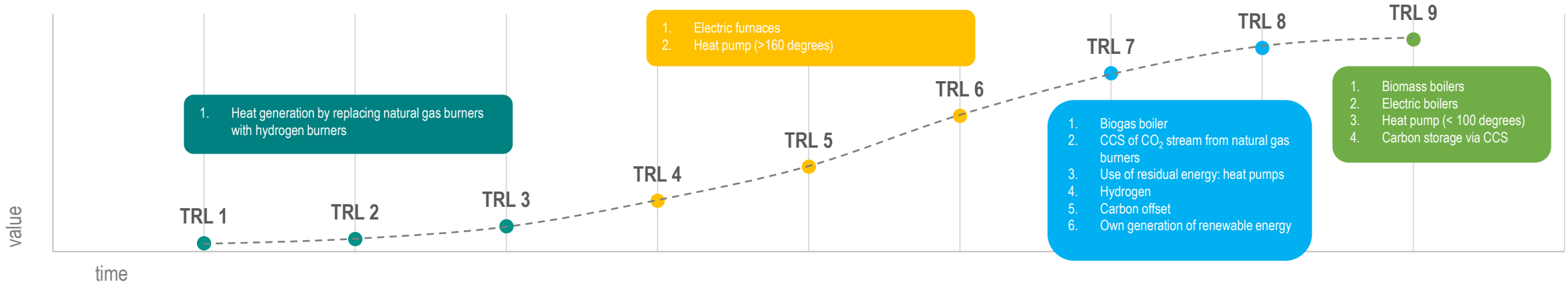


Source: CBS, NRK, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Rubber & plastic product industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Using hydrogen as a fuel instead of natural gas has the potential to directly avoid much of the emissions from a production plant using conventional natural gas burners. The latest hydrogen roadmap expects that high-temperature industrial heating with hydrogen fuel will take at least another 10 years before it becomes a realistic option (source: PBL/TNO).
In its sustainability policy, the NRK (National Rubber Association) has seven core principles as a starting point, as established in accordance with the ISO 26000. These principles form the basis of the NRK business and socially responsible behaviour.

Techniques in test and prototype phase:

Electric furnaces are an alternative to natural gas-fired furnaces to reduce energy consumption and cut CO_2 emissions. They are already used in processes such as F-gas regeneration and destruction. The TRL of low-temperature (<100 degrees) heat pumps is 9 and those above 160 degrees is only 4-5.

Techniques in pre-commercial phase:

Hydrogen is an alternative with significant potential to reduce CO_2 emissions. This can be done by replacing fuel gas in furnaces or boilers with hydrogen. Burning green hydrogen (produced with solar, wind, biomass) releases water and heat, avoiding CO_2 emissions altogether. Blue hydrogen uses CCS to reduce CO_2 emissions from burning natural gas.
Heat pumps use electricity to transfer heat from a low-temperature source to a higher-temperature application. This technology is widely used in processes that require heat at temperatures below 200°C. This technology can convert renewable and waste heat from processes into heat for end-use applications. With this alternative, heat can be generated for on-site use and even supply heat to third parties.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

The use of biomass boilers has a lot of potential, but in the Netherlands there is an ongoing debate whether biomass is actually renewable energy. CCS (Carbon Capture & Storage) is already used in the chemical industry. CCU (Carbon Capture & Usage) is more suitable for fuels and basic chemicals.
Electric boilers have gotten a lot of attention within the sector. Due to relatively high electricity prices, a viable business case remains complex. However, operational costs are again relatively low compared to conventional fossil fuel-fired boilers. Indeed, these require a lot of maintenance.
For recycling, a distinction can be made between mechanical recycling and chemical recycling. Both applications have a different TRL and have no direct CO_2 emissions.

Source: NRK, CE Delft, PBL/TNO, ABN AMRO Group Economics

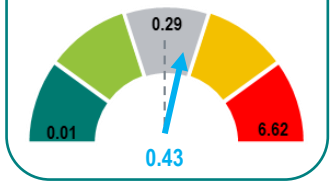
Emissions sector: Building materials industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of other non-metallic mineral products. This division includes manufacture of glass, ceramic products, cement, lime and gypsum, concrete, plaster and cement products, and natural stone processing.

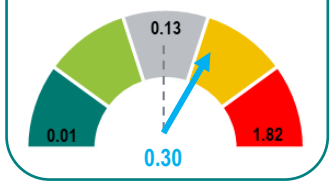
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

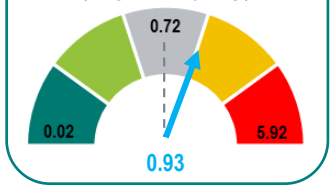
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

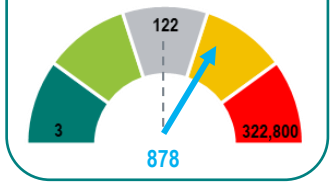


Emissions by tangible assets
(in kg/euro; 10yr avg.)

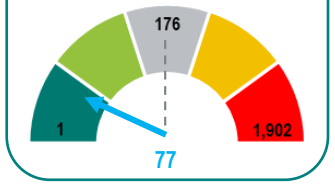


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



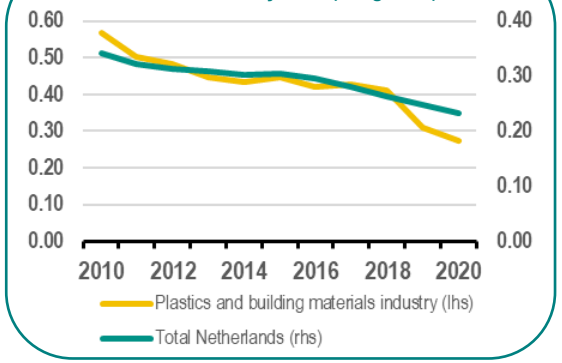
Emissions by job
(in ton/job; 10yr avg.)



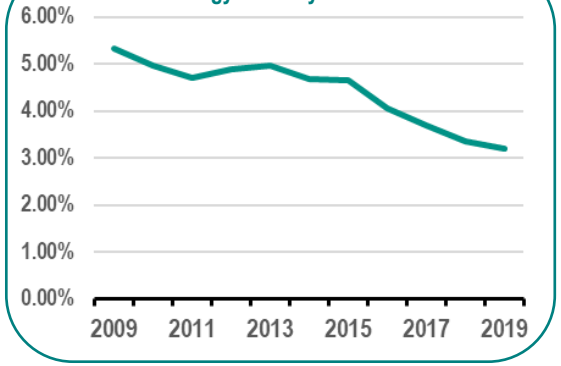
Emissions by GDP are not much different from the national average, but the ratio also includes the plastics industry. Emissions by turnover and tangible assets score slightly higher than average. Emissions by company are also slightly higher than the average for the total economy, at 878,000 kg per company. Emissions by job slightly low compared to the other indicators. The sector's emissions decreased more sharply in the last few years than the number of jobs. The number of jobs decreased only slightly.

Trend in emission indicators:

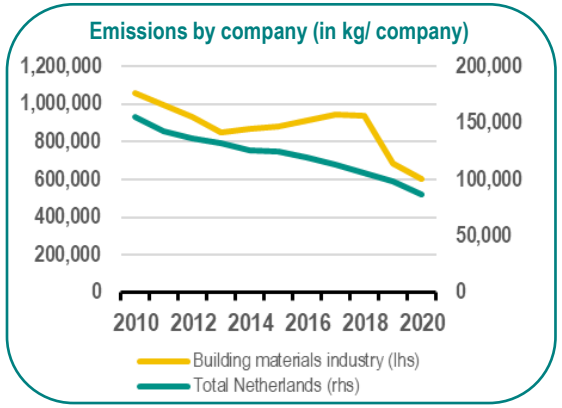
Emissions by GDP (in kg/euro)



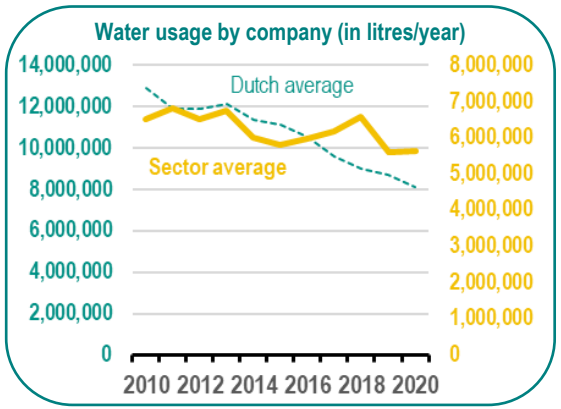
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions by GDP are not much different from the national average, but the ratio also includes the plastics industry. Emissions by turnover and tangible assets score slightly higher than average. Emissions by company are also slightly higher than the average for the total economy, at 878,000 kg per company. Emissions by job slightly low compared to the other indicators. The sector's emissions decreased more sharply in the last few years than the number of jobs. The number of jobs decreased only slightly.

Emissions by company broadly follow a downward trend and are more than 43% lower in 2020 compared to 2010 levels. This reduction is due to a sharp fall in greenhouse gas (GHG) emissions over the period 2010-2020 (of 43%) combined with an increase in the number of companies of 7% over the same period. Emissions per company are also much higher than the national average. GHG emission intensity is relatively high in this sector. Turnover in the sector increased by about 20% over the period 2010-2020, while energy costs in the sector decreased by almost 32% on average over the same period. In total final energy consumption, natural gas has a share of almost 75%. Gas consumption in the sector has decreased more sharply in the last few years. Water consumption decreased by 13% over the period 2010-2020, or about 1.3% per year on average.

Other indicators:

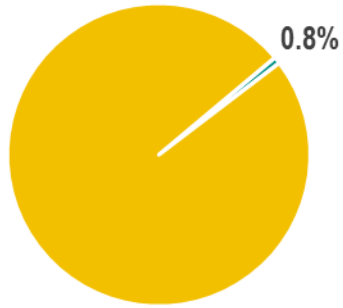
Energy costs vs. revenue:
(10yr average)
4.4%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
102.9%

Water usage by company per year:
(in litres)
6,214,294

Sector share in GHG emissions:



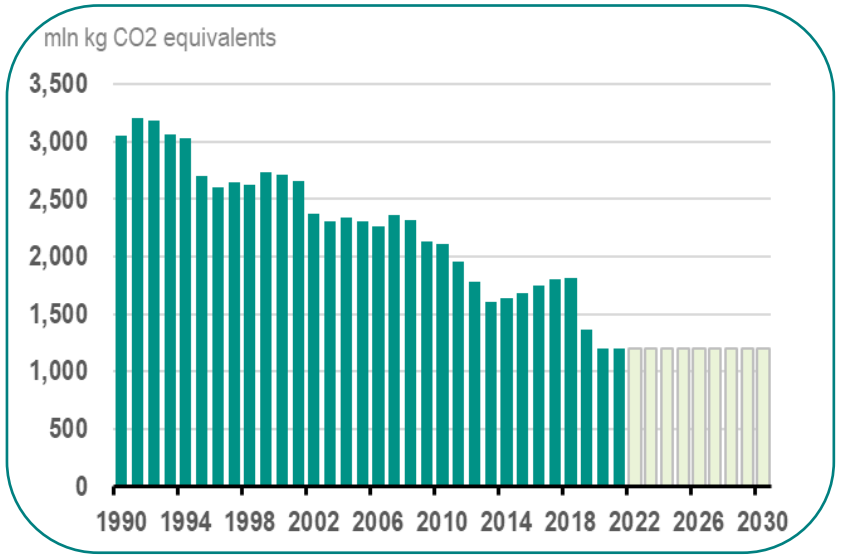
Energy costs are relatively high relative to operating profit. High raw material costs partly have a negative impact on margins and operating result. At 4.4%, energy costs relative to turnover are relatively high compared to the national average (of 1.4%). Water is not widely used in the sector and is well below the national average water use per company.

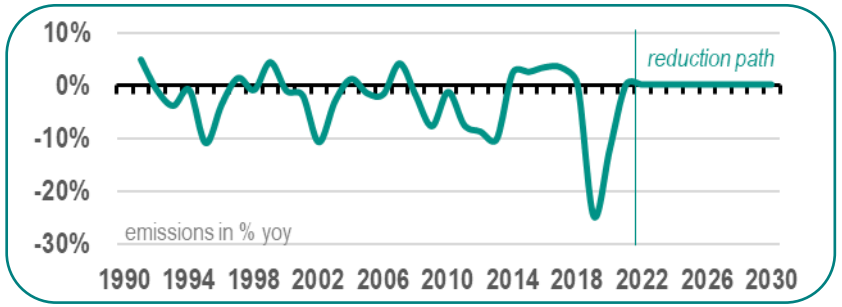
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Building materials industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

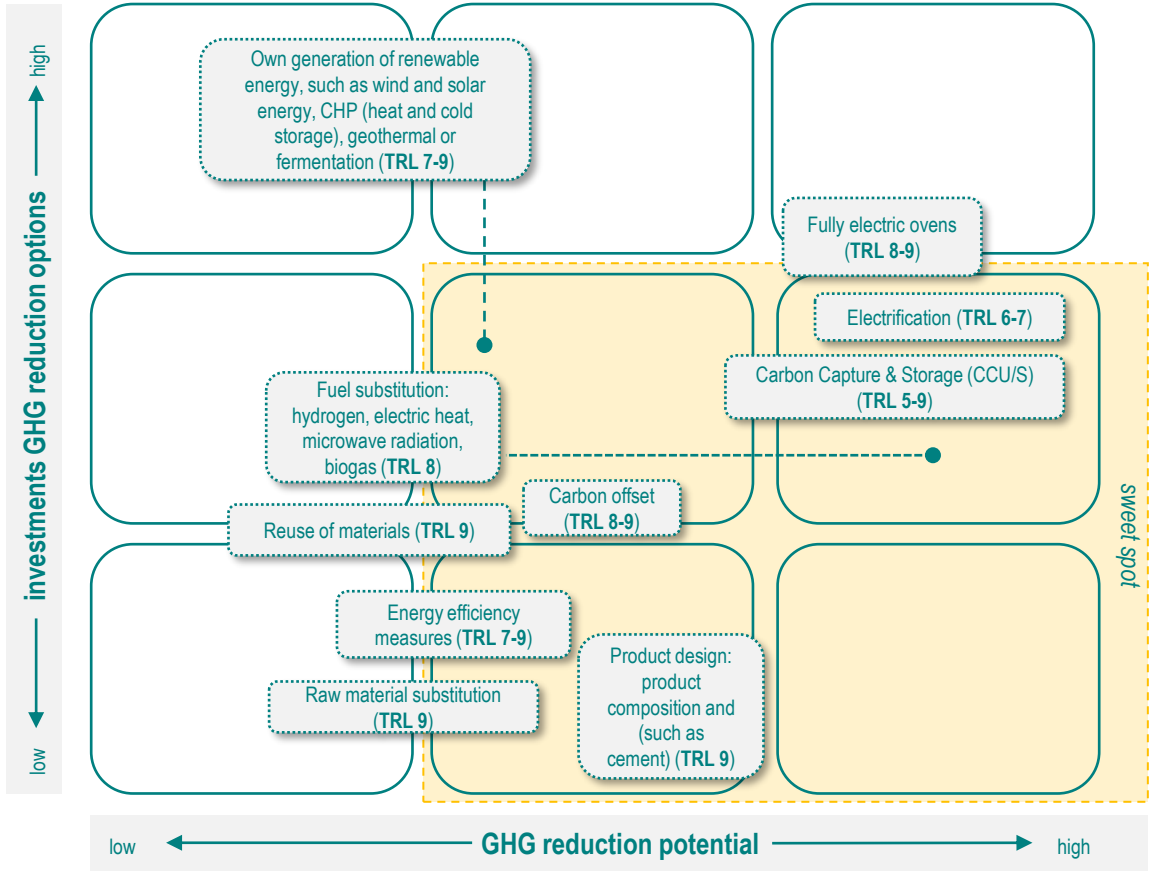
Emission pathway & projection:





The goal of the Dutch government is to reach 60% of 1990 levels in terms of greenhouse gas emissions by 2030. For the building materials industry, this target has already been achieved. However, companies in the sector should still make efforts to further reduce greenhouse gas emissions. After all, the overarching goal is climate neutrality by 2050.

GHG reduction options: investment & effectiveness



In the total greenhouse gas emissions of this sector, the cement industry in the Netherlands has a significantly high share. The primary (and almost only) source of direct scope 1 CO_2 emissions in the Dutch cement industry comes from the process of drying the wet blast furnace slag. This process uses a lot of natural gas. Replacing this fuel with a lower-carbon alternative or changing this process is essential to reduce greenhouse gas emissions. Broadly speaking, the options for the sector fall into five decarbonisation categories. These include: 1) fuel substitution, 2) process design, 3) product design, 4) use of residual energy/heat and 5) carbon use and storage. Industrial processes in this sector have already been significantly optimised and they have resulted in emission reductions since the 1990s. However, further process improvements can further reduce high-temperature energy consumption.

Emission reduction target:

Minimum emission reduction through 2030:
-25
(in mln kg CO_2 eq.)

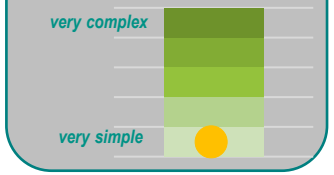
Minimum emission reduction through 2030 per year:
-3
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
- target achieved -

Minimum % annually in emissions through 2030:
- target achieved -

Average % annual change in emissions over last 20 years:
-2.9%

Feasibility of emission target:

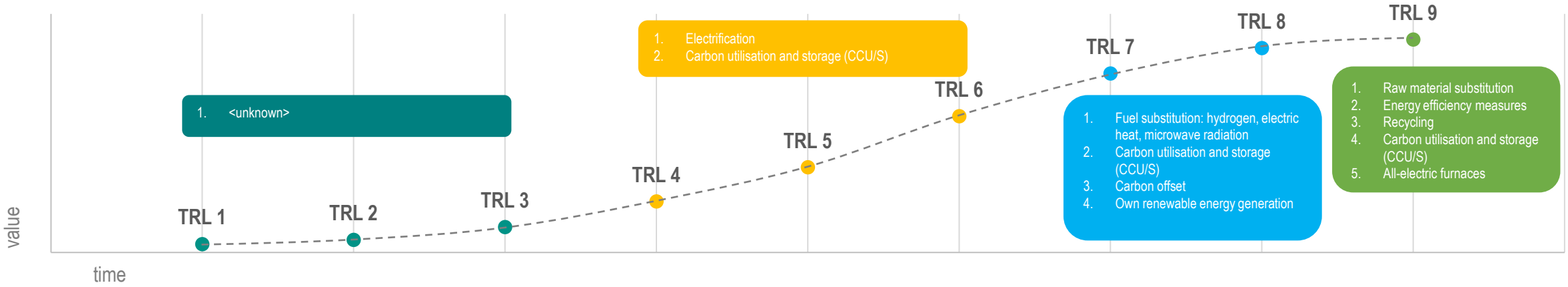


Source: CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Building materials industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase still contains relatively few new techniques. Best practices have landed well in the sector. Nevertheless, innovation is not standing still here either. An example is in product design with the development of lightweight bricks. This innovation is still in the early stages of further development. In addition, the reduction potential of this option is still unknown.

Techniques in test and prototype phase:

Carbon utilisation and storage is at different stages of maturity for different subsectors. Where it remains at TRL 5 in one subsector, the technology has TRL 9 in another. In theory, the carbon storage ratio could reach 100% in all subsectors. However, often the scale is too small and the economic feasibility of this option is relatively low. Location of the production facility and high transport costs are often a barrier. Furthermore, Construction Stored Carbon also has a positive impact on carbon capture and bio-based building.
Although some barriers still need to be overcome, the International Energy Agency (IEA) has suggested that carbon storage is the most impactful new technology to reduce carbon emissions (especially in the cement industry).
A common decarbonisation option used across industry is electrification. Electrification of processes has great potential for many subsectors to reduce greenhouse gas emissions. And once electricity is produced using renewable energy sources, the industrial process becomes much more sustainable.

Techniques in pre-commercial phase:

Fuel switching is challenging, as it sometimes also involves changes in operating licences. It also often requires (too) major changes to production processes. The goal of fuel switching is to implement fuels with a lower carbon footprint, but at the same time have little disruption in production processes. In the Dutch cement industry, the drying process is a major source of greenhouse gas emissions. The main fuel for this process is currently gas. Substituting gas for a low-emission alternative - such as increased use of heat pumps, hydrogen, biogas, residual heat or solar power as fuel - is a good step towards reducing emissions.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.
The building materials industry has a relatively high heat demand, so the reduction potential of its own renewable energy generation is relatively low.

Techniques commercial deployment phase:

The implementation of all-electric furnaces requires significant furnace innovation for their application in large-scale production. Some processes require a constant supply of large amounts of electricity, which requires additional reinforcement of the local grid. And such reinforcement often does not happen overnight. Moreover, many electric furnaces still have limited capacity. In contrast, electric furnaces are many times more energy-efficient than conventional furnaces. Recycling external flows is an opportunity for increased efficiency and thus lower emissions. In the glass industry, for instance, every 10% increase in the share of recycled glass increases efficiency by about 3%. In other subsectors, there are again limited opportunities for recycling. A wide variety of energy efficiency options exist, such as improving process design, preheating with waste heat and using waste heat for steam generation. Electric furnaces are predominantly used in small-scale applications. However, it is a good option to speed up decarbonisation. Incidentally, in some cases, fewer or no ovens and natural drying processes for some products are also being considered.

Source: CBS, IEA, CE Delft, PBL/TNO, ABN AMRO Group Economics

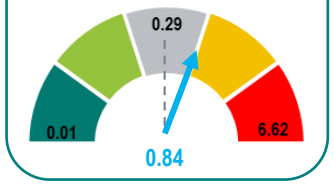
Emissions sector: Base metal industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of metals in primary form.

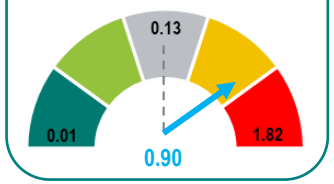
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

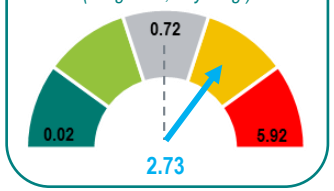
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

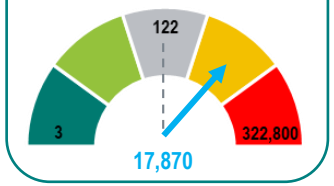


Emissions by tangible assets
(in kg/euro; 10yr avg.)

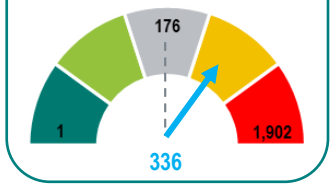


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



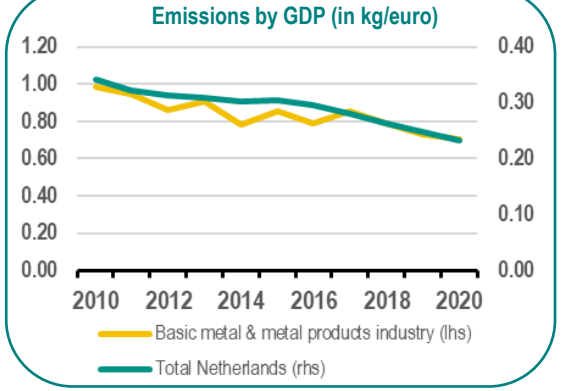
Emissions by job
(in ton/job; 10yr avg.)



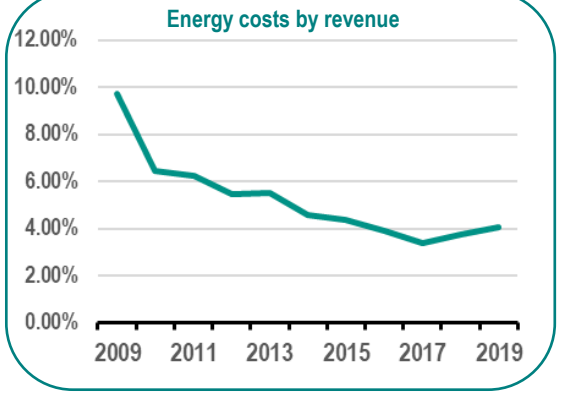
The base metal industry is an energy-intensive sector and therefore a major emitter of greenhouse gases. As a result, all emission indicators in the base metal industry are pointing upwards and well beyond the national average.

Trend in emission indicators:

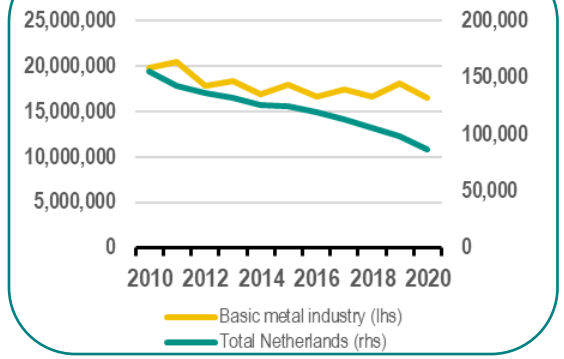
Emissions by GDP (in kg/euro)



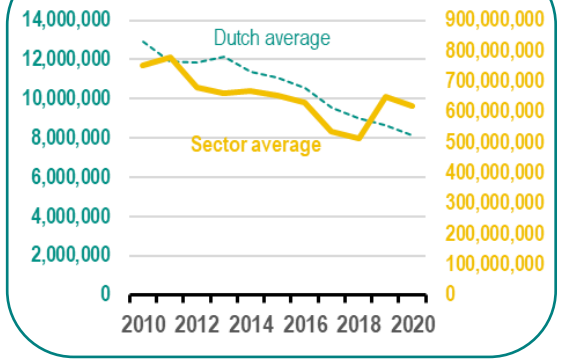
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



For emissions to GDP, the base metal industry and the metal products industry are taken together in the figure above. However, the base metal industry's share of both greenhouse gas emissions and value added is significantly higher than the metal products industry. The emissions to GDP ratio is higher than the national average, but the trend in the ratio since 2010 broadly follows the trend of the national average. In the case of emissions by company, this differs. Not only are emissions per company significantly higher than the national average, but here the sector also shows a more stable to slightly decreasing trend. The ratio of energy costs to turnover is relatively high, but since 2009 it has decreased significantly. Turnover increased by about 6% over the period 2009-2020, while energy costs fell by 39% over the same period. Water use was on a downward trend since 2010, but in the last three years, the use per company has increased slightly again, mainly because the number of companies has decreased.

Other indicators:

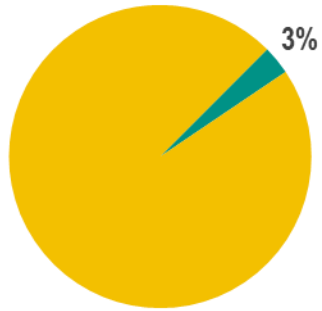
Energy costs vs. revenue:
(10yr average)
5.2%

Share in total water consumption:
1.5%

Energy costs vs. result:
(10yr average)
151.5%

Water usage by company per year:
(in litres)
649,817,365

Sector share in GHG emissions:



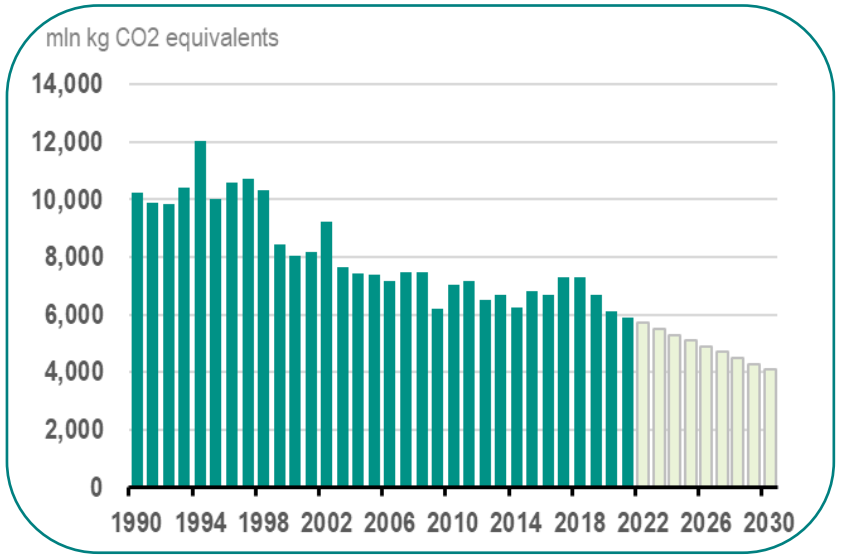
The sector has a relatively high share of total greenhouse gas emissions. Not only does the sector have a high ratio in terms of energy costs to turnover, but the average water use in the sector is also higher. The high ratio of energy costs to earnings reflects the fact that margins in the sector are not optimal due to fierce international competition and energy intensity is high.

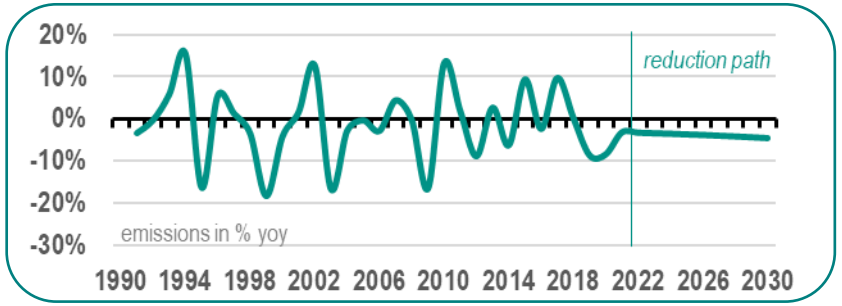
Source: CBS, Metaal Nederland/Berenschot, ABN AMRO Group Economics

GHG emission reduction options: Base metal industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

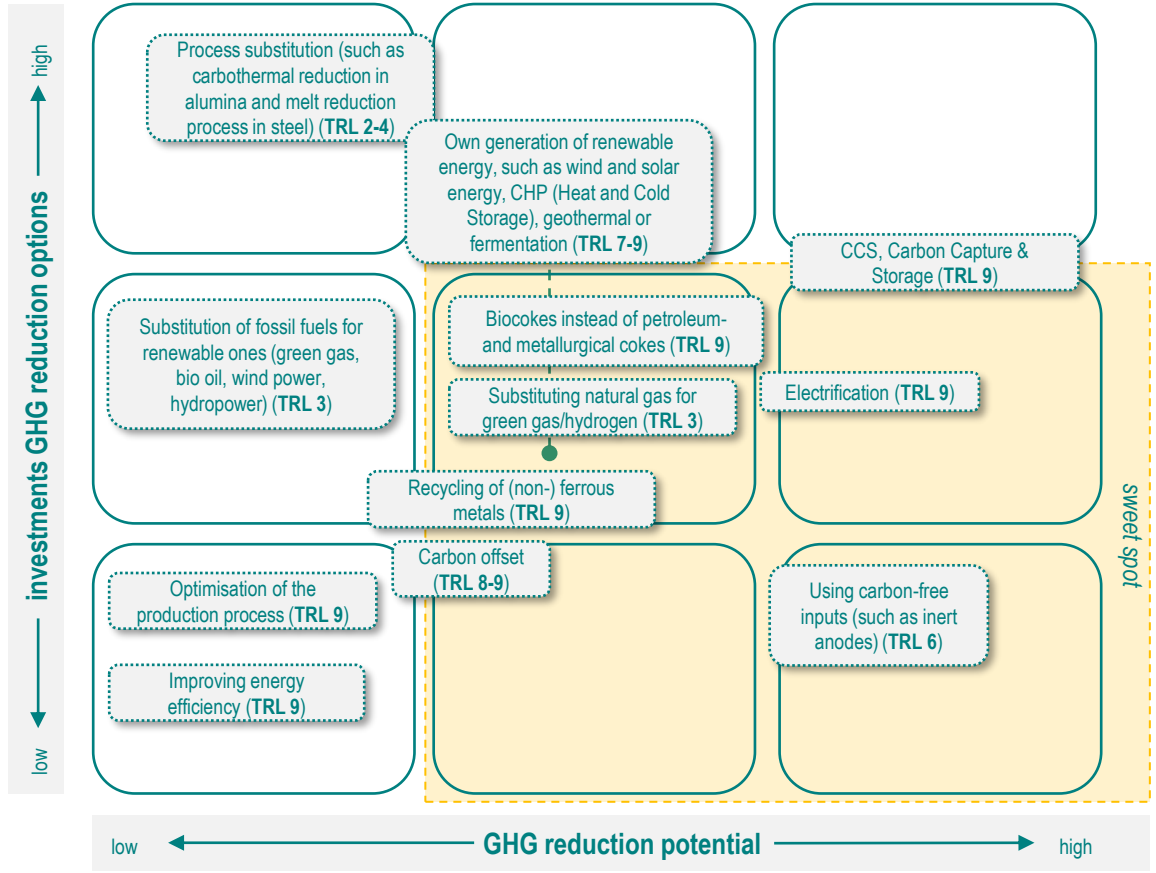
Emission pathway & projection:





Tata Steel IJmuiden also has a large share in the historical trend of greenhouse gas emissions from the base metal industry. Encouragingly, however, the sector has shown a declining trend in total greenhouse gas emissions since 1990. However, from 1990 to 2020, these emissions fell by only 13%, or about 1.3% per year. This rate is highly insufficient to meet the set 2030 target. Annually, the sector needs to reduce at least 223 million kg of CO_2 equivalents, or 3.7% per year. It makes the decarbonisation challenge big, so the pace of reduction needs to be stepped up. To do so, the sector has several emission reduction options at its disposal, which we discuss below.

GHG reduction options: investment & effectiveness



The base metal industry has sufficient options available to reduce existing emissions, with enough options in the so-called 'sweet spot' (relatively low investment and high GHG reduction potential). The main options with high GHG reduction potential are electrification, carbon storage and replacing polluting inputs in the production process (such as fossil fuels) by carbon-free variants. In the aluminium industry, for example, the use of inert anodes is an interesting technique. Anodes are high-quality blocks of carbon used in the electrolysis process, and the inert variant of these is carbon-free. In addition, the base metal industry - like many other industries - has the opportunity to improve energy efficiency and optimise the production process. These are usually quite simple techniques to implement, but tend to have low reduction potential.

Emission reduction target:

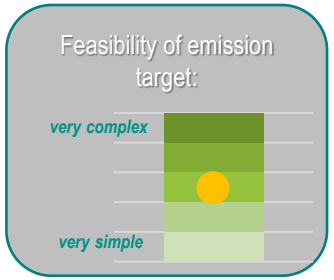
Minimum emission reduction through 2030:
2,008
(in mln kg CO_2 eq.)

Minimum emission reduction through 2030 per year:
223
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-33%

Minimum % annually in emissions through 2030:
-3.7%

Average % annual change in emissions over last 20 years:
-1.3%

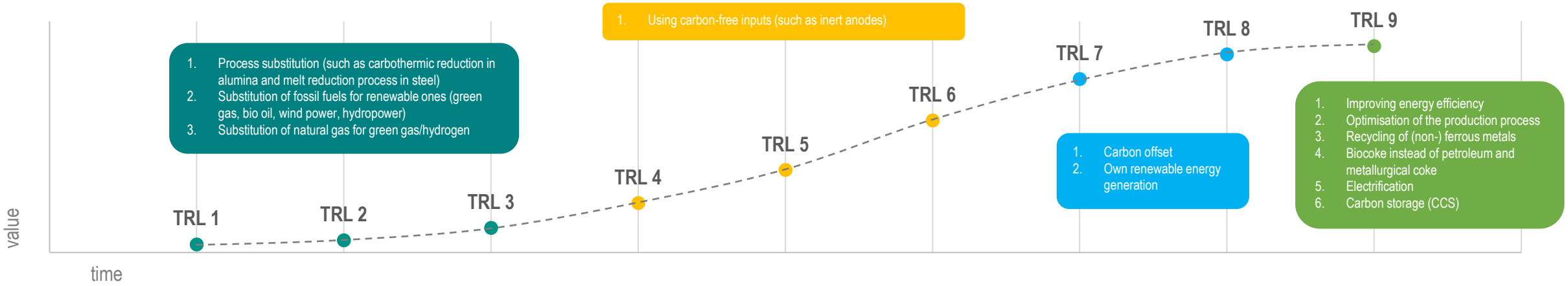


Source: Metaal Nederland/Berenschot, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Base metal industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Three technologies are plotted in the concept phase. These include all kinds of substitution option, such as process substitution and fuel substitution.
Carbothermal reduction in the aluminium industry is a non-electrochemical process. Due to the high complexity in this technology, it does not appear to be an economically viable option in the short or medium term. However, in theory, energy savings of 47% can be achieved with this technology, making it an interesting option for energy-intensive sectors to develop further.
Although the technologies in relation to fuel replacement are only being tested on a small scale, initial study results indicate that green gas and hydrogen have a promising role to play in replacing natural gas.

Techniques in test and prototype phase:

In the aluminium industry, anodes are used in the production process. These have two major disadvantages: 1) the anodes have to be replaced every four weeks, 2) the oxidation of carbon leads to significant direct CO_2 emissions. Inert anodes (the carbon-free variant) do not have these two disadvantages and thus improve operational efficiency. However, the technology, as we mentioned above, is still in the testing phase. Some rigged projects with inert anodes indicate that TRL 9 could not be reached until 2024.

Techniques in pre-commercial phase:

Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Greater efficiency and further optimisation of processes is relatively easy to implement at low cost. It also reduces the impact of energy on profits. Industrial motor-driven systems in particular offer many opportunities for energy-efficiency measures.
Recycling of metals is a growth market. Producing metals from secondary materials requires significantly less energy. This leads to less environmental damage. In addition, metal recycling rates are relatively high, which in turn contributes to a decreasing threat of raw material scarcity. However, there are some differences per metal.
Bio-coke as a substitute is used more often as a raw material and reducing agent. However, the exact impact on the production process still needs further investigation.
Large-scale industrial electrification is of great importance to reduce greenhouse gas emissions in industry. However, this will require an accelerated rollout and scale-up of transport infrastructure.
The advantage of the mitigation option carbon storage is its low impact on the production process.

Source: Metaal Nederland, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

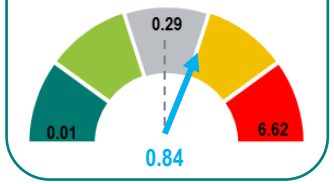
Emissions sector: Metal products industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of metal products (not machinery and equipment).

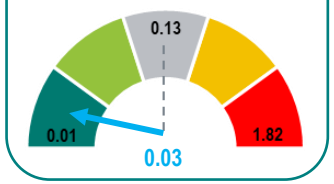
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

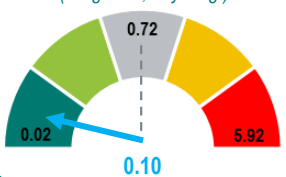
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

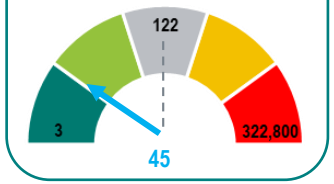


Emissions by tangible assets
(in kg/euro; 10yr avg.)

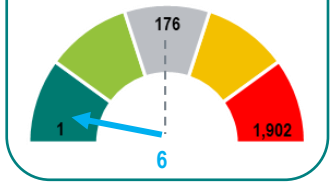


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)

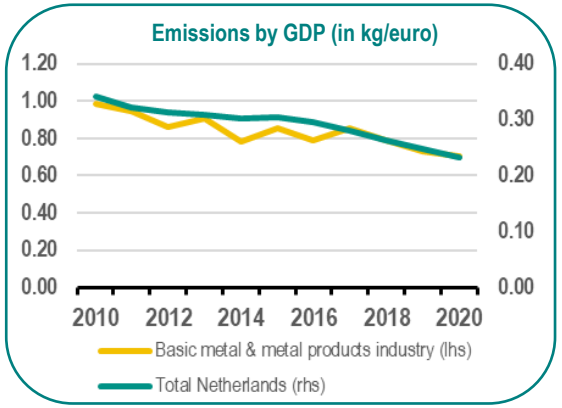


Emissions by job
(in ton/job; 10yr avg.)

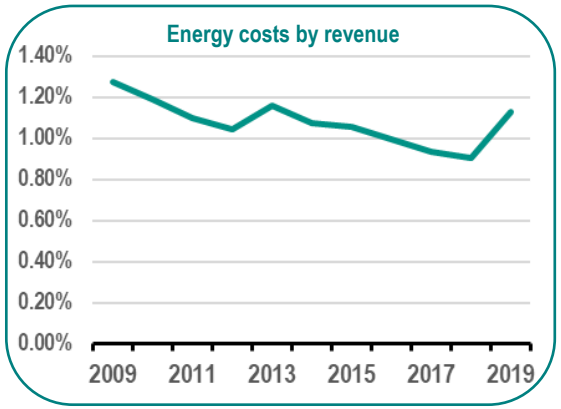


Trend in emission indicators:

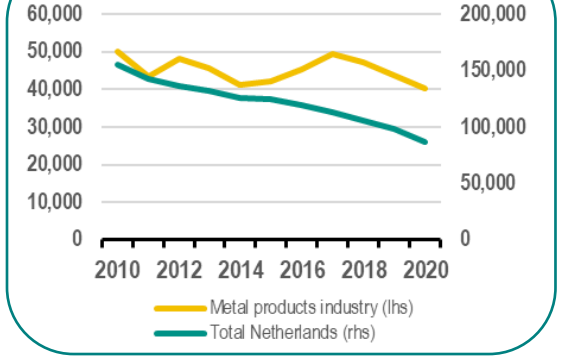
Emissions by GDP (in kg/euro)



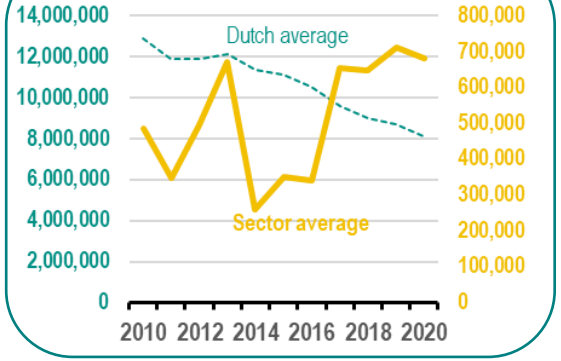
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Other indicators:

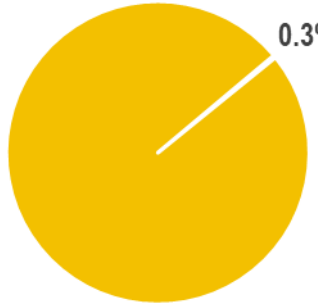
Energy costs vs. revenue:
(10yr average)
1.1%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
12.9%

Water usage by company per year:
(in litres)
513,294

Sector share in GHG emissions:



The metal products industry is a lot less emission-intensive than the related base metal industry (sometimes the former is also characterised as the metallurgical industry), but his comes as the energy intensity is much higher in the earliest parts of the value chain. The emissions to GDP therefore give a distorted picture for this sector, as the base metal industry has a significantly higher share in both emissions and value added. On all other emission indicators, the metal products industry scores much lower and well below the national average.

As in the base metal industry, the metal products industry also shows a divergent trend in terms of emissions to company. But the cause is significantly different from each other. For instance, emissions in the metal products industry increased by 6% over the period 2010-2020 (they decreased by 13% in the base metal industry). The increase in the number of companies in the period 2010-2020 was significantly high in the metal products industry with an increase of 37% (in the base metal industry, the growth here was 'only' 11%). From 2018 to 2021, growth in the number of companies increased more sharply in the metal products industry, explaining the sharper downward trend in the intensity ratio. Energy costs by turnover are relatively low and relatively stable over time. However, water use in the sector is more volatile over the years, but all in all, the sector has only a low share in this.

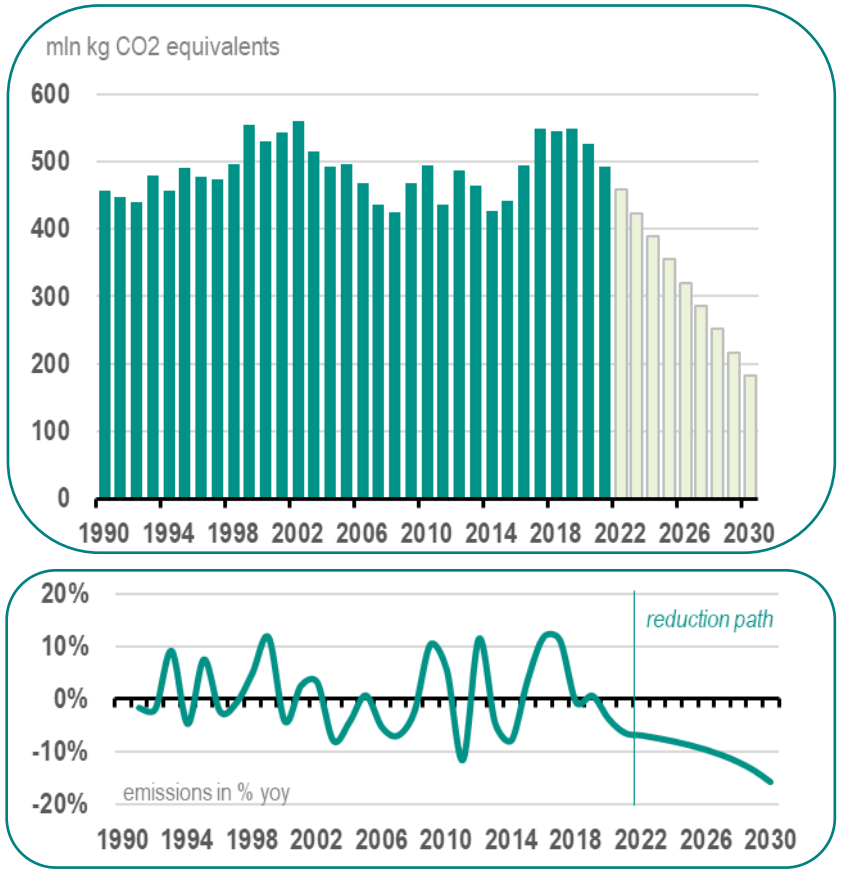
At 0.3%, the metal products industry has a low share in the Netherlands' total emissions. Its energy intensity and hence emissions intensity are relatively low. The sector also has low water consumption. With over 513,000 litres of water per company per year, the sector ranks third from bottom in use of all industrial sectors.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Metal products industry

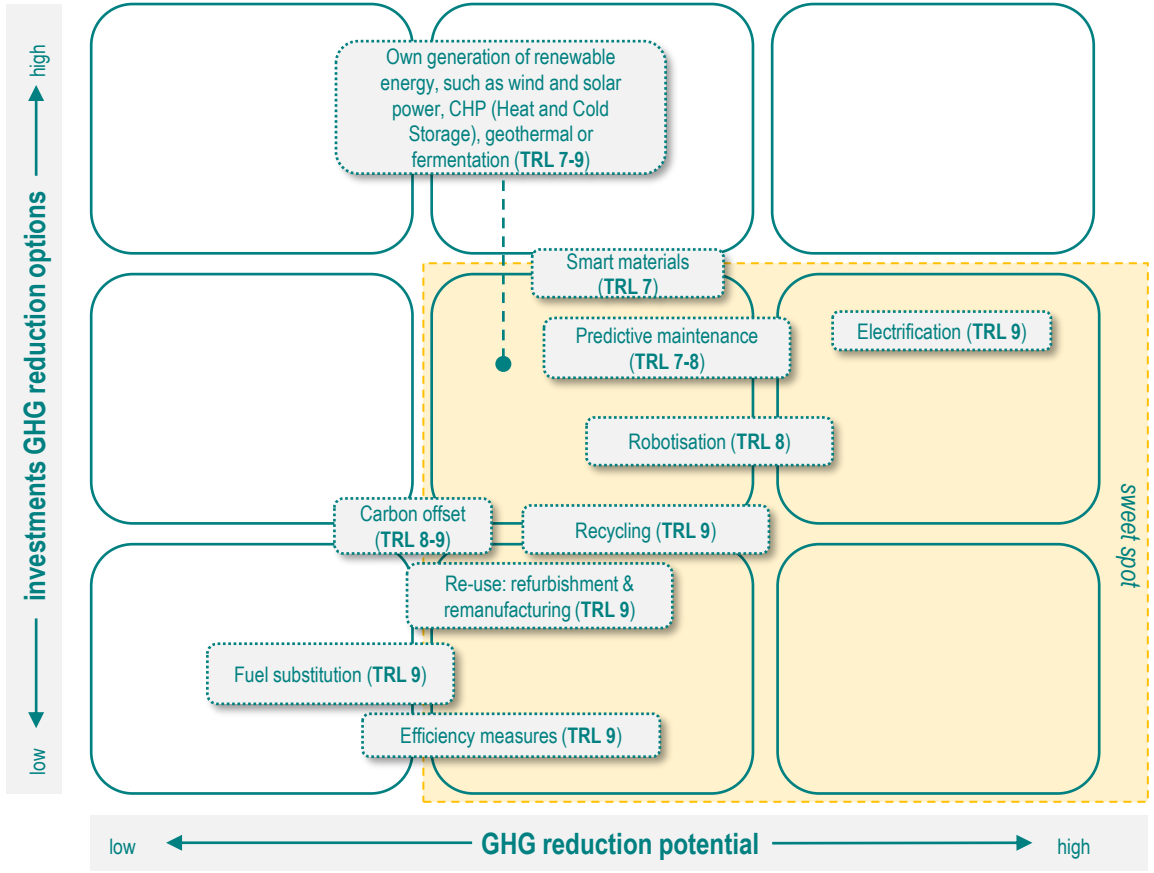
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



The trend in greenhouse gas emissions from the metal products industry has been very erratic over the past 30 years. Emissions increased by 16% from 1990 to 2020. At the end '90's and at the end of the last decade, emissions peaked. The flat trend in emissions indicates that the challenges for the sector are great to reach the 2030 target. For this, the sector needs to reduce at least 38 million kg of CO_2 equivalents annually, which is 7.3% per year. However, over the past 20 years, emissions have increased by an average of 0.7% annually.

GHG reduction options: investment & effectiveness



In the metals products space recycling is a way to make metal use more sustainable. Reuse is less energy-intensive and reduces the carbon footprint. A TNO study showed that innovations across the manufacturing industry made a major contribution to reducing environmental impact (Manufacturing Industry Roadmap, 2022). The study showed that greenhouse gas emission reductions of 25-70% can be achieved through 1) smart maintenance: the use of ICT to achieve predictive maintenance, 2) smart materials: the use of new materials and new production technology (think Metal Injection Moulding and 3D metal printing), 3) refurbishment and remanufacturing and 4) introduction of as-a-service business models. Other ways of working can also bring many sustainability gains. Welding, for instance, requires a lot of energy. Instead of welding, gluing can be used, for example.

Emission reduction target:

Minimum emission reduction through 2030:
345
(in mln kg CO_2 eq.)

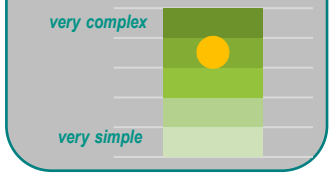
Minimum emission reduction through 2030 per year:
38
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-65%

Minimum % annually in emissions through 2030:
-7.3%

Average % annual change in emissions over last 20 years:
0.7%

Feasibility of emission target:

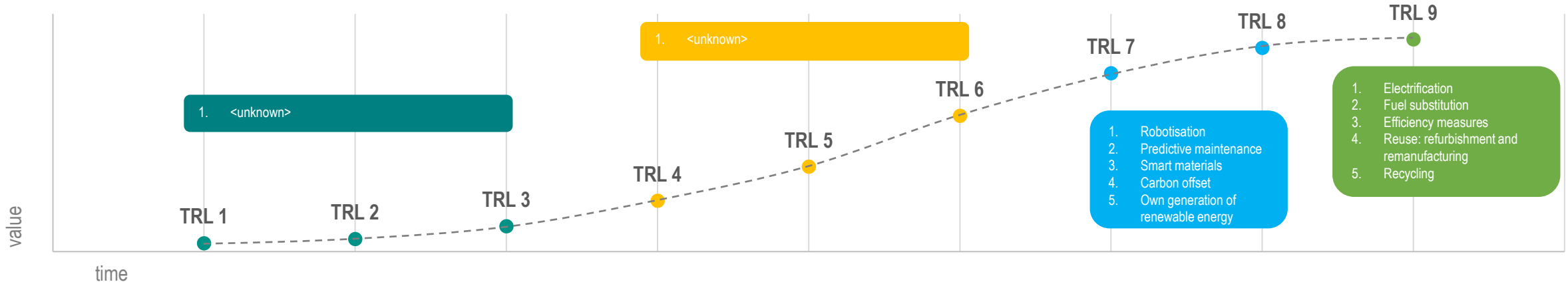


Source: Metaal Nederland, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Metal products industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Robots are used throughout the manufacturing industry to optimise production processes, reduce production costs and robotise repetitive handling. Robots are becoming increasingly efficient in terms of energy consumption and are used in many different applications. The most common application is for moving an object. But it can also be drilling, cutting, sawing, polishing operations. A robot can be deployed in a compact production line, achieving automation on balance with limited space.

Predictive maintenance enables insight into the condition of industrial processes. This improves efficiency and can extend service life. Data collection thus makes it possible to predict maintenance needs in time. This benefits the reliability and availability of a machine or plant. An additional big advantage is that it also allows a close monitoring of energy consumption.

Innovation in new materials continues. Materials can thus be designed in favour of a sustainable future.

Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein

Techniques commercial deployment phase:

Electrification is the most impactful measure to reduce greenhouse gas emissions. Purchasing green power (solar power, biomass) also contributes to reducing the carbon footprint. Green power from biomass is somewhat cheaper compared to solar power, but it ultimately delivers smaller CO_2 reductions.

Improving efficiency within the industry involves optimising the primary production process. Further automation, precision applications and connectivity between machine further increases efficiency. Thanks to the use of advanced technologies such as GPS and smart sensors, companies are able to achieve ever higher accuracy in the work process. Measures such as regular equipment maintenance also contribute to improving efficiency.

Material efficiency refers to longer use, more intensive use and more active reuse of materials, components and final products. Greening transport is a good option.

With recycling, the impact of metal use is reduced because no new raw materials are extracted. Moreover, transport movements decrease significantly.

Source: Metaal Nederland, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

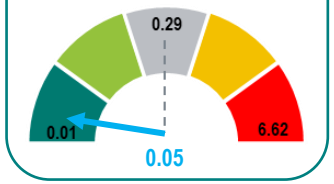
Emissions sector: Electrotechnical industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the Manufacture of computers and of electronic and optical equipment.

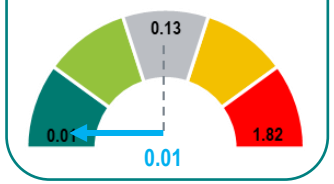
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

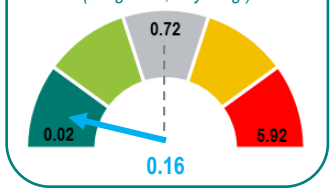
Emissions by GDP
(in kg/euro; 10yr avg.)



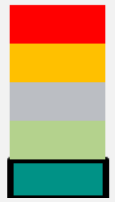
Emissions by revenue
(in kg/euro; 10yr avg.)



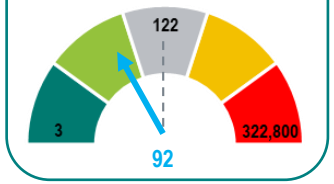
Emissions by tangible assets
(in kg/euro; 10yr avg.)



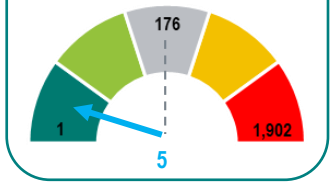
Emission intensity:



Emissions by company
(in ton/company; 10yr avg.)



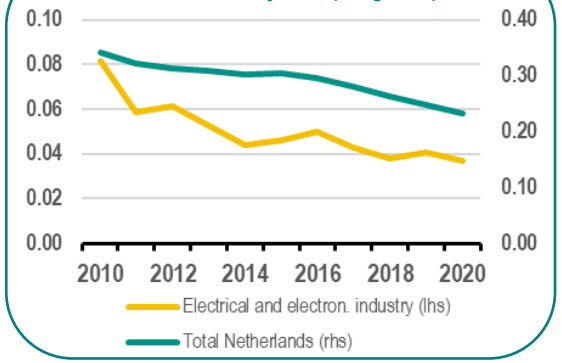
Emissions by job
(in ton/job; 10yr avg.)



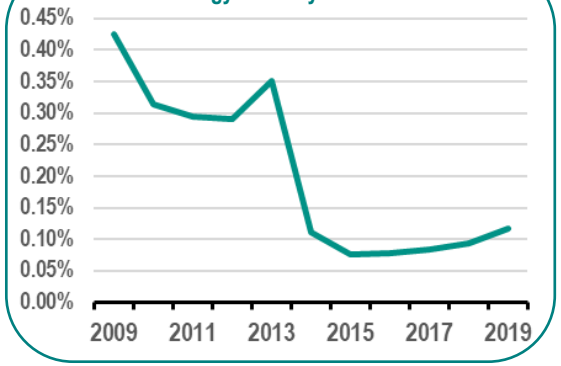
The emissions intensity of the electrical engineering sector is low. On almost all emission indicators shown above, the final score is relatively low. On the indicator emissions by turnover, the sector even accounts for the lowest possible score. The only indicator where there is still some increase is emissions by company. Over the past ten years, an average of about 92,000 kg of CO_2 is emitted per company on an annual basis.

Trend in emission indicators:

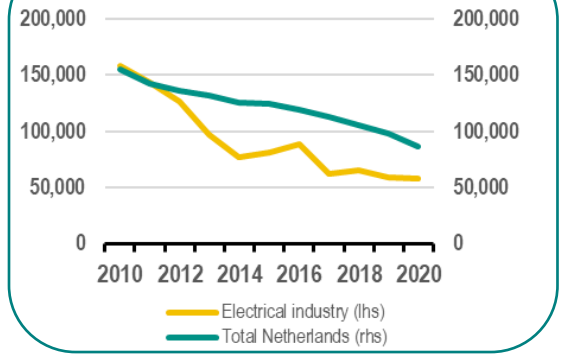
Emissions by GDP (in kg/euro)



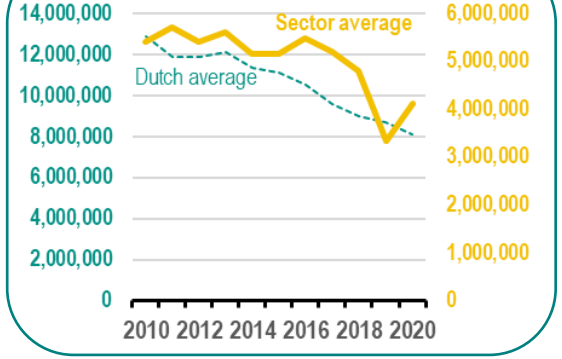
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions to GDP are compared here in combination with the electrical appliance industry sector. The indicator is about 5-6 times lower than the national average. The decrease in the emissions indicator in the sector since 2010 is much stronger (-55%) than at the national level (-32%). Emissions by company are at a similar level to the national average, although the decrease since 2010 has been much stronger, than the national average. This is mainly because greenhouse gas emissions have been reduced by almost 60% over the past 10 years, while the number of companies in the sector has increased by 6% over the same period. Energy costs by turnover have also fallen sharply since 2010, with a sharp reduction in the indicator in 2013 and 2014. Turnover increased significantly faster, while energy costs decreased slightly. The sector has also shown improvements in total water consumption. Water consumption is almost constant in the period up to 2018, after which consumption begins to decline and is at sharply lower levels.

Other indicators:

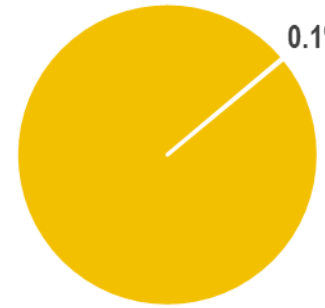
Energy costs vs. revenue:
(10yr average)
0.2%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
3.3%

Water usage by company per year:
(in litres)
5,040,186

Sector share in GHG emissions:



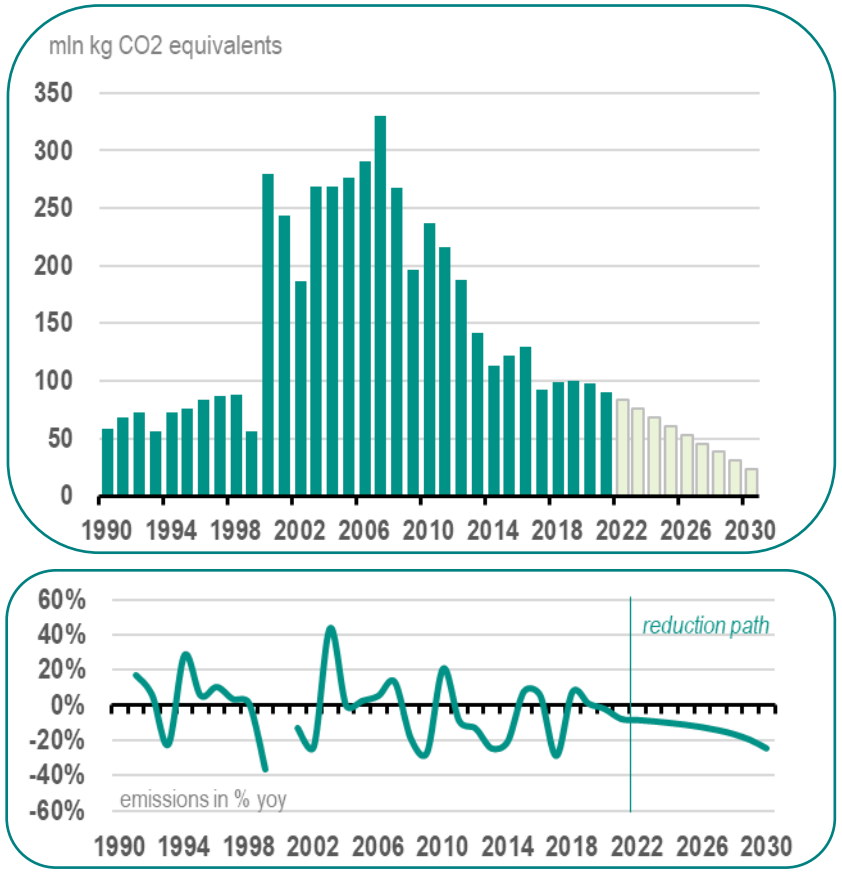
The sector's share of total emissions from companies in economic sectors is marginal. The sector is invariably in the top five sectors with lowest emissions. In terms of water consumption, the sector also has very little share overall.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Electrotechnical industry

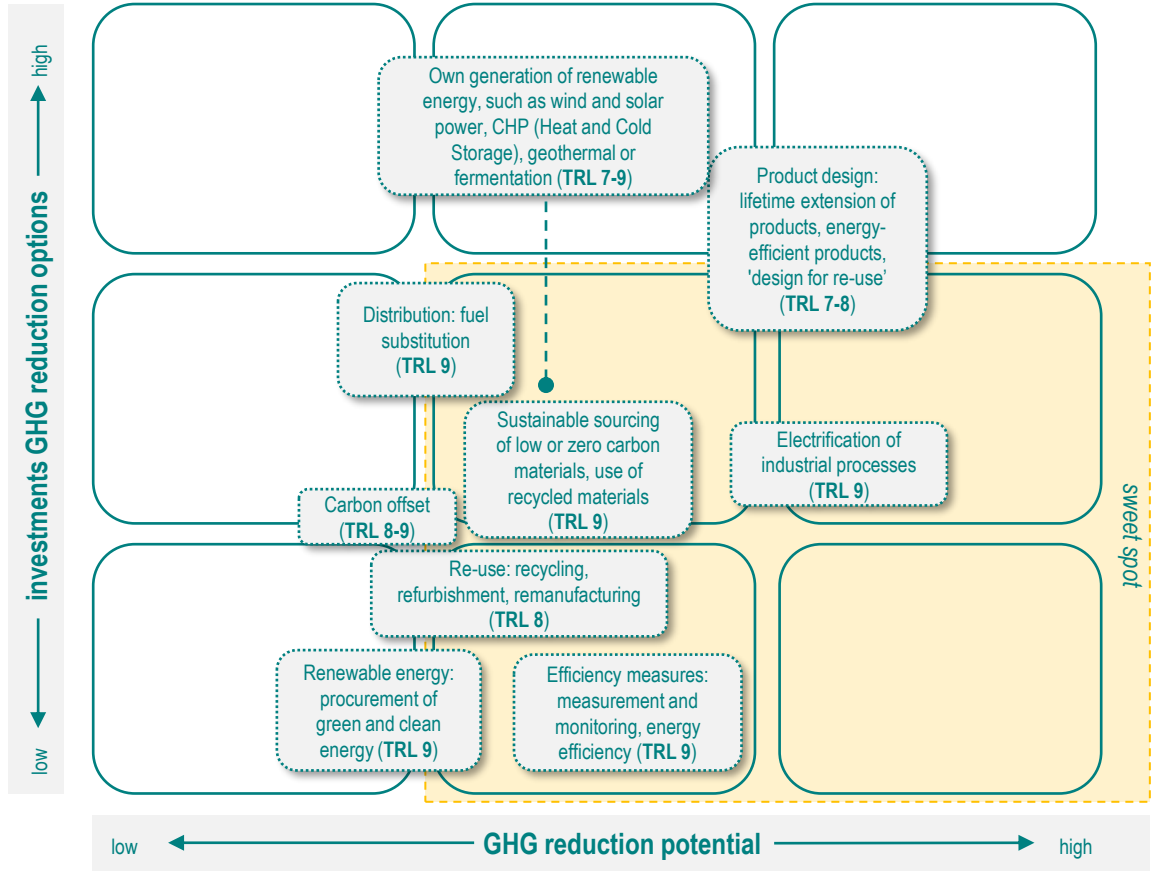
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



The sector shows a very erratic pattern in greenhouse gas emissions over the years. Up to the year 2000, the level of emissions is fairly low and constant. After that, emissions increase exponentially faster, mainly because both the number of active companies in this sector and production increase significantly faster. The peak in emissions is reached in 2007, after which emissions enter a more downward trend. Until 2020, emissions in the sector are reduced by about 70%, or about 5% per year. With the trend from 2007 in mind, the path to the 2030 target seems relatively easy to achieve. Emissions in the sector are still above 1990 levels, so the emission reduction path remains challenging.

GHG reduction options: investment & effectiveness



The decarbonisation options for the electrical industry differ little from those for the electrical appliance industry. Extending the average lifetime of an electrical appliance product from three to, say, five years can have a significant impact on the environmental footprint not only of the appliance, but also of the industry. The European Commission has updated its energy label requirement for electronic products and proposed minimum efficiency requirements for IT equipment. The EU Waste Electrical and Electronic Equipment Directive requires 75% of small IT equipment to be recovered by the manufacturer and 55% to be prepared for reuse and recycling. Screening, monitoring and measuring products and processes for their impact on greenhouse gas emissions is relevant to understand exactly where the greenhouse gas emission pain lies for an individual company. In this way, more targeted action can be taken.

Emission reduction target:

Minimum emission reduction through 2030:
75
(in mln kg CO_2 eq.)

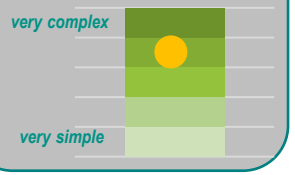
Minimum emission reduction through 2030 per year:
8
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-76%

Minimum % annually in emissions through 2030:
-8.5%

Average % annual change in emissions over last 20 years:
11.4%

Feasibility of emission target:



Source: CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

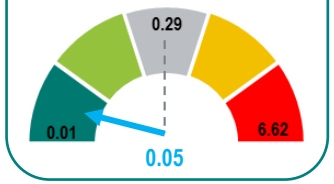
Emissions sector: Electrical appliances industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of electrical equipment.

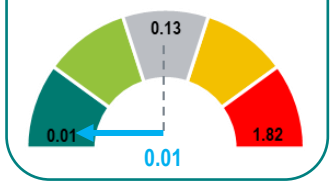
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

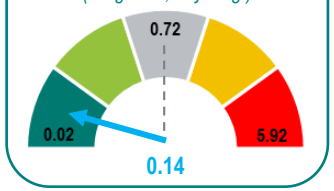
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

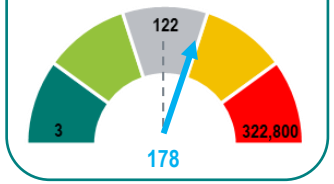


Emissions by tangible assets
(in kg/euro; 10yr avg.)

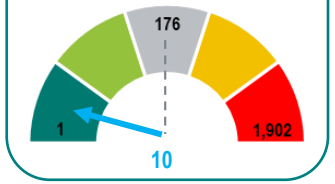


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



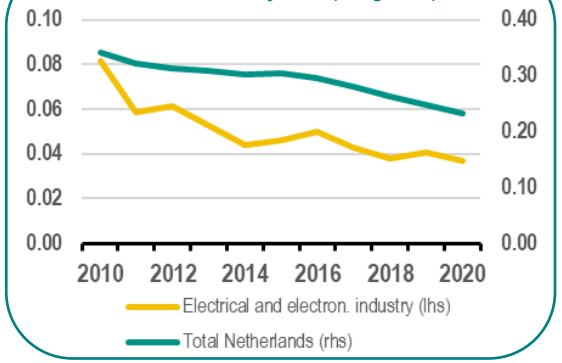
Emissions by job
(in ton/job; 10yr avg.)



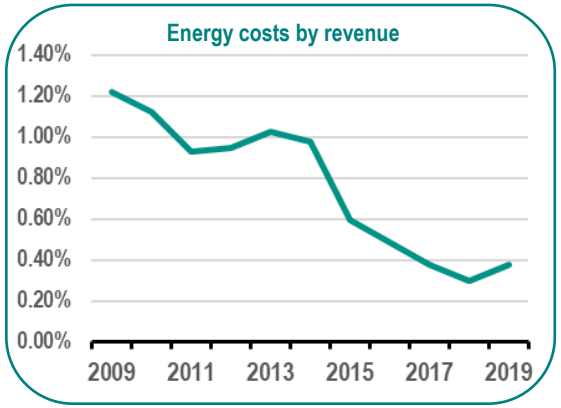
The sector is generally not emission-intensive. On about five emission indicators, the sector scores relatively low and in some cases accounts for the lowest possible score. The sector excels only on emissions to company. On this emission indicator, the electrical appliance industry scores higher than the national average.

Trend in emission indicators:

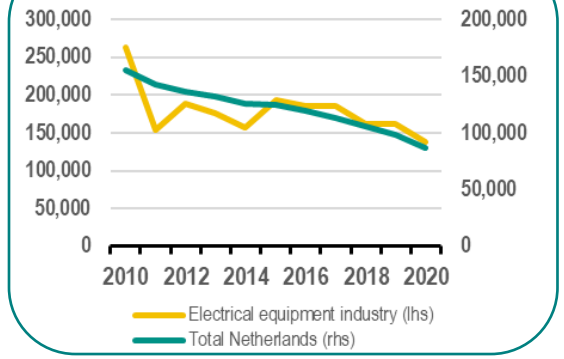
Emissions by GDP (in kg/euro)



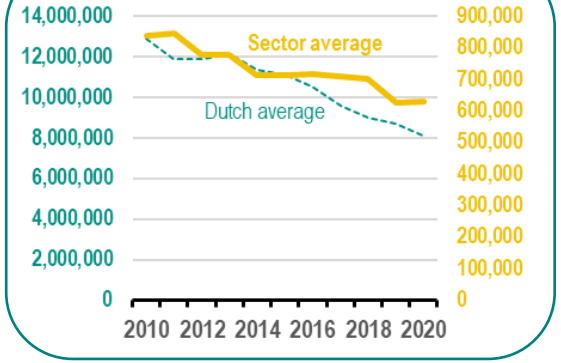
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The decrease in the emissions indicator since 2010 is much stronger (-55%) than at the national level (-32%). Emissions by company in the sector are fractionally higher than the national level and show a more erratic pattern over the past decade. Greenhouse gas emissions fell by 44% between 2010 and 2020, while the number of companies remained almost the same over the same period. The ratio of energy costs to turnover has fallen sharply since 2010, by almost 1 percentage point. This is mainly because energy costs have shown a steady decline since 2010, while turnover has increased much more sharply in those years. But it is not only in this that the sector has become more efficient. Water consumption per company has also decreased significantly, from over 800,000 litres per company to just over 600,000 litres per company. This is a decrease of 25%.

Other indicators:

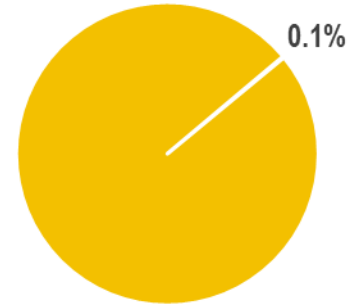
Energy costs vs. revenue:
(10yr average)
0.8%

Share in total water consumption:
0.2%

Energy costs vs. result:
(10yr average)
13.8%

Water usage by company per year:
(in litres)
732,110

Sector share in GHG emissions:



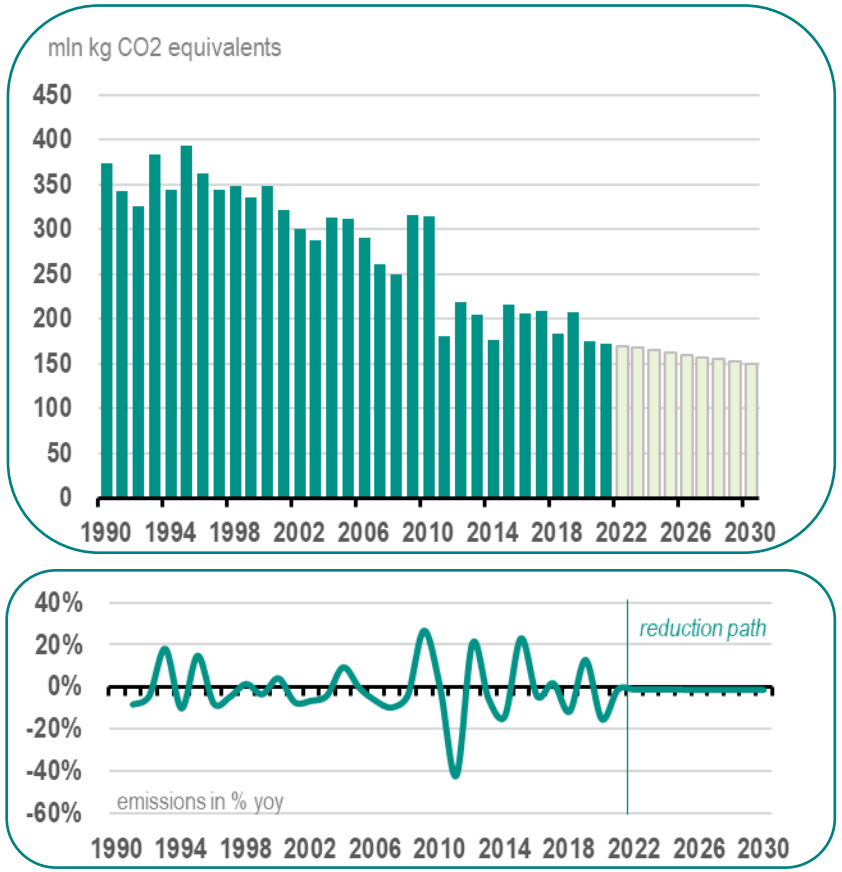
Both in terms of greenhouse gas emissions and water consumption, the sector has a low share compared to the total. However, energy costs by results are relatively high and this is related to the low margins in the sector. The average water consumption per company over the past 10 years comes to over 730,000 litres of water per year.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Electrical appliances industry

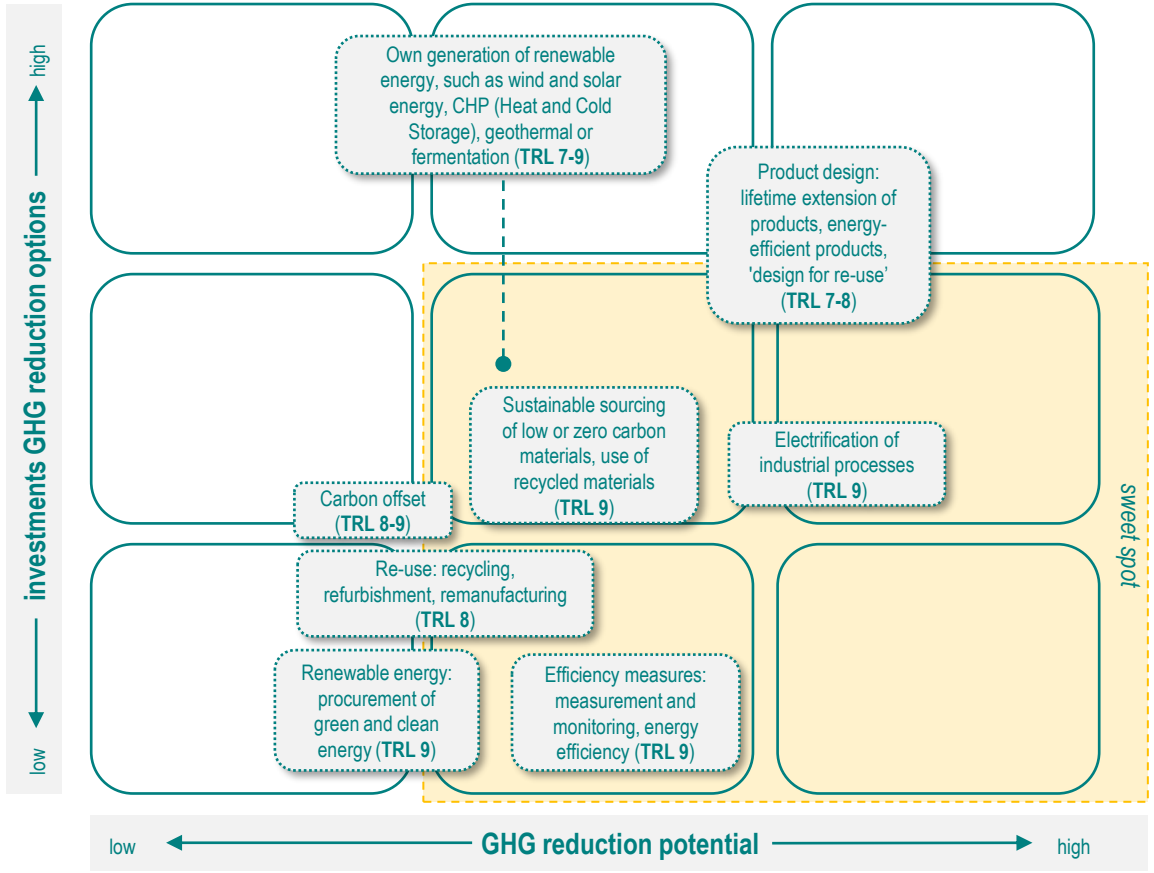
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



The efficiency gains made by the sector in recent years are clearly reflected in the trend of greenhouse gas emissions. Emissions have decreased by 53% since 1990. And this is good news for the feasibility of the 2030 emissions target. The sector only needs to reduce emissions by 1.6% a year, and compared to many other sectors, this is little. This also makes it look like a fairly straightforward task for the sector to achieve its 2030 target. After all, the average emission reduction over the period 1990-2020 is about 1.5% annually.

GHG reduction options: investment & effectiveness



The decarbonisation options for the electrical appliance industry differ little from those for the electrical engineering industry. The products of the electrical appliance industry have a major impact on total greenhouse gas emissions. For instance, about two-thirds of total household energy consumption is accounted for by all kinds of electrical appliances (white goods, brown goods, etc.). Extending the average lifetime of an electrical product from three to, say, five years can have a significant impact on the ecological footprint of the appliance, but also of the industry. Screening, monitoring and measuring products and processes for their impact on greenhouse gas emissions is relevant to understand exactly where the greenhouse gas emission pain lies for an individual company. That way, more targeted action can be taken.

Emission reduction target:

Minimum emission reduction through 2030:
25
(in mln kg CO_2 eq.)

Minimum emission reduction through 2030 per year:
3
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-15%

Minimum % annually in emissions through 2030:
-1.6%

Average % annual change in emissions over last 20 years:
-1.5%

Feasibility of emission target:

Source: CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

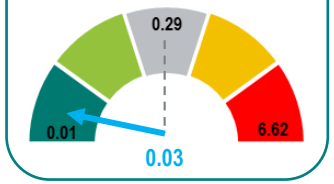
Emissions sector: Machinery industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of other machinery and equipment.

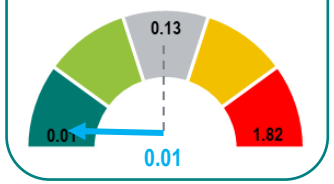
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

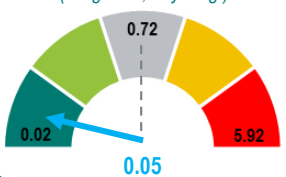
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

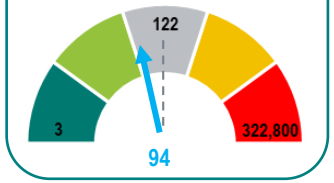


Emissions by tangible assets
(in kg/euro; 10yr avg.)

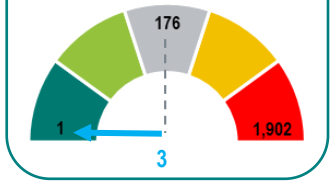


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



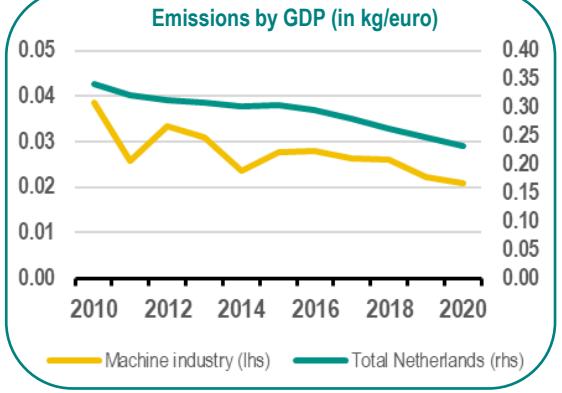
Emissions by job
(in ton/job; 10yr avg.)



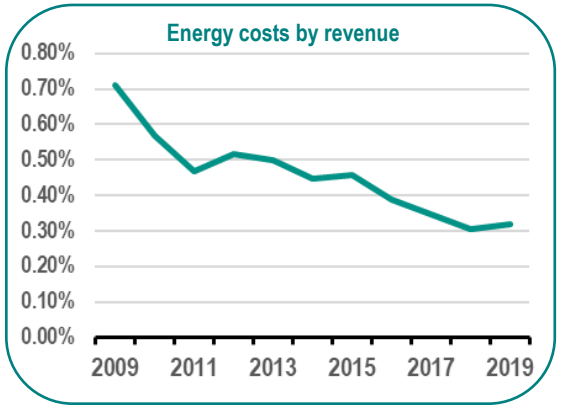
Overall, the machinery industry has a low emission intensity. In terms of emissions by company, the sector scores around the national average. But on all other emission indicators, the sector is in the lowest class almost every time. The machinery and equipment manufactured by the sector are responsible for emissions in other industrial sectors. However, only relatively few greenhouse gas emissions are released in making the machines even.

Trend in emission indicators:

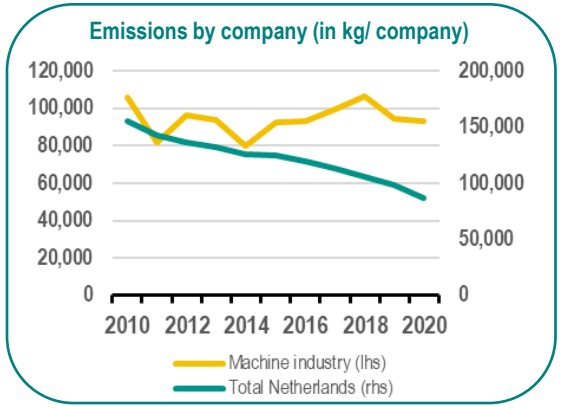
Emissions by GDP (in kg/euro)



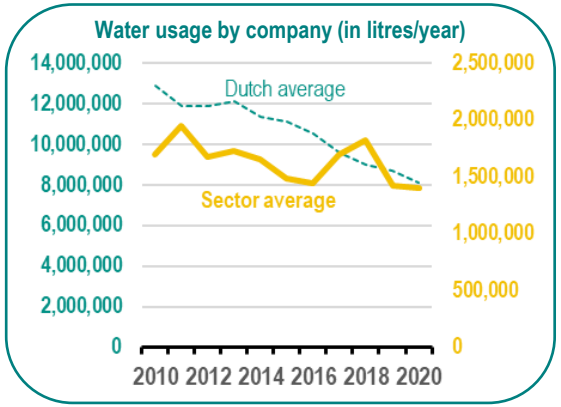
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions to GDP are lower than the national average by a factor of 10-11. Despite trends in emissions to GDP in the sector being more erratic than the national average, the two are largely parallel. However, the decline in emissions to GDP has been sharper over the past decade than the national average (46% versus 32%). This is partly because value added in the sector has grown almost three times faster than GDP growth for the Netherlands as a whole. Emissions by company show a completely different pattern. Here, emissions per company in the sector have fluctuated between 105,000 kg per company and 80,000 kg per company over the past decade, in a very volatile trend. Business growth in the sector is considerably lower than the national average, as it is quite complex to start up a business in this sector due to high entry barriers. Both energy costs by turnover and total water consumption are relatively low and show a decreasing trend over a decade.

Other indicators:

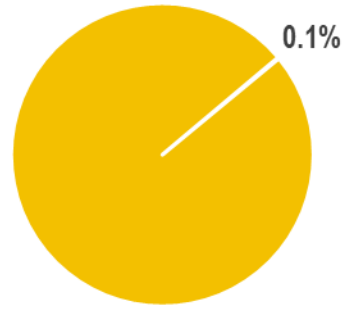
Energy costs vs. revenue:
(10yr average)
0.5%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
4.2%

Water usage by company per year:
(in litres)
1,634,292

Sector share in GHG emissions:



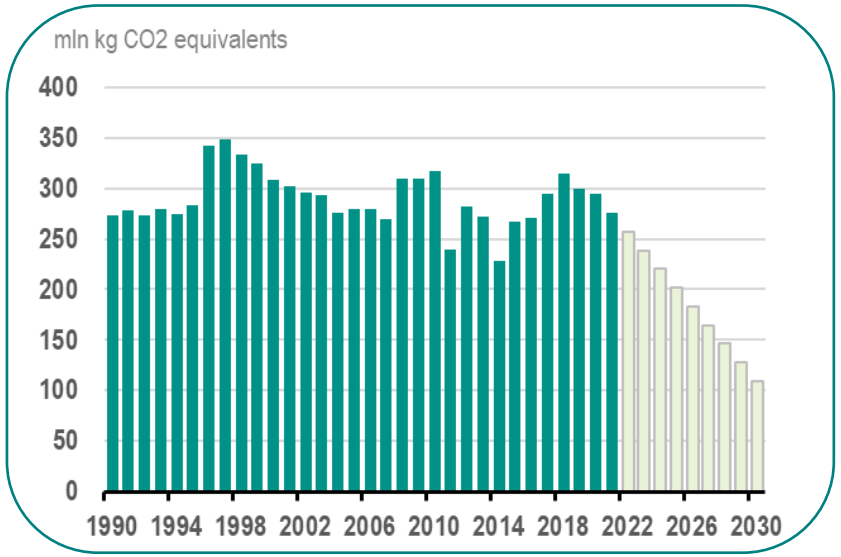
A low emissions intensity of the sector, is almost automatically associated with a low share of total greenhouse gas emissions by companies in economic sectors. The sector also uses and consumes relatively little water. On average, about 1.6 million litres of water passed through each company annually over the past 10 years.

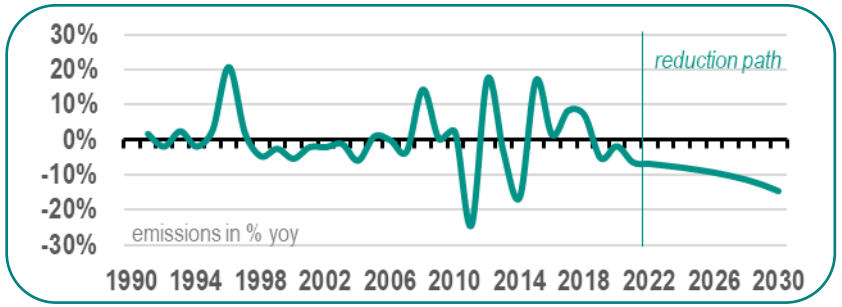
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Machinery industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

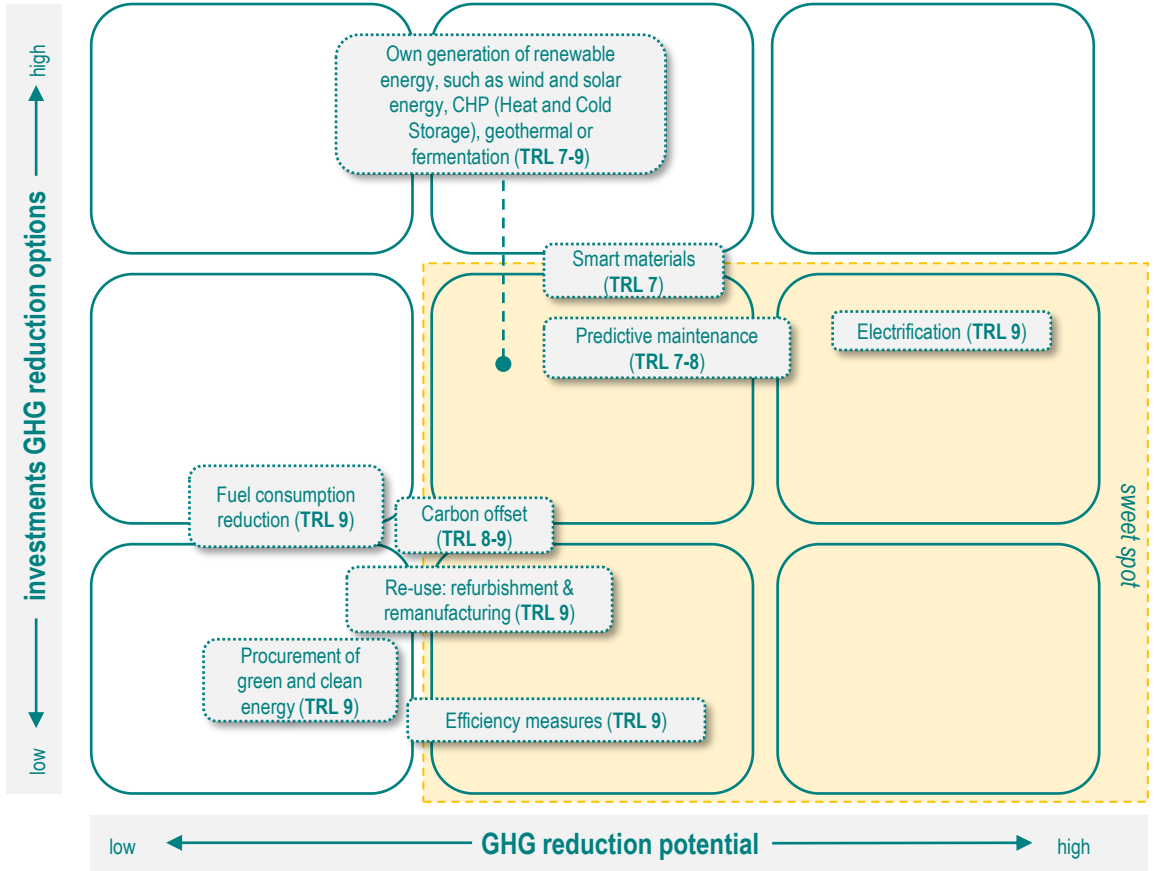
Emission pathway & projection:





Despite having a low share in total greenhouse gas emissions and being characterised by low emission intensity, the sector has done very little to reduce emissions over the past 30 years. The level of greenhouse gas emissions is at a higher level in 2020 than in 1990. Specifically, this means that the sector still has a lot of work to do on the emission reduction plan until 2030. To reach this 2030 target, the sector needs to reduce emissions by at least 7% annually. However, on average, the sector adds around 0.7% in greenhouse gas emissions every year. This makes the 2030 target for the sector very difficult to achieve.

GHG reduction options: investment & effectiveness



The machinery industry still has plenty of opportunities to reduce emissions further. A study by TNO showed that innovations across the manufacturing industry have made a major contribution to reducing environmental impact (Routekaart Maakindustrie, 2022). The study showed that greenhouse gas emission reductions of 25-70% can be achieved through 1) smart maintenance: the use of ICT to achieve predictive maintenance, 2) smart materials: the use of new materials and new production technology (think Metal Injection Moulding and 3D metal printing), 3) refurbishment and remanufacturing and 4) introduction of as-a-service business models. Most of the machinery industry's carbon footprint is directly related to electricity consumption. If so, measures to save energy and the use of renewable energy are good first steps to reduce the footprint.

Emission reduction target:

Minimum emission reduction through 2030:
185
(in mln kg CO_2 eq.)

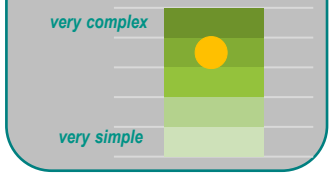
Minimum emission reduction through 2030 per year:
21
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-63%

Minimum % annually in emissions through 2030:
-7.0%

Average % annual change in emissions over last 20 years:
0.7%

Feasibility of emission target:

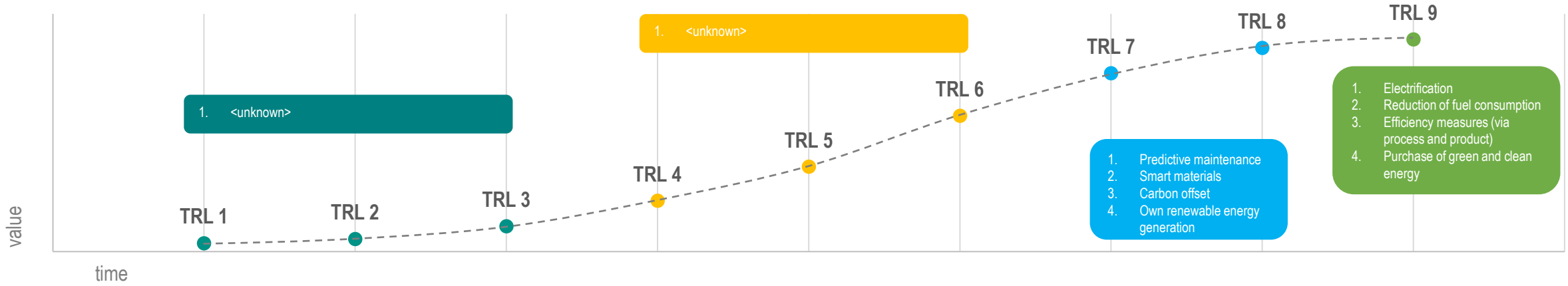


Source: Regieteam Circulaire maakindustrie, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Machinery industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Predictive maintenance enables insight into the condition of industrial machinery. This improves efficiency and can extend service life. Thus, with data collection, it is possible to predict maintenance needs in time. This benefits the reliability and availability of a machine or plant. An additional big advantage is that it also allows a close monitoring of energy consumption.
Innovation in new materials continues. Materials can thus be designed in favour of a sustainable future. For example, porous materials can be ideal for capturing and storing CO_2.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Electrification is the most impactful measure to reduce greenhouse gas emissions in the machinery industry.
Purchasing green power (solar power, biomass) also contributes to reducing the carbon footprint. Green power from biomass is somewhat cheaper compared to solar power, but it ultimately delivers smaller CO_2 reductions.
Improving efficiency within the machinery industry involves optimising the primary production process. Further automation, precision applications and connectivity between machine further increases efficiency. Thanks to the use of advanced technologies such as GPS and smart sensors, machine builders are able to achieve ever higher accuracy in the work process.
Measures such as regular equipment maintenance also contribute to improving efficiency. Material efficiency refers to longer use, more intensive use and more active reuse of materials, components and final products.
Greening transport is a good option. Reducing fuel consumption involves awareness of use and frequency, choosing more fuel-efficient vehicles and regularly checking tyre pressure.

Source: Regieteam Circulaire Maakindustrie, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

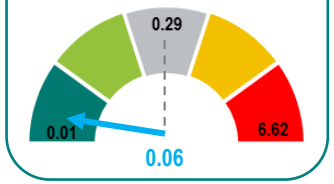
Emissions sector: Transport equipment industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the manufacture of transport equipment. This category is an aggregation of categories: manufacture of cars, trailers and semi-trailers and manufacture of other means of transport.

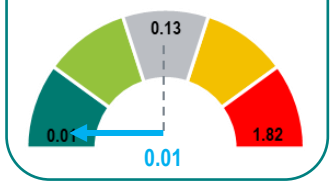
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

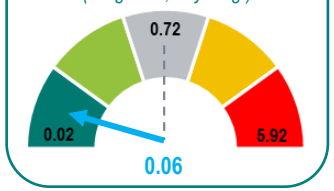
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

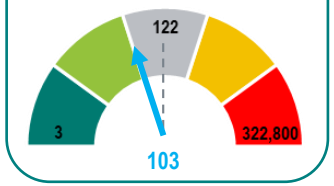


Emissions by tangible assets
(in kg/euro; 10yr avg.)

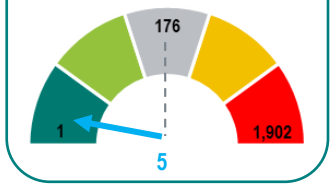


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



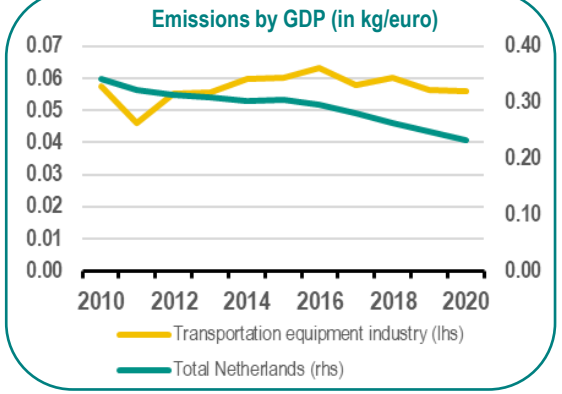
Emissions by job
(in ton/job; 10yr avg.)



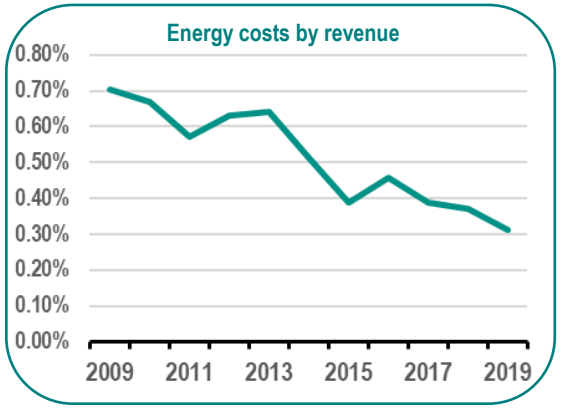
The transport equipment industry ranks the lowest with many emission indicators. Only emissions by company rank relatively high. When it comes to emissions by turnover, the sector is responsible for the lowest score compared to all other sectors. Thus, on balance, the transport equipment industry can be characterised as a low-emission-intensity sector.

Trend in emission indicators:

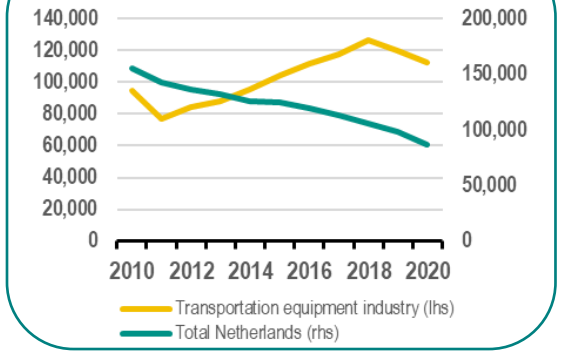
Emissions by GDP (in kg/euro)



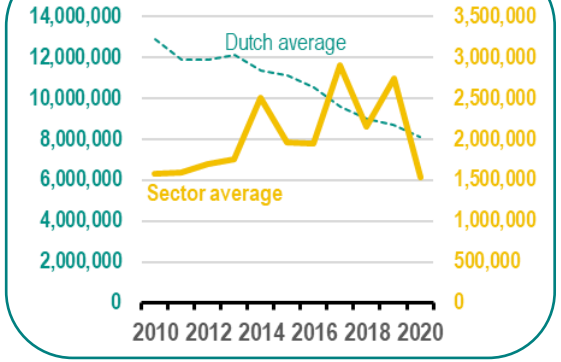
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



On both emissions to GDP and emissions to company, the sector shows a stable to increasing trend over the past decade. This is somewhat disappointing. On average, emissions to GDP are about five times lower than the national average. On emissions by company, however, the sector shows similar levels compared to the national average. However, in the sector, this emission indicator has increased by 19% in the last 10 years, while the national average achieved a 44% decrease in the same period. This is partly because the number of companies operating in the sector has remained almost constant over 10 years, while emissions have increased by 12% over the same 10 years. Energy costs by turnover, however, have seen an improvement since 2010. In it, there is a decrease from 0.7% to 0.3%. Turnover has grown much faster than energy costs over the period 2010-2020, indicating efficiency gains. Water consumption is erratic over 10 years. The level in 2020 is identical to 2010.

Other indicators:

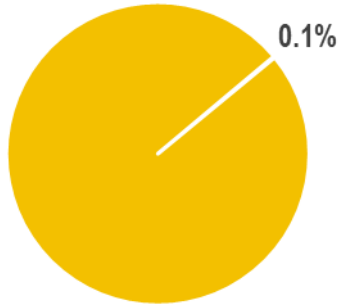
Energy costs vs. revenue:
(10yr average)
0.5%

Share in total water consumption:
9.0%

Energy costs vs. result:
(10yr average)
9.5%

Water usage by company per year:
(in litres)
2,033,364

Sector share in GHG emissions:



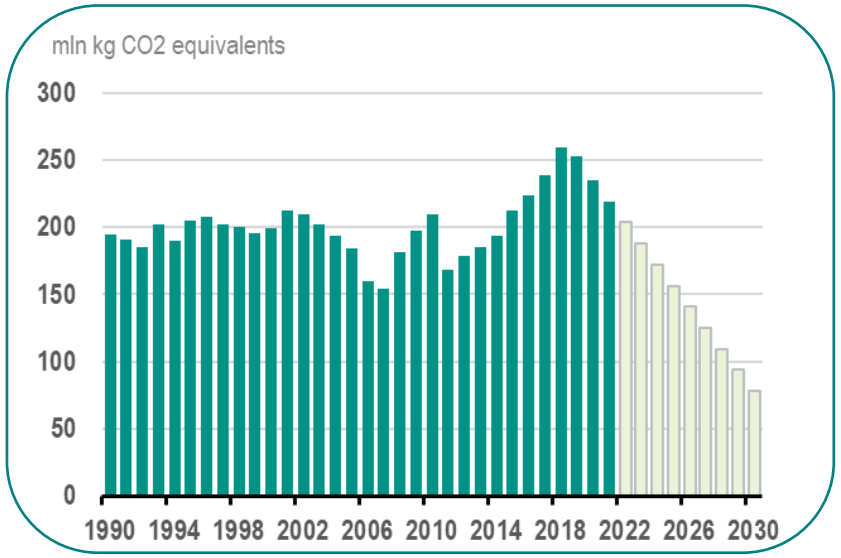
The transport equipment industry's overall share of total emissions from companies in economic sectors is low. In contrast, water consumption in the sector is relatively high again, accounting for 9% of the total. Margins within the sector are at a low level and this causes energy costs to be high by result.

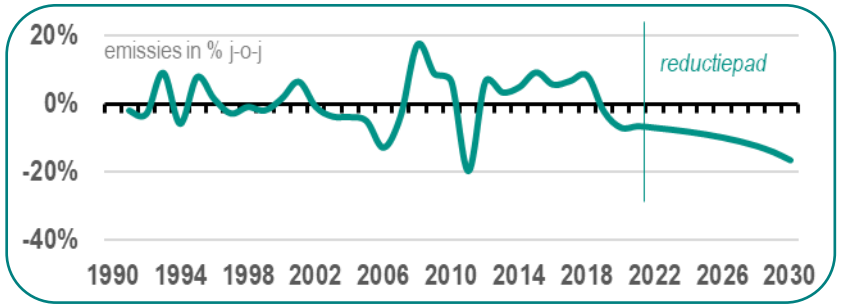
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Transport equipment industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

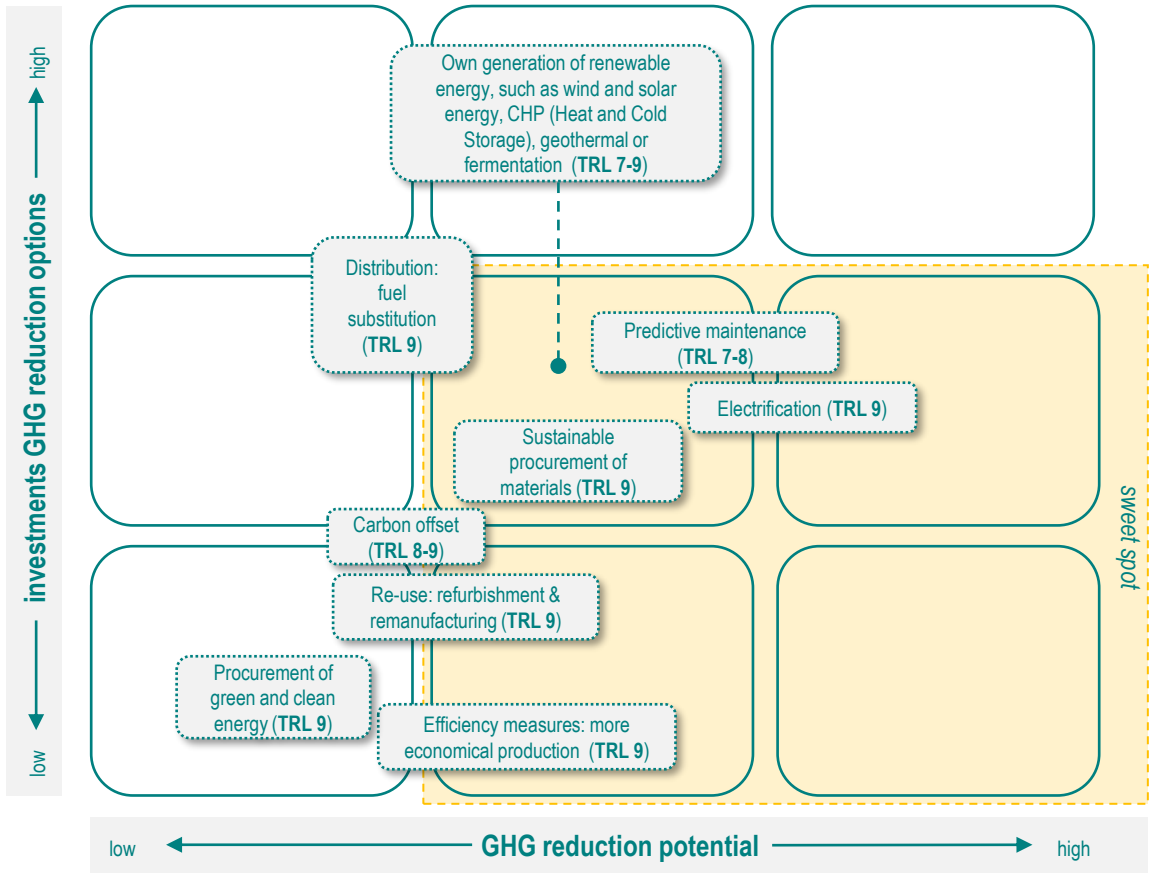
Emission pathway & projection:





The historical path in greenhouse gas emissions shows a disappointing picture. Little work has been done in the sector to reduce emissions. The pattern in emissions is very erratic until 2012 and then increases sharply. The peak in emissions is reached in 2018, after which emissions fall again. However, the question is whether the sector can maintain the reduction in emissions. Over the past 30 years, emissions are increasing by almost 1% annually on average. To reach the 2030 target, however, an annual reduction of 7% is needed. This makes the feasibility of the 2030 target very difficult to achieve.

GHG reduction options: investment & effectiveness



Most common manufacturing processes still consume large amounts of energy, metals, plastics and toxins, all of which leave a huge environmental footprint. Developing strategies in the transport equipment industry to reduce emissions is therefore of great importance, especially achieving emission reductions on a larger scale. This requires a lot of effort and, above all, requires companies to adopt and also scale up the use of new technologies and associated processes. Transport equipment manufacturers can also harness sustainable procurement and processing methods to control non-durable raw materials and reduce material wastage on production floors. It fits under the heading of efficiency as well as reuse and sustainable procurement. Integrating renewable energy into existing power grids and then into production processes is also an essential to make (electric) vehicles more low-carbon.

Emission reduction target:

Minimum emission reduction through 2030:
157
(in mln kg CO_2 eq.)

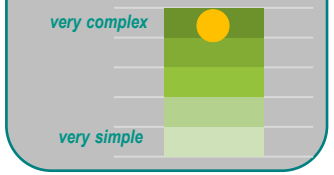
Minimum emission reduction through 2030 per year:
17
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-67%

Minimum % annually in emissions through 2030:
-7.0%

Average % annual change in emissions over last 20 years:
0.9%

Feasibility of emission target:

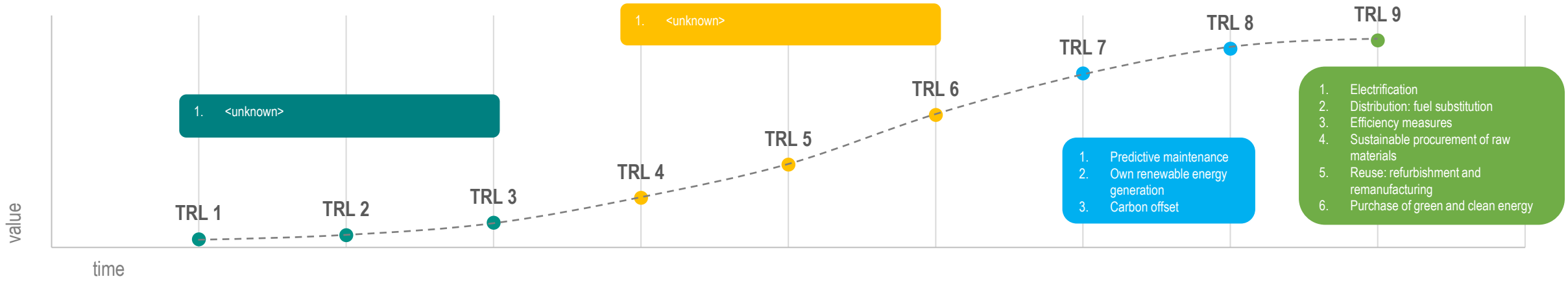


Source: ACEA, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

GHG emission reduction options explained: Transport equipment industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Predictive maintenance enables insight into the condition of industrial machinery. This improves efficiency and can extend service life. Thus, with data collection, it is possible to predict maintenance needs in time. This benefits the reliability and availability of a machine or plant. An additional big advantage is that it also allows a close monitoring of energy consumption.
Carbon footprint can also be reduced with in-house generation of sustainable energy. Sustainable generation techniques can be realised in or on own buildings or land. But it is also possible to realise own generation by taking a share in generation on third-party buildings or land.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Besides more efficiency measures and electrification, the sector has several options to reduce this footprint. Automakers worldwide have succeeded in recent years in decoupling CO_2 emissions from production growth by sourcing more and more energy from renewable and/or low-carbon sources. Purchasing fossil-free steel also contributes to more sustainable sourcing of materials and ultimately a lower carbon footprint. Investing in new technologies throughout the supply chain is a good way to ensure low-carbon production of crucial materials. At the same time, it requires more intensive cooperation with supply chain partners.
Greening transport is a good option. Reducing fuel consumption involves awareness of use and frequency, opting for more fuel-efficient vehicles and checking tyre pressure regularly.

Source: ACEA, CBS, CE Delft, PBL/TNO, ABN AMRO Group Economics

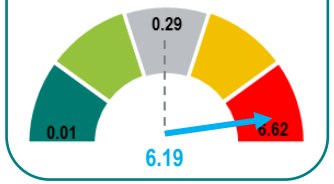
Emissions sector: Energy supply

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the production and distribution of and trade in electricity, natural gas, steam and chilled air. This section includes: production and distribution of and trade in electricity, natural gas and hot water.

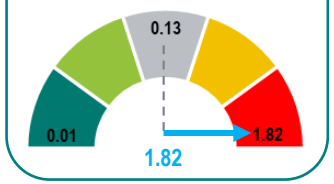
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

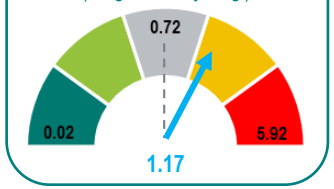
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

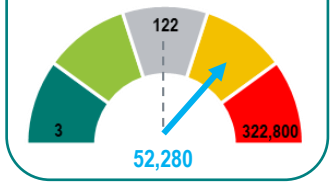


Emissions by tangible assets
(in kg/euro; 10yr avg.)

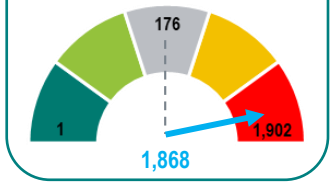


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



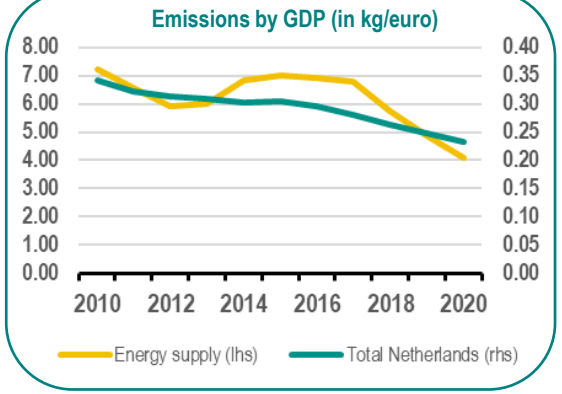
Emissions by job
(in ton/job; 10yr avg.)



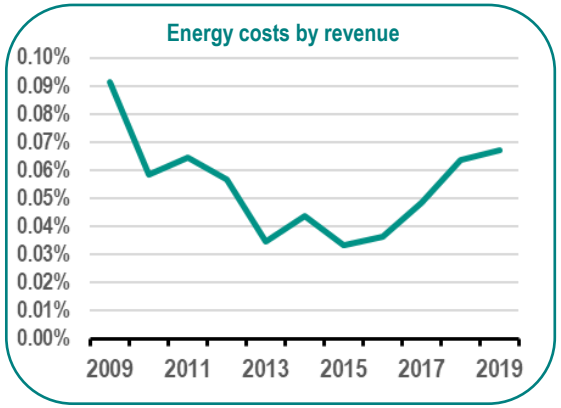
The emission indicators in energy supply strike out to the extreme right in almost all cases on the above gauges. On the indicator 'emissions by turnover', the sector has the highest possible score. Only on the emission indicators by company and by tangible fixed assets does the sector show an above-average score. This makes the sector a very emission-intensive sector.

Trend in emission indicators:

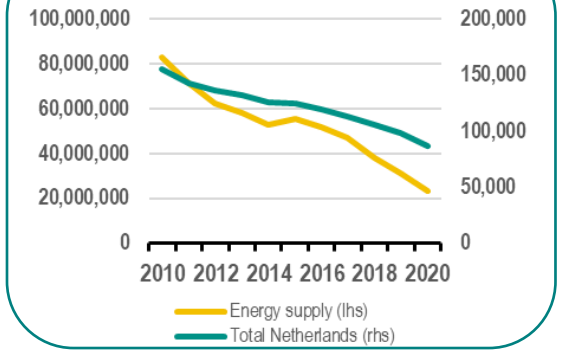
Emissions by GDP (in kg/euro)



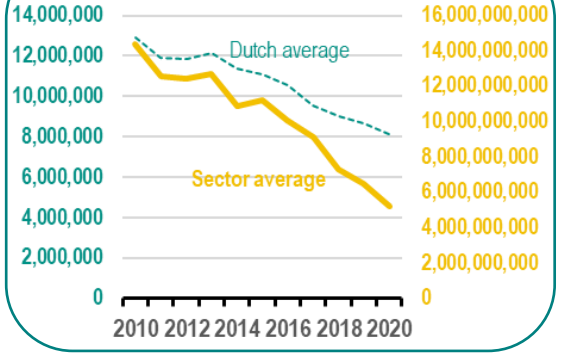
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Average emissions per company are more than 400x higher than the national average. Despite the sharp increase in the number of companies over the past 10 years in energy supply (growth of 201%), emissions per company have been decreasing every year since 2010. They have fallen by 72% in 10 years, a much faster reduction than the national average (of 44%). We also see this picture in emissions to GDP. Here too, the ratio is falling at a much faster pace compared to the rest of the Netherlands. However, the acceleration in the reduction comes late, especially from 2018 onwards. Since then, added value in the sector has been increasing, with a further decrease in emissions. Water consumption per company in the sector is high, but has decreased significantly over the past 10 years. Over the period 2010-2020, water used and consumed per company decreased 64%. Energy costs are relatively low in this sector and the ratio to turnover fluctuates in a range of 0.09% and 0.03%.

Other indicators:

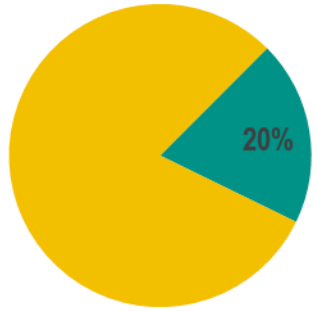
Energy costs vs. revenue:
(10yr average)
0.1%

Share in total water consumption:
56.6%

Energy costs vs. result:
(10yr average)
0.7%

Water usage by company per year:
(in litres)
10,202,581,084

Sector share in GHG emissions:



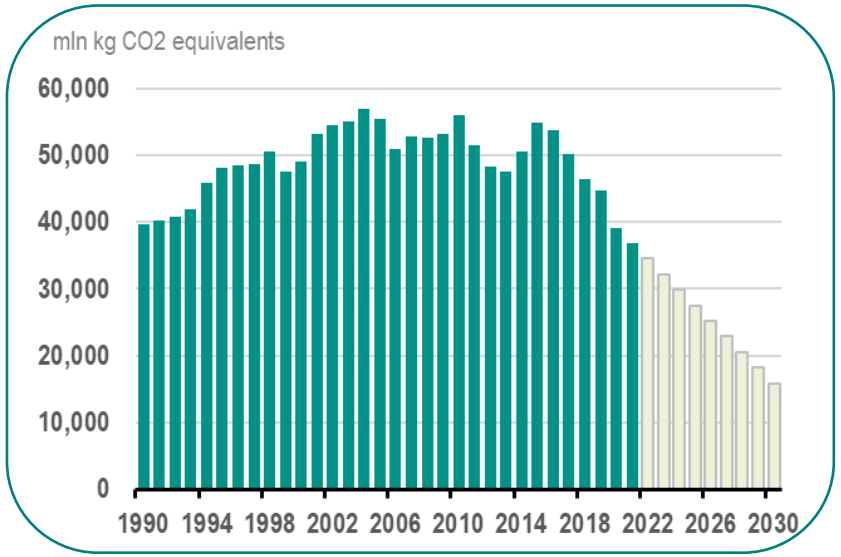
With the exception of industry, energy supply is the largest emitter of greenhouse gases in the Netherlands with a share of almost 20%. In addition, the sector is also a major consumer of water with a share of almost 57%. On average, about 10 billion litres of water are consumed per company annually. The sector has relatively low energy costs, resulting in low ratios to turnover and profit.

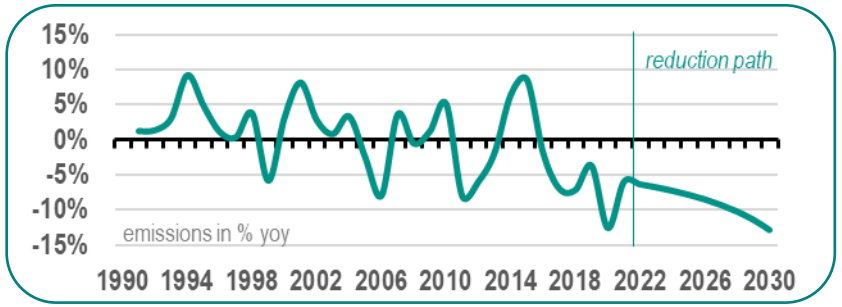
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Energy supply

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

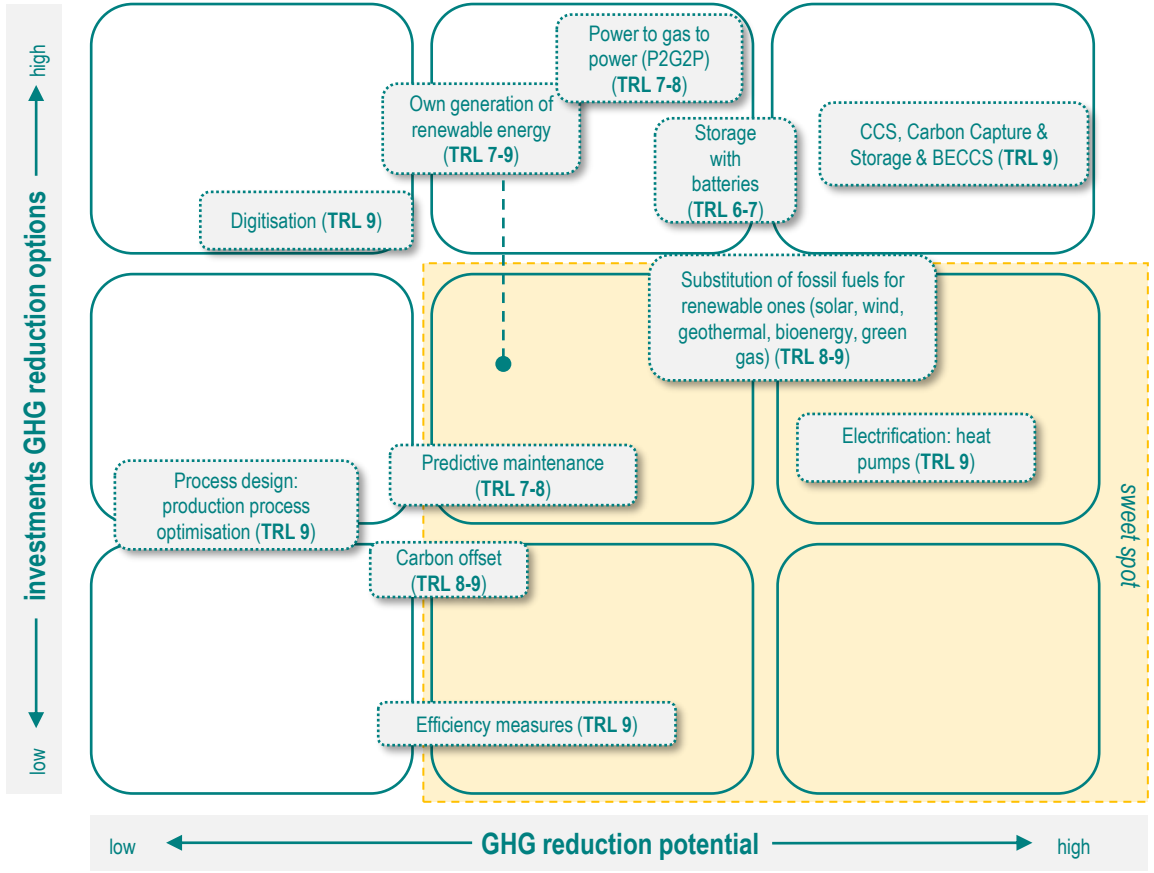
Emission pathway & projection:





The level of greenhouse gas emissions in 2010 are at almost the same level as the sector's emissions in 1990. During that period, emissions show an erratic pattern over the years, reaching record levels in 2004. From 2015, greenhouse gas emissions are steadily decreasing in the sector, falling by almost 30% until 2020. This is about 6% year-on-year. It contrasts sharply with the long-term average since 1990 of 0.1% per year. Until 2030, the sector needs to reduce at least 6.6% in emissions per year. Given the results in the past five years, this seems within reach, although there is still a long way to go. The trend towards more sustainable is only going to accelerate more, especially in this sector with many entities which are subject to ETS (emissions trading scheme).

GHG reduction options: investment & effectiveness



In the energy supply sector, the ultimate goal is to achieve an energy supply based entirely on renewable energy. Well-functioning and reliable energy grids with sufficient grid capacity are important prerequisites underpinning a successful energy transition. Due to both demand and supply factors, the grid has undergone strong development in recent years. The rapidly growing demand from data centres and the electrification of industry/transport make rapid grid reinforcement a priority. But the construction of private and public initiatives generating renewable energy on a larger scale (via solar, wind) are also putting great pressure on grid capacity. Research shows that significant and early decarbonisation of energy supply is a crucial factor towards a low-carbon economy. This means that the transition to decarbonisation requires substantial growth in investment in renewables (especially offshore wind and solar), but also in grids, for example.

Emission reduction target:

Minimum emission reduction through 2030:
23,315
(in mln kg CO_2 eq.)

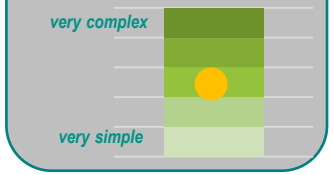
Minimum emission reduction through 2030 per year:
2,591
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-59%

Minimum % annually in emissions through 2030:
-6.6%

Average % annual change in emissions over last 20 years:
0.1%

Feasibility of emission target:

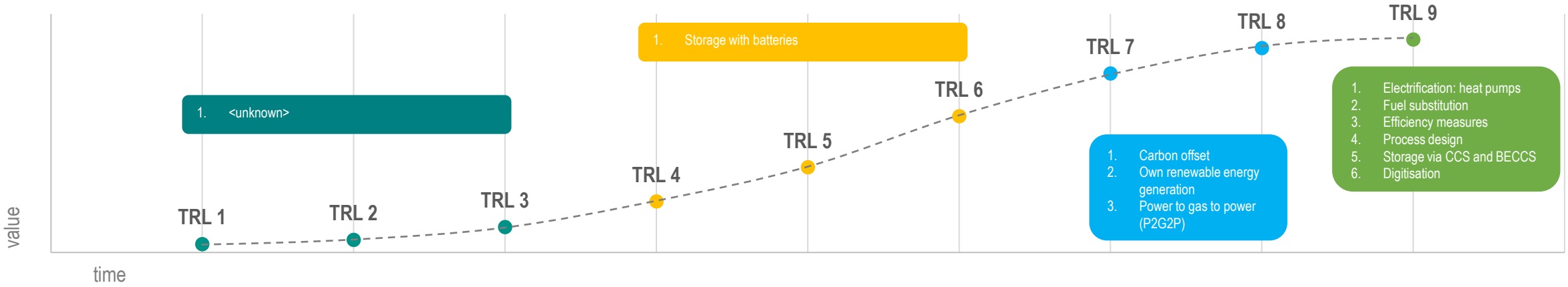


Source: NVDE, McKinsey, Netbeheer Nederland, CBS, CE Delft, PBL, ABN AMRO Group Economics

GHG emission reduction options explained: Energy supply

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

There are still relatively few new techniques in the concept phase - but also in the test and prototype phase - as far as we are aware. The best practices are now well established in the sector and very many new techniques are not a real necessity for this sector. Much can already be achieved with currently available techniques. Nevertheless, innovation is not standing still in this sector either. Especially in the field of electricity storage, further steps can be taken.

Techniques in test and prototype phase:

Innovation in battery storage is a relevant component to alleviate the issue of supply-demand imbalance. Indeed, technological advances in battery storage are fuelled by the need to integrate larger amounts of renewable energy, such as wind and solar power, into electricity grids. Affordable and flexible electricity storage technologies will help drive the transition to clean energy.

Techniques in pre-commercial phase:

Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.
Renewables are growing rapidly and have become cheaper over the years. Moreover, renewables are an essential component in the energy transition. However, solar and wind are unpredictable and security of supply is precisely a crucial factor in energy supply. To deal with the imbalance, gas and coal-fired power plants can step in. But also, for instance, encouraging end-users to adjust their consumption and battery storage can partly help here.
P2G2P technology (power-to-gas-to-power) uses excess electricity to produce hydrogen. This is stored in the gas network and can later be converted back into electricity. The "clean gas" created by P2G2P technology enables long-term storage. But it is also expensive and inefficient.

Techniques commercial deployment phase:

Heat pumps, both fully electric and in hybrid versions, can achieve a great deal of sustainability with the technology available today. Open and closed soil energy systems are heat pump systems that buffer heat and cold in the underground, thus reducing or avoiding the use of fossil energy.
Replacing fuels can be done in several ways. Besides solar, wind and geothermal energy, there is also bioenergy. Bioenergy is a sustainable heat alternative to natural gas, provides controllable electrical power. Green gas is the sustainable variant of natural gas and is made by upgrading biogas until it has the same quality as natural gas. Green gas is produced cleanly and is renewable. Green gas can be used for the same applications as natural gas.
For efficiency measures, the first things to consider are initiatives that reduce energy consumption and the carbon footprint. This involves more internal efficiency. But system efficiency can also pay off a lot, making the most efficient use of the energy grid. Carbon capture and storage with bioenergy (BECCS) is a technology where CO_2-neutral biomass is burned into fuel, with the resulting CO_2 emissions captured or stored.

Source: NVDE, McKinsey, Netbeheer Nederland, CBS, CE Delft, PBL, ABN AMRO Group Economics

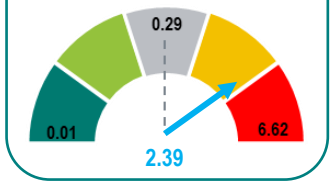
Emissions sector: Water companies & waste management

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in water extraction and distribution; waste and wastewater management and remediation. This section includes: water extraction and distribution and waste treatment and recycling.

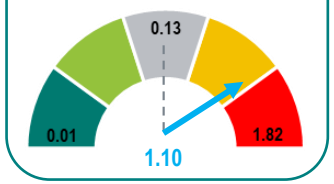
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

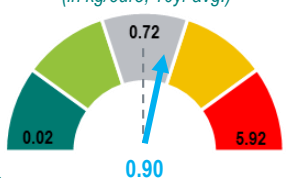
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

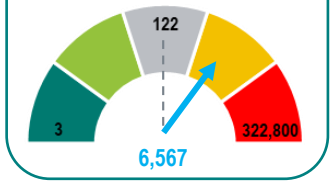


Emissions by tangible assets
(in kg/euro; 10yr avg.)

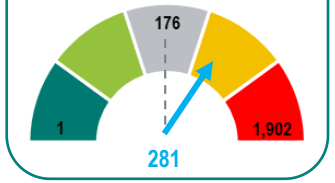


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)

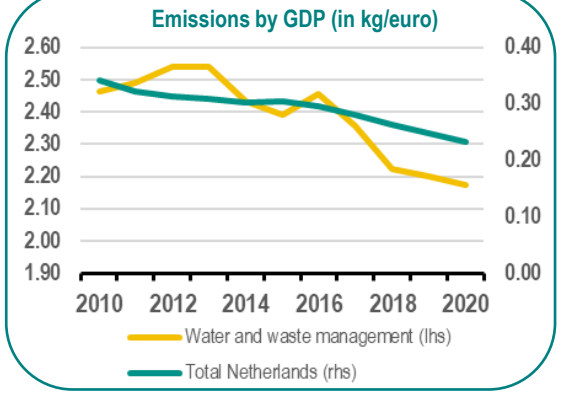


Emissions by job
(in ton/job; 10yr avg.)

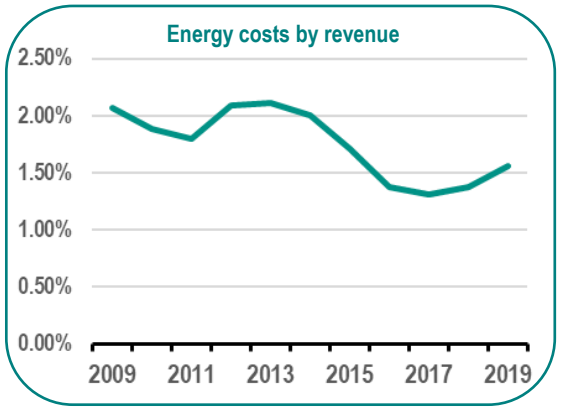


Trend in emission indicators:

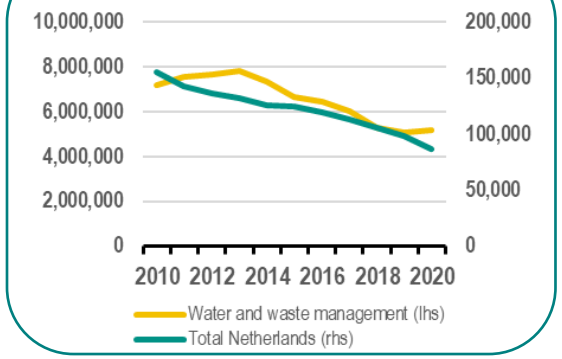
Emissions by GDP (in kg/euro)



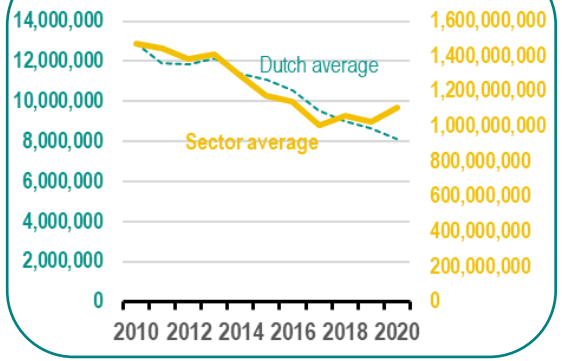
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Other indicators:

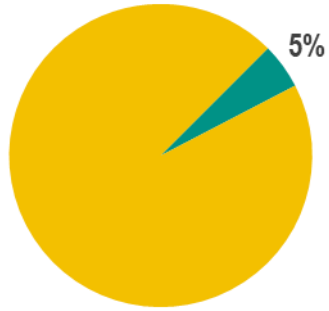
Energy costs vs. revenue:
(10yr average)
1.8%

Share in total water consumption:
13.3%

Energy costs vs. result:
(10yr average)
20.3%

Water usage by company per year:
(in litres)
1,229,233,575

Sector share in GHG emissions:



The water companies & waste management sector scores relatively high on almost all the above emission indicators. Waste incineration plants in particular have a high share, especially on the emissions to GDP and emissions to turnover scores. This is because the sector achieves relatively low added value and lower turnover figures compared to the high GHG emissions. For instance, the sector has a share of only 0.6% of total GDP. Nevertheless, the water and waste sector has a crucial and indispensable supporting function within the Dutch economy.

Emissions to GDP and emissions to company are significantly higher in the sector compared to the average for the Dutch economy. Emissions to GDP have decreased by 12% since 2010, which is mainly due to the fact that added value has increased more than greenhouse gas emissions over the past 10 years (+25% vs. +10%, respectively). However, the decrease in the indicator (of 12% since 2010) is much lower than the decrease in the indicator for the total Dutch economy (32% over the same period). This also applies to emissions by company. Energy costs by turnover fluctuate between 2.1% and 1.3% in the years between 2010 and 2020, bringing the ratio on average to 1.8% over 10 years. Despite having relatively high water consumption per company, companies in the sector have been able to reduce this consumption. The number of companies here has grown more strongly over the past 10 years (+55%) than water use has increased (+15%).

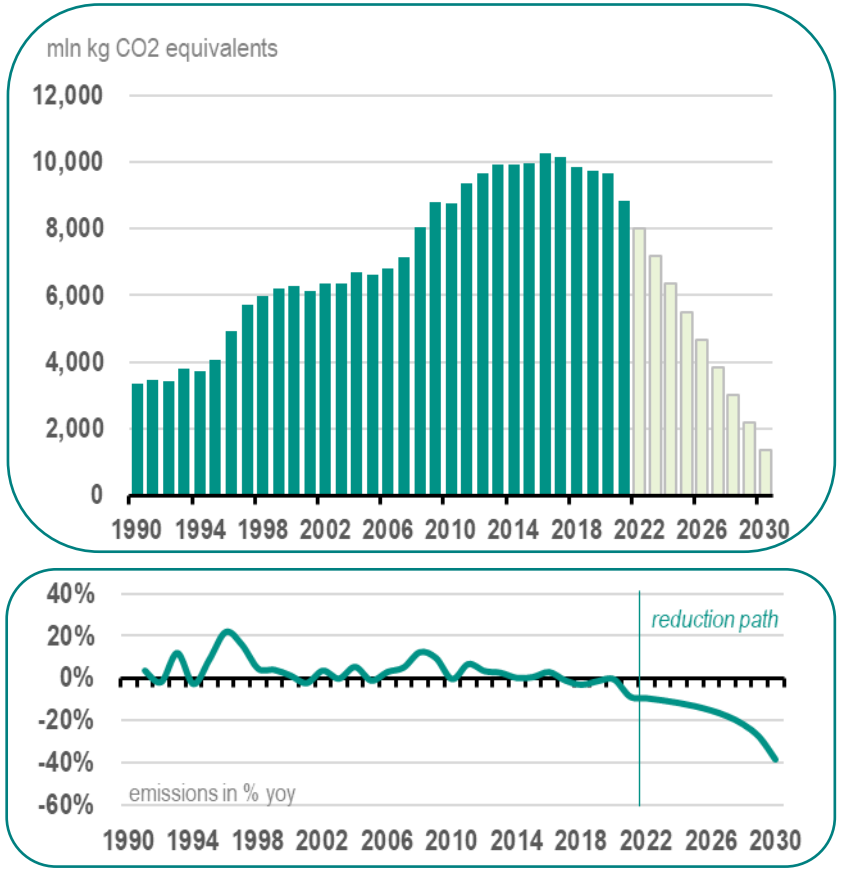
Water use by companies in this sector is high at 13.3% share of total water use. It is the third largest consumer of water. At 4.9%, the sector has a high share in total greenhouse gas emissions in the Netherlands. Drinking water companies aim to make energy consumption in the water chain more sustainable, as this is where most emissions are mainly related.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Water companies & waste management

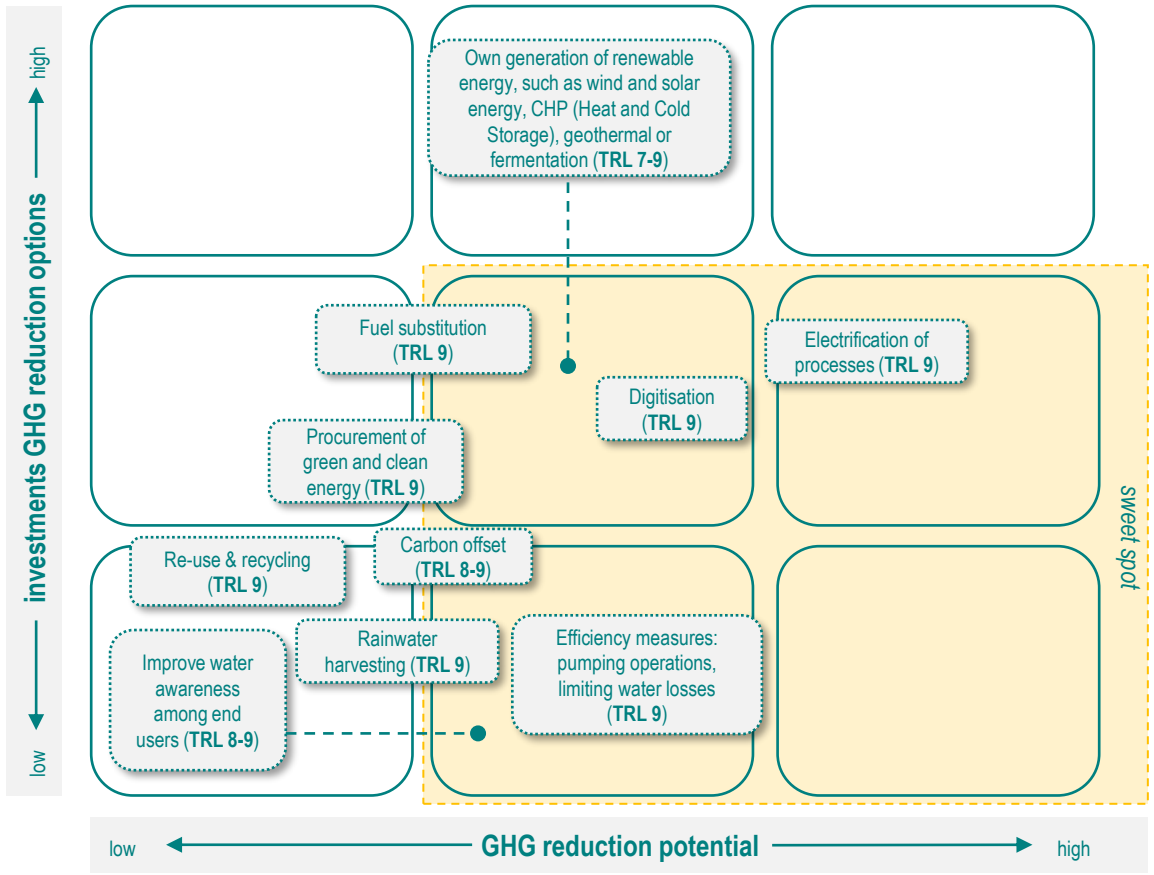
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Total greenhouse gas emissions in the sector have skyrocketed by 188% since 1990. The vast majority of these CO_2 emissions in the sector are emitted at waste incinerators. The waste mountain has increased by 63% from 1990 to 2018. However, greenhouse gas emissions increased more sharply over the same period, by 194%. After 2018, emissions are decreasing slightly. To eventually be at 60% of 1990 levels with greenhouse gas emissions in 2030, the sector still has a long way to go. The reduction rate from 2018 onwards is nowhere near enough. Indeed, to reach the 2030 target an annual reduction of almost 10% is needed and this will remain a major challenge.

GHG reduction options: investment & effectiveness



GHG emissions released from drinking water treatment depend on the type of treatment and the electromechanical equipment used to run the treatment plants. These include pumps, motors, blowers and mixers. In most cases, GHG emissions in the drinking water treatment stage are indirect emissions from the use of grid electricity to run all equipment. But there may also be direct GHG emissions from fuel consumption/combustion for motors driving the pumps or powering equipment with emergency generators. Most of the energy consumption is due to pumping and filtration systems. The deployment and production of biogas helps to reduce electricity consumption or replace fossil fuels. The more biogas is used as energy, the fewer greenhouse gas emissions from the (waste) water treatment phase.

Emission reduction target:

Minimum emission reduction through 2030:
8,331
(in mln kg CO_2 eq.)

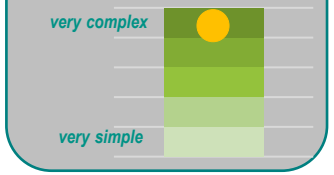
Minimum emission reduction through 2030 per year:
926
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-86%

Minimum % annually in emissions through 2030:
-9.6%

Average % annual change in emissions over last 20 years:
3.7%

Feasibility of emission target:

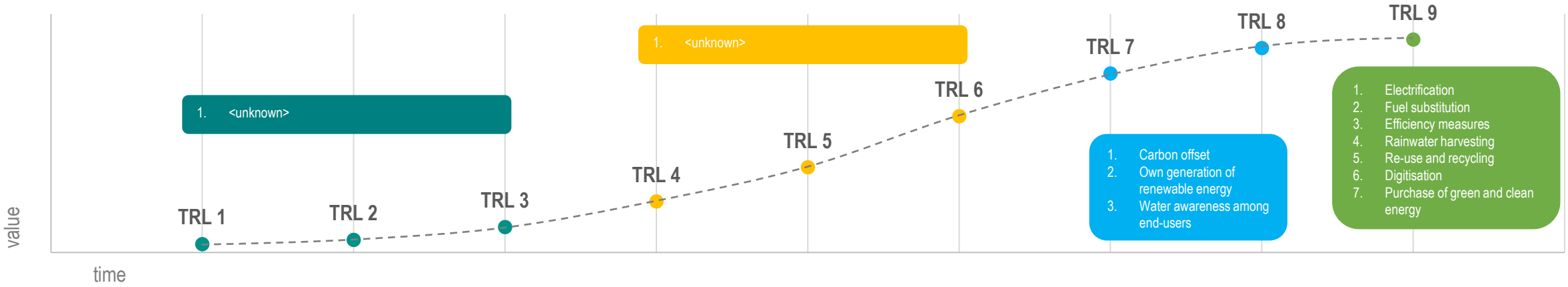


Source: VEWIN, Wacclim, CBS, ABN AMRO Group Economics

GHG emission reduction options explained: Water companies & waste management

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The water sector is currently estimated to contribute up to 5% of global greenhouse gas emissions. These are mainly carbon dioxide (CO_2) from energy consumption, as well as emissions of methane (CH4) and nitrous oxide (N2O) from wastewater treatment. Techniques to reduce emissions of these greenhouse gases are present, but also undoubtedly under development. There are still relatively few new techniques in the concept phase - as well as in the test and prototype phase - to our knowledge. Best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.
The water sector can also replace fossil fuel energy with - sustainable technologies on its own buildings or land or for that matter taking a share of green energy generated on third-party buildings or land. Reducing water consumption also reduces emissions. This starts with identifying 'legitimate' needs and service those needs with the lowest feasible ecological footprint per litre. This can only be achieved by raising awareness among end-users.

Techniques commercial deployment phase:

Drinking water companies can contribute to sustainability and a circular economy by using only sustainably generated energy and by recovering residues. Improving efficiency can be done in several ways. Besides optimising pumps and other equipment, installations and instrumentation can be upgraded, automatic controls applied and regular maintenance done to increase efficiency.
Rainwater harvesting at homes and businesses can help reduce wastewater flows, reserve capacity and reduce costs.
Digitalisation can support the processes. For example, consider 'smart' pumps, leak detection sensors and other digitally driven solutions that reduce the amount of energy used in treating and transporting water and waste. These reduction opportunities are low-hanging fruit and have already proven themselves.

Source: VEWIN, Wacclim, CBS, ABN AMRO Group Economics

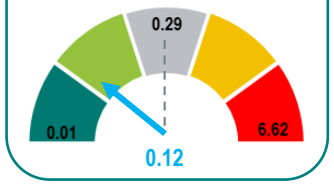
Emissions sector: Construction industry

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in the construction industry. This section includes: general and specialised building and civil engineering works, building installation and building finishing. It also includes new construction, repair, alteration and conversion work, erection of prefabricated buildings or structures on site and temporary structures.

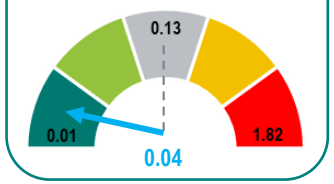
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

Emissions by GDP
(in kg/euro; 10yr avg.)



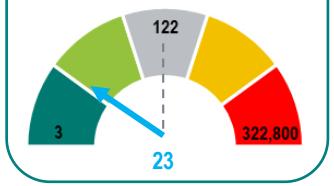
Emissions by revenue
(in kg/euro; 10yr avg.)



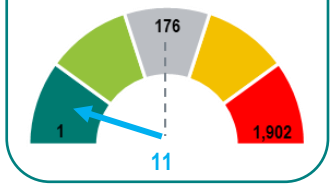
Emissions by tangible assets
(in kg/euro; 10yr avg.)

Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



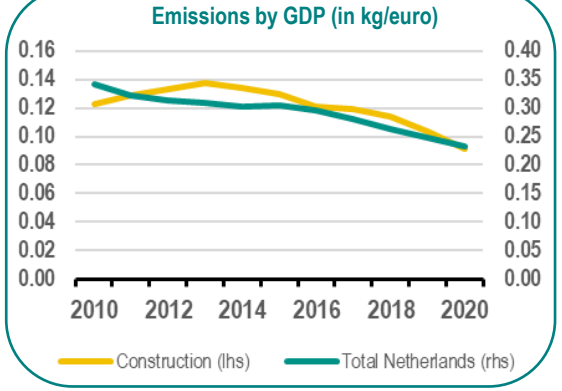
Emissions by job
(in ton/job; 10yr avg.)



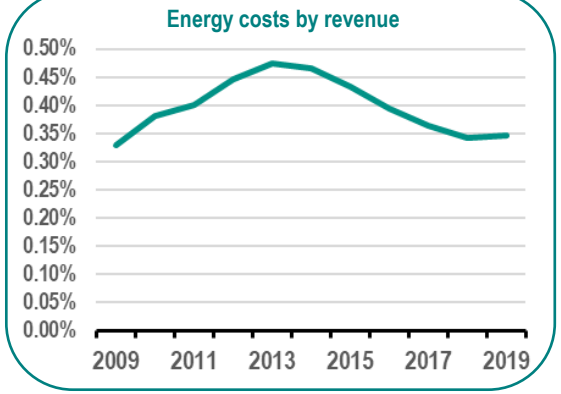
The emission intensity of construction is relatively low. The sector scores well below the national average on most emission indicators with the exception of 1) emissions to GDP ratio and 2) emissions to company ratio. The only two slightly elevated indicators concern emissions by GDP and by company. The main transition challenges for construction are 1) free emissions to zero-emission construction and 2) from waste to value. This is supported by various programmes and agreements (Circular Construction Economy Transition Agenda and Built Environment Climate Agreement).

Trend in emission indicators:

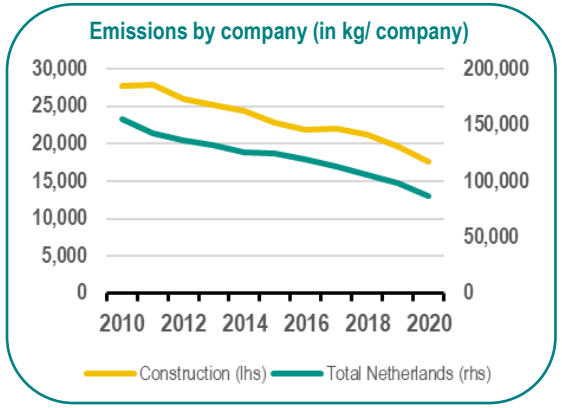
Emissions by GDP (in kg/euro)



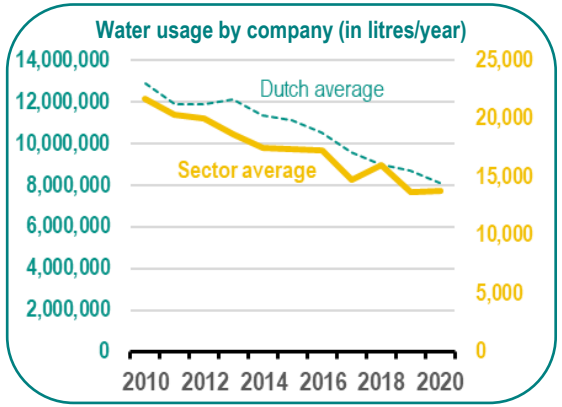
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The built environment consists of homes and buildings with a function other than residential (such as a factory, office, shop, hotels etc. and public spaces). The construction industry is an important link within the built environment. Emissions to GDP and also to business are relatively low compared to the national average. The trend in emissions reduction in the construction industry is broadly similar to the national average since 2010. Water use is relatively low and has also decreased by over 36% since 2010. Energy costs by turnover have fluctuated in a narrow range between 0.35% and 0.50% since 2010. This is marginal and thus the rise during 2013 did not significantly affect business activity and results either.

Other indicators:

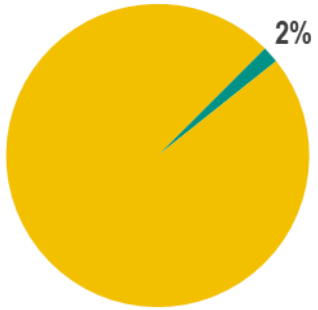
Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
4.8%

Water usage by company per year:
(in litres)
17,375

Sector share in GHG emissions:



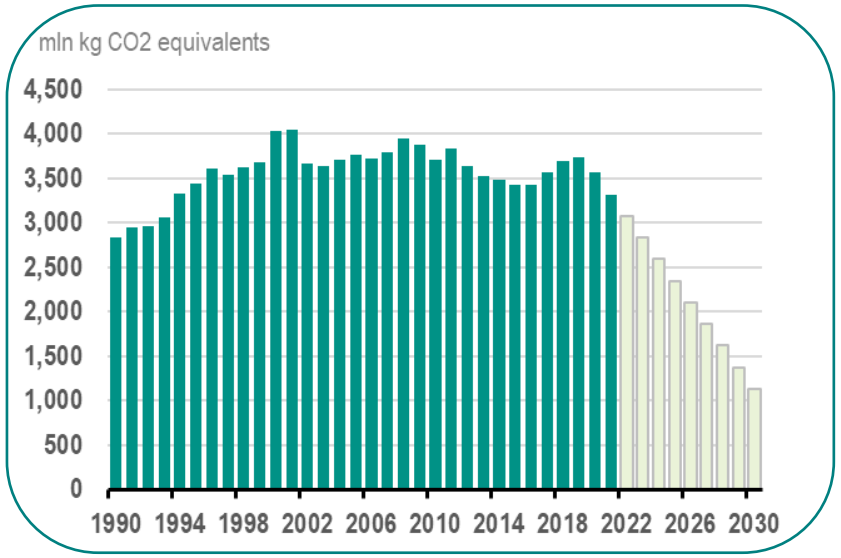
Energy costs by turnover are low. Water use is also negligible in construction relative to other sectors. Despite its low emission intensity, the sector has a relatively high share of total greenhouse gas emissions at 1.8%. It thus occupies the 14th position among all sectors (out of 34 in total).

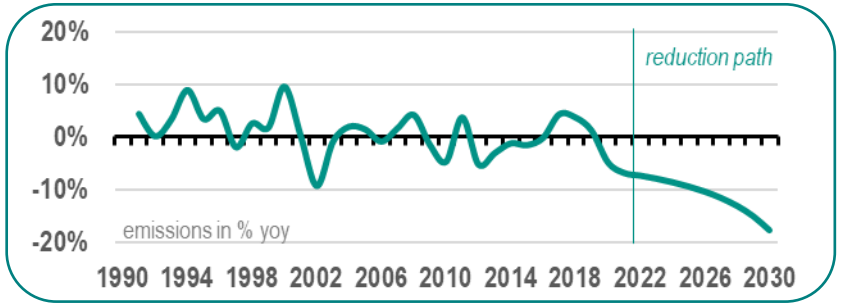
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Construction industry

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

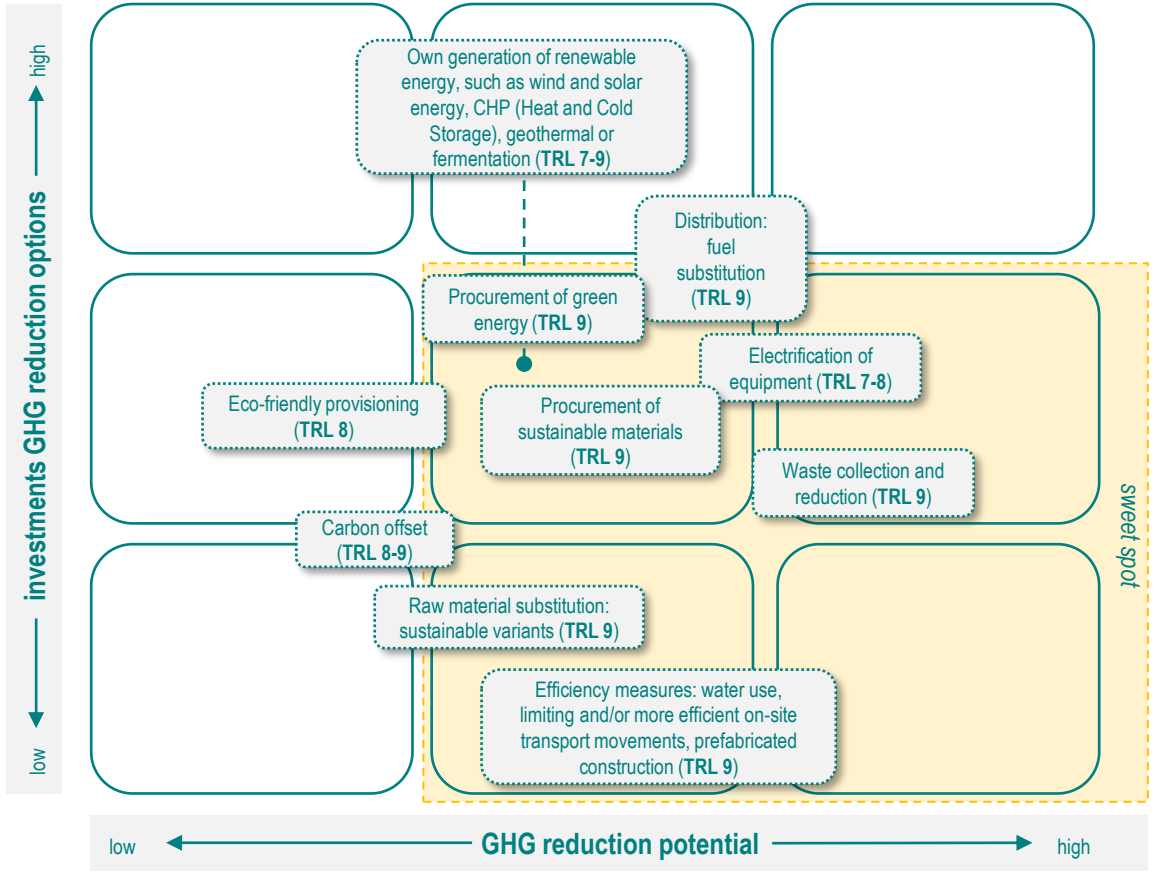
Emission pathway & projection:





The construction sector faces a number of challenges to de-carbonise despite relatively low emissions. To start with, GHG emissions have increased by as much as 26% since 1990, or almost 1% per year on average. It is a disappointing finding and indicates that the sector still has quite a challenge ahead towards the 2030 target. In fact, the construction sector needs to reduce some 270 million kg of CO_2 annually or by 7.6% each year as a minimum to reach the 2030 target. A chain approach can help the transition on its way. Owners and users, producers of building materials, installers, energy companies, construction companies and the government need to work together more intensively.

GHG reduction options: investment & effectiveness



New buildings can be steered towards climate-neutral relatively easily with government policies and building codes. With existing buildings, however, this process will be much slower, which is mainly related to the affordability of sustainability measures. To speed up the reduction of emissions towards the climate-neutral target, the sector has five different options: electrification (through e.g. electric or hybrid heat pumps, heat pump boilers, electric boilers, air conditioning, electric cooking), energy efficiency (through e.g. digitalisation, smart lighting, appliances and control systems), behavioural changes (through e.g. education and awareness, changing consumption patterns and adjusting habitual behaviour), renewable energy (through e.g. bioenergy, solar panels, utilising waste heat) and building insulation (through e.g. roof, wall, floor insulation and double glazing). Ultimately, the sector aims for a 100% circular construction economy.

Emission reduction target:

Minimum emission reduction through 2030:
2.430
(in mln kg CO_2 eq.)

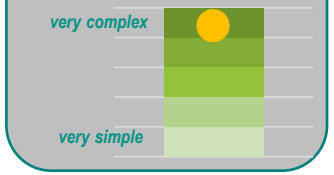
Minimum emission reduction through 2030 per year:
270
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-68%

Minimum % annually in emissions through 2030:
-7.6%

Average % annual change in emissions over last 20 years:
0.8%

Feasibility of emission target:

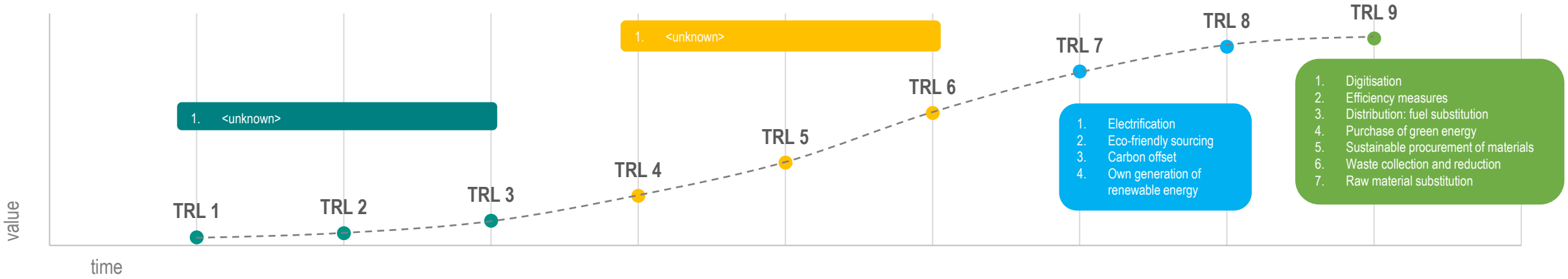


Source: Bouwend Nederland, CBS, CE Delft, PBL, ABN AMRO Group Economics

GHG emission reduction options explained: Construction industry

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

All construction and infrastructure companies have to deal with sustainability, especially from a legislative and regulatory perspective. But clients and financiers also increasingly have sustainability requirements on their agendas. This ensures that innovation to reduce emissions from the sector will also remain important in the coming years. However, there are still relatively few new techniques in the concept phase - but also in the test and prototype phase - as far as we are aware. Best practices are now well established in the sector. Nevertheless, innovation is not standing still here either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Electrification of construction vehicles, equipment and other machinery help reduce CO_2 emissions. Deploying electric construction equipment (such as cranes and rolling stock) as part of a low-emission construction site can help prevent many greenhouse gas emissions, even if this is taken into account during construction planning.
Construction logistics solutions of physical goods and passenger transport for construction projects help reduce the carbon footprint. This can be done, for example, by setting up an optimal distribution network (coordinating on the basis of origins and destinations) or innovatively designing the construction process so that fewer logistics flows are needed on balance.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Digitisation of the construction process lowers the carbon footprint. Technology makes the process more efficient and therefore more sustainable. Besides the decreasing carbon intensity of electricity, energy efficiency is a key benefit of electrification that reduces carbon emissions. In the case of space heating, heat pumps are three times more efficient than conventional variants because their input energy is spent on moving heat rather than creating it.
Sustainable procurement of materials can consider materials that contain 'low-embodied' energy. But it can also involve buying local products and materials.
Smart building logistics can lead to increased efficiency. For instance, many polluting truck and van journeys can be saved. In the construction process and when purchasing sustainable materials, for instance, prefabricated building components can sometimes be used under conditioned conditions. The use of diesel generators can also be avoided by using alternative green electricity, which may or may not be self-generated.

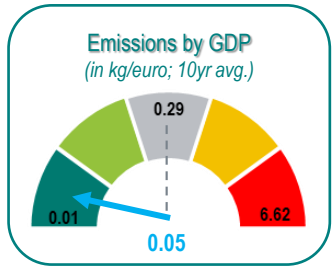
Source: Bouwend Nederland, CBS, CE Delft, PBL, ABN AMRO Group Economics

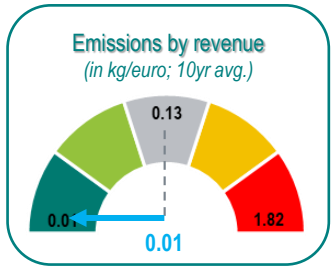
Emissions sector: Trade (retail & wholesale)

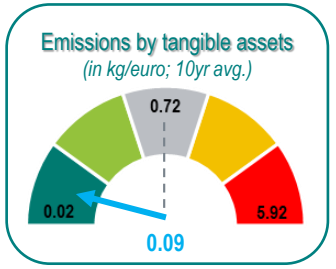
Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in wholesale and retail trade; automotive repair. This section includes: wholesale and retail trade (sale without alteration) in all types of goods and services provided in the sale of goods, brokering/brokering, repair of cars and motorbikes.

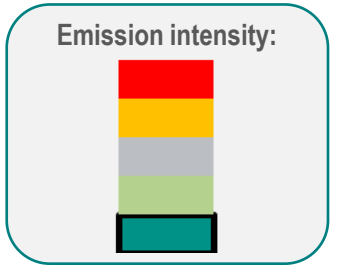
Emission indicators & intensity:

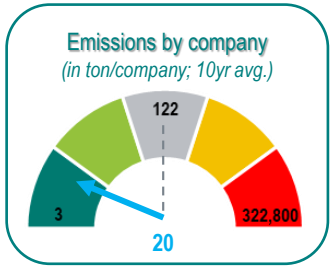
(grey dotted line = average NL score; blue arrow = sector score)

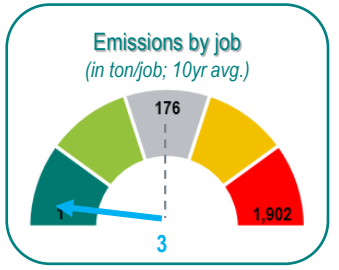




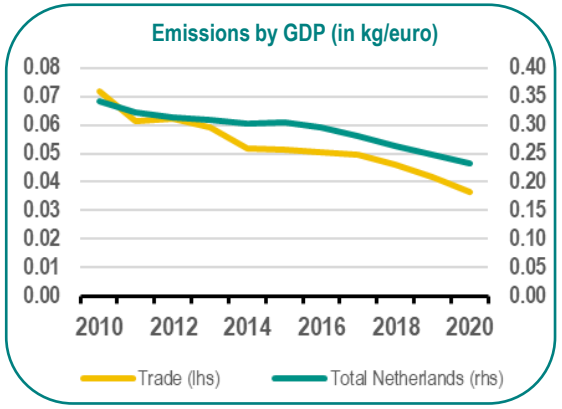


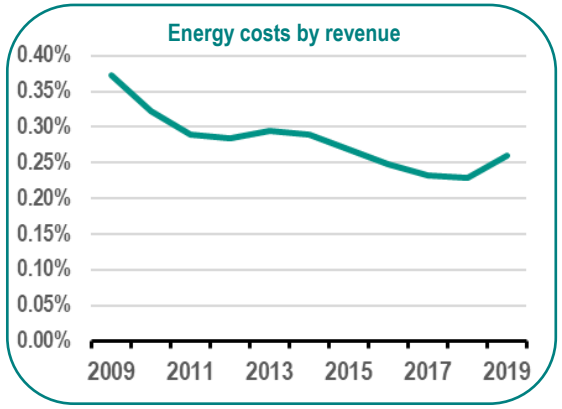


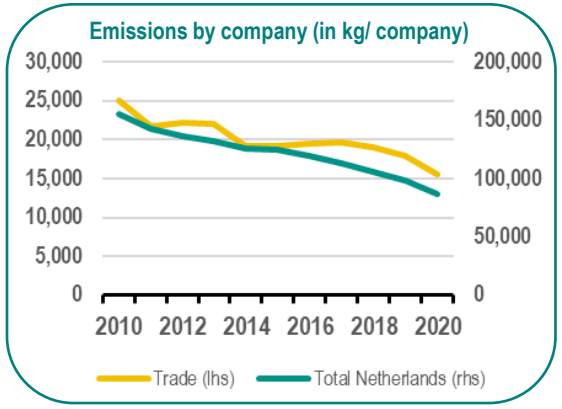


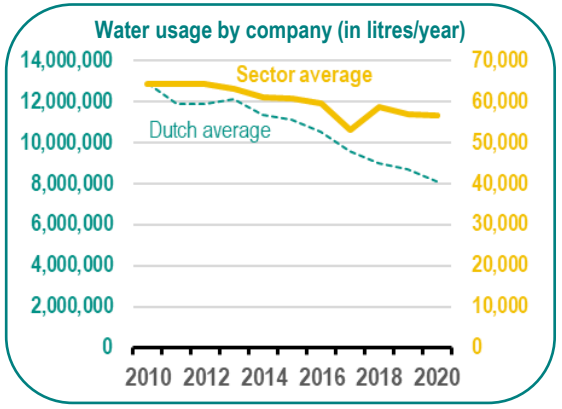


Trend in emission indicators:









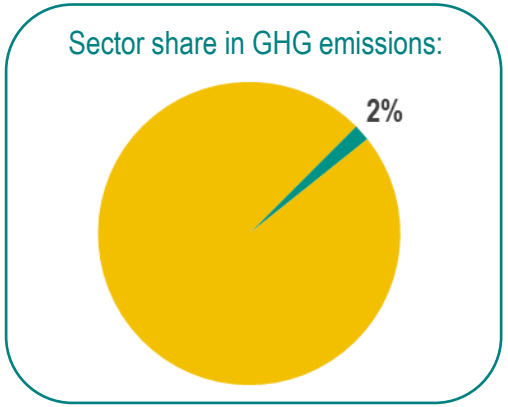
Other indicators:

Energy costs vs. revenue:
(10yr average)
0.3%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
6.5%

Water usage by company per year:
(in litres)
60,313



Compared to other sectors, the trade sector (both retail and wholesale) scores lower on almost all emission indicators. This sector has a relatively high added value, while its emissions are relatively low. In addition, this sector - compared to other sectors - has a relatively high number of companies and individuals. This also ensures relatively low scores on these emission indicators. Moreover, the turnover generated in this sector annually is much higher than in any other sector.

Water use per company and energy costs by turnover are relatively low. Water use has been fairly constant since 2010 and has been 55,000 and 65,000 litres per company per year since then. Nevertheless, water use has decreased by about 12% over the past 10 years. This is mainly because the number of companies increased by almost 30% from 2010-2020, while total water use remained almost stable over the same period. Here, awareness has apparently increased and efficiency gains have been made in water use. Energy costs by turnover have marginally and only slightly decreased over the period 2010-2020: from 0.37% to around 0.26%, a decrease of 0.11%-point over 10 years. Emissions to GDP and to business are significantly lower than the national average. This is due to the high value added and high number of companies in the sector, against a lower level of emissions. The trend in emission indicators broadly follows the national trend.

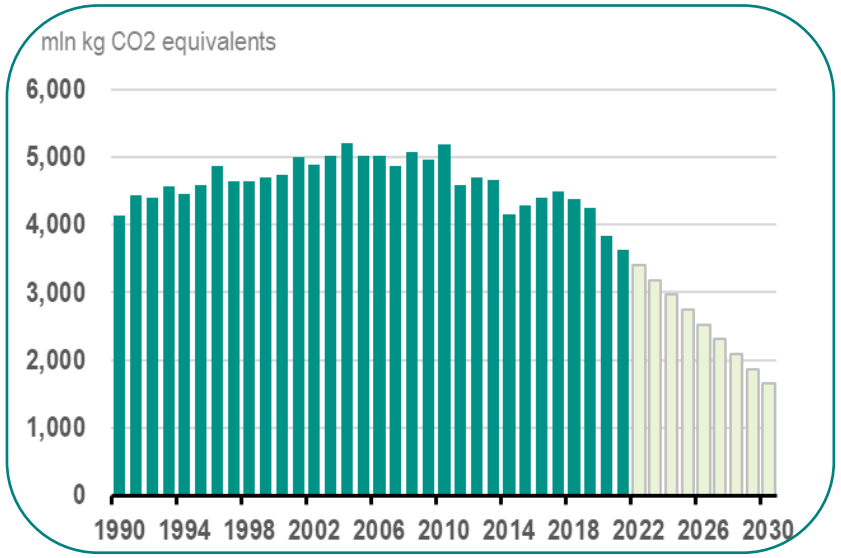
The sector consumes little energy annually. Typically, the sector uses small-scale and low-intensity electrical equipment and installations (both lighting, computers, networks, air conditioners) and energy-intensive machinery or processes are less common in this sector. Nevertheless, at 1.9%, the sector has a high share of total GHG emissions, falling within the top 12 (out of 34 sectors).

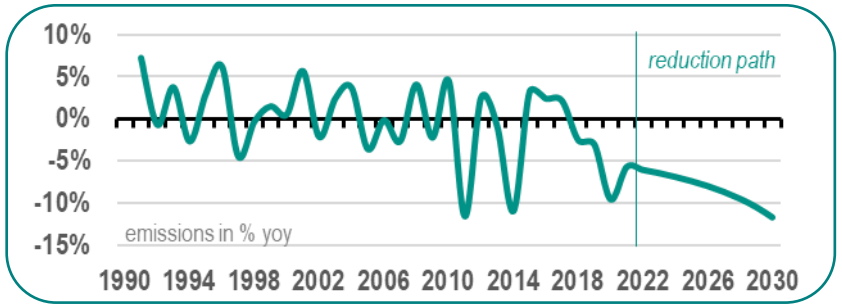
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Trade (retail & wholesale)

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

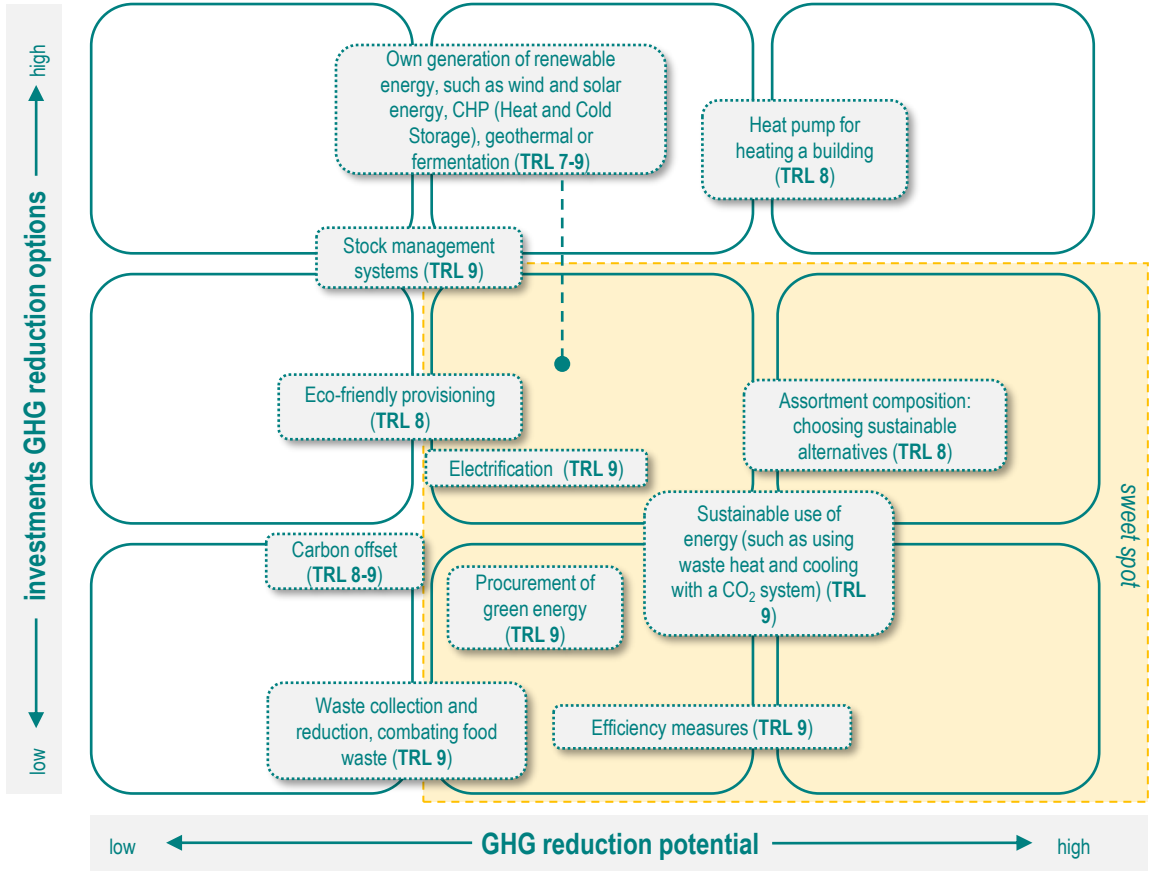
Emission pathway & projection:





Greenhouse gas emissions in the sector increased on balance from 1990 to 2010, reaching two peaks: in 2004 and 2010. After 2010, the sector shows a more positive trend in emissions and emissions decline more sharply. Between 2010 and 2020, GHG emissions fall by about 26%. The sector needs to reduce about 243 million kg of CO_2 annually until 2030, or about 6.3% per year. This will be quite a challenge from a historical perspective, as over the past 20 years the average reduction in CO_2 is only 0.1% per year. However, if the sector maintains the post-2012 reduction rate, the 2030 target could just be within reach.

GHG reduction options: investment & effectiveness



The trade sector (retail and wholesale together) consists of a multitude of businesses, which collectively contribute only marginally to total annual greenhouse gas emissions. In terms of energy and water use, it is particularly important to be energy-conscious and alert to energy use in lighting, heating the shop and/or storage area and cooling products. Although the transition is slow, consumers are increasingly demanding low-carbon and environmentally friendly products. NGOs and the government are also demanding a reduction in GHG emissions. Investing in a low-carbon value chain and sustainable processes now is going to bring competitive advantage in the longer term. It requires more intensive cooperation with chain partners to move the low-carbon approach from a marginal issue to a central issue. The sector can make a valuable contribution to encouraging consumers to live more sustainably.

Emission reduction target:

Minimum emission reduction through 2030:
2,187
(in mln kg CO_2 eq.)

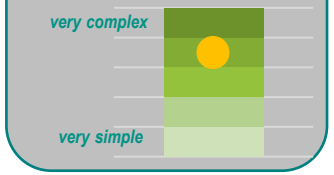
Minimum emission reduction through 2030 per year:
243
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-57%

Minimum % annually in emissions through 2030:
-6.3%

Average % annual change in emissions over last 20 years:
-0.1%

Feasibility of emission target:

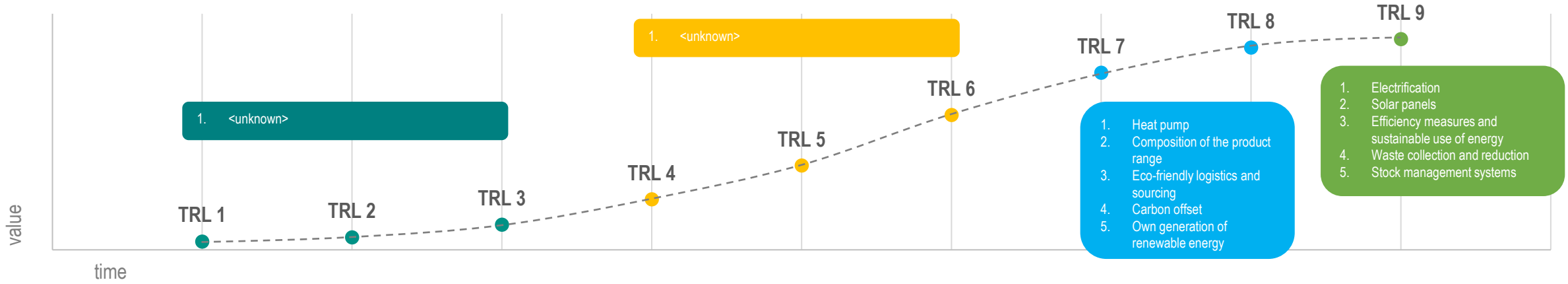


Source: SSK keurmerk, CBS, ABN AMRO Group Economics

GHG emission reduction options explained: Trade (retail & wholesale)

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

At the concept and validation stage, the sector has few if any new decarbonisation options ready for further development. But that does not detract from the fact that innovation towards emission reduction technologies will continue in the coming years. However, at the time of writing this analysis, innovations in this area were still scarce or not identified.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Much of the innovation is currently focused on in the technical further development of existing heat pumps. For example, work is under way on quieter heat pumps and higher efficiency. There are also heat pump innovations that mainly focus on using new materials with a low Global Warming Potential (GWP). However, it will take several years for these new technologies to become available and widely deployable. These innovations currently have a TRL 3-5.
On balance, a different composition of the product range can also contribute to a lower carbon footprint. Consider, for instance, offering mainly products that comply with the Global Recycling Standard or products that incorporate environmentally friendly raw materials. Or putting the product together in such a way that it extends the lifespan of the products by offering repair solutions. It is important that consumers also eventually realise the importance of a low-carbon and more sustainable way of life. Environmentally friendly logistics could include, for example, encouraging sustainable delivery options (local pick-up point), route optimisation, use of electric transport and bicycles.

Techniques commercial deployment phase:

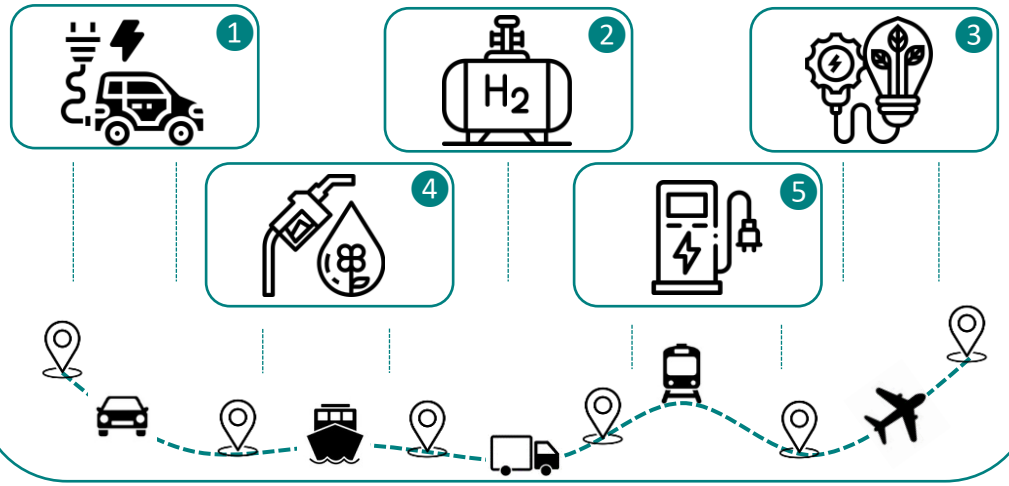
Efficiency measures and the sustainable use of energy include a wide range of possibilities. Examples include avoiding open refrigeration and freezer cabinets, re-using packaging, closed front doors in hot weather (air conditioning optimisation), combating food waste (cooperation with food banks, catering industry), more seasonal organic local produce, less meat products, LED lighting and censoring.
Electrification - for example, by having charging points available for electric cars and electric cars for home delivery and sourcing green energy reduces the carbon footprint. Combined with purchasing green energy, this has an even greater impact on final GHG emissions.
In this context, the aim of an inventory management system is to reduce waste production and, on balance, achieve more efficient processes and distribution. And the moment the network/route is shared, it brings more optimisation of the logistics system. Wholesalers are well positioned to optimally coordinate return flows so that chains are ordered and minimal waste occurs ('closed loop supply chains'). The NVG makes it clear that wholesalers are an important link in the circular economy.

Source: NVG, CBS, PBL, ABN AMRO Group Economics

GHG emissions: Mobility

Mobility does not refer only to the Transport & Storage sector, although this sector ultimately has a large share in total mobility. Transport is broadly about moving goods or people. Mobility, however, is broader. It refers to the ability to move or be moved freely. Transport thus describes the act of moving something or someone, while mobility describes the ability of a person to move or be moved. As such, mobility - like the built environment - relates to several sectors.

Mainstream decarbonisation options



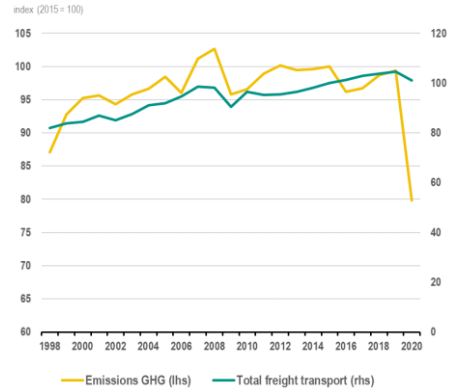
1. Electrification
2. Hydrogen
3. Change user behaviour

(energy awareness)

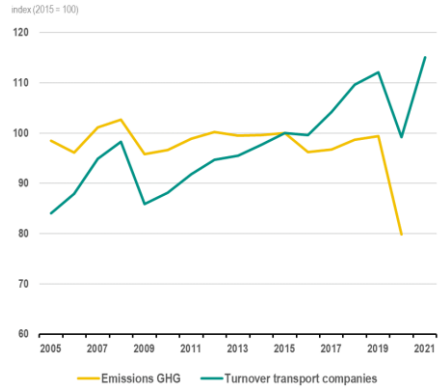
4. Bio-energy & -fuels
5. Charging infrastructure investments

Emissions transport & storage vs turnover and transport flows:

GHG emissions vs transport flows to and from NL



GHG emissions vs turnover transport companies

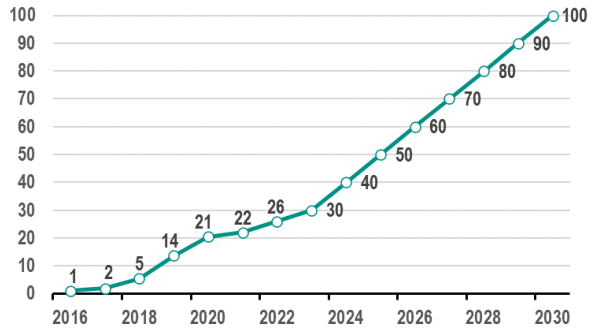


In 2020, the mobility sector was responsible for 30.7 megatons of greenhouse gas emissions, including 30 megatons of CO_2 emissions. Road transport is the biggest emitter. Passenger cars account for about half of total mobility emissions.

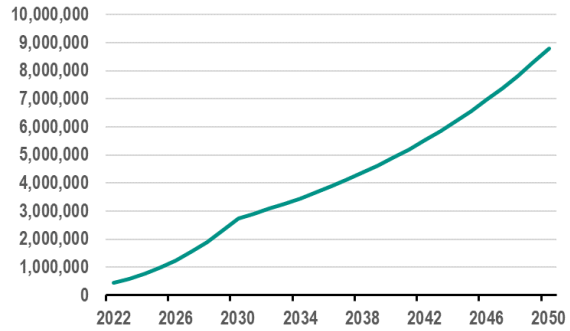
By 2050, mobility sectors should emit zero greenhouse gases. The government's vision for the mobility sector for 2050 is 'carefree mobility, for everything and everyone, where there are no more CO_2 emissions'. Electrification is an obvious emission reduction option in the mobility sector, but it is not nearly enough to achieve the set targets for the sector. Much more is needed for that. From 2030, all new passenger cars must be zero-emission vehicles. Between 2030 and 2050, the stock of passenger cars emitting greenhouse gases will decrease due to obsolescence and depreciation. So by 2050, all passenger cars on the road should be emission-free cars. Similarly, the entire fleet of buses, vans, trucks, shipping and construction traffic should emit zero greenhouse gases by 2050. Charging infrastructure (battery or fuel cell) on roads and at ports is crucial. Therefore, investing in charging and refuelling infrastructure should be a policy priority. The introduction of inner-city zero-emission zones from 2025 is going to force many transport companies to transport goods without emissions. The ultimate aim of this is that from 2030 vehicles with emissions will no longer be welcome in inner cities. Meanwhile, 25 municipalities have committed to the zero-emission initiative and more will follow.

For shipping, fuel is the biggest cost and using more synthetic paraffin should reduce emissions in shipping. To reduce emissions in aviation, several measures are being taken. Such as replacing paraffin by adding bio-kerosene to the mix and encouraging the production of synthetic paraffin. In addition, short-haul air travel can be discouraged by higher taxes. And alternative modes of travel (such as trains) can also be made more attractive. For more insight into decarbonisation in shipping see: 'ESG Economist - Decarbonizing international shipping'

Share of EVs in total new car sales through 2030 (%)



Projected growth of EVs in the Netherlands through 2050



By the end of 2021, the fleet had 8.7 million passenger cars and some 420,000 new passenger cars sold annually (2016-2019), but that number dropped significantly in 2020 and 2021 due to chip problems. The fleet of battery-electric cars consists of 244,000 passenger cars and 488 fuel cell-electric cars. By 2030, the number of emission-free new passenger cars will equal the now total new passenger car sales of around 440,000. To get there, the share of battery-electric passenger cars must rise sharply in just nine years, from 20% in 2021 to 100% in 2030. However, this requires simultaneous and substantial investments in the charging infrastructure and grid capacity, as these are still lacking.

Source: CBS, RVO, ABN AMRO Group Economics

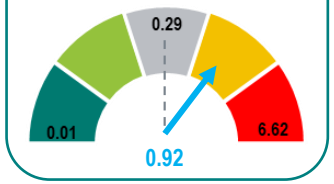
Emissions sector: Transport & storage (total)

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in transport and storage. This section includes: the transport of people or goods, whether scheduled or non-scheduled, by rail, pipeline, road, water or air; - supporting activities such as terminal and parking facilities, cargo handling, storage, etc.; postal services; rental of means of transport with driver or operating personnel.

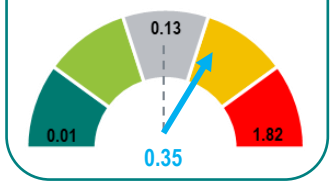
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

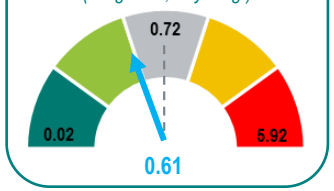
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

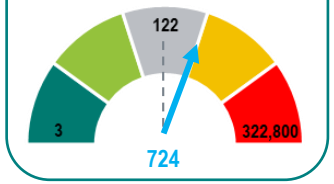


Emissions by tangible assets
(in kg/euro; 10yr avg.)

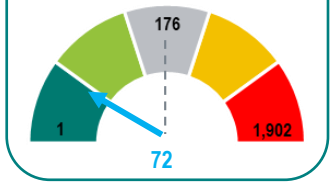


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



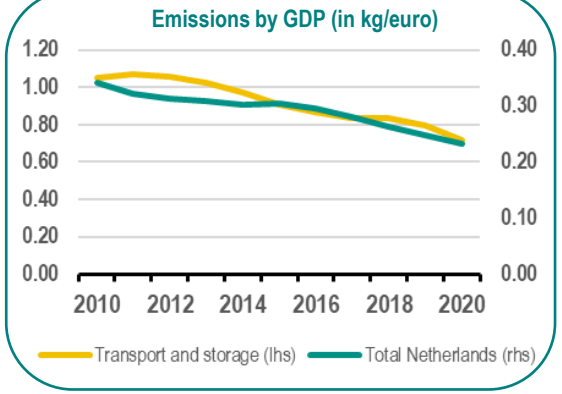
Emissions by job
(in ton/job; 10yr avg.)



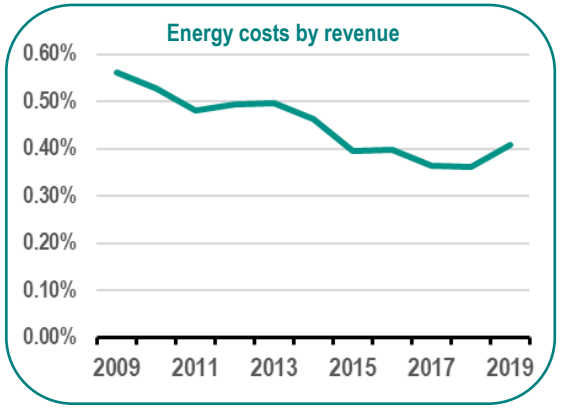
On three emission indicators, the Transport & Storage sector scores above average, such as on emissions by GDP, turnover and company. On the other indicators (by job and by tangible assets), the sector shows a lower score than the national average. On emission indicators by GDP and turnover, the sector is in the top 5. GHG emissions have decreased by 16% over the past 10 years, while value added and turnover have increased. Two subsectors show relatively high scores here: air and water transport.

Trend in emission indicators:

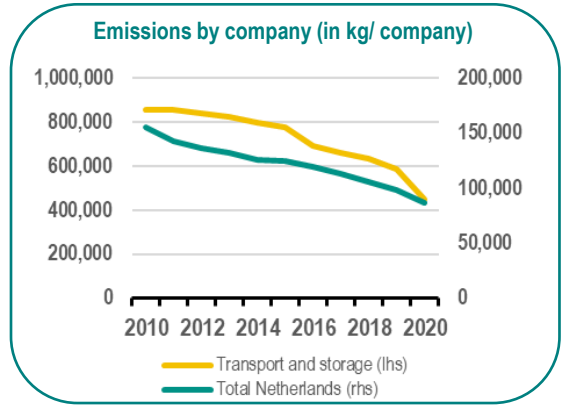
Emissions by GDP (in kg/euro)



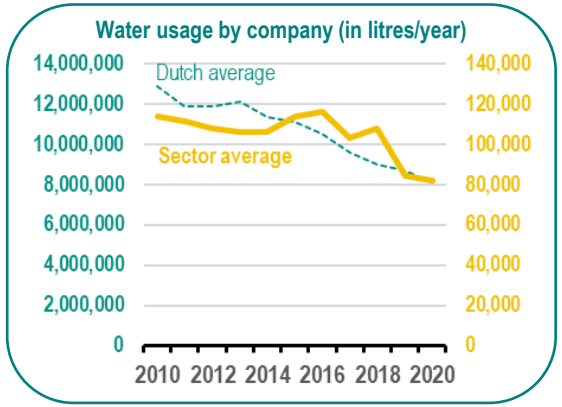
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Although emissions by GDP and by company are higher than the national average, the trends both indicators mirror the trend at the national level. The emission to GDP ratio and the emissions to company ratio has declined by around 32% since 2010. However, these figures include the disruption in activity from Covid-19, resulting in sharply lower GHG emissions in 2020 and 2021. This distortion applies more to passenger transport than freight transport. Energy costs by turnover are marginal and have fallen slightly since 2010: from 0.6% to 0.4%. Total water use compared to other sectors has fallen slightly since 2010. The number of companies in the sector has increased much more than total water use over 10 years (70% versus 14%), improving water efficiency.

Other indicators:

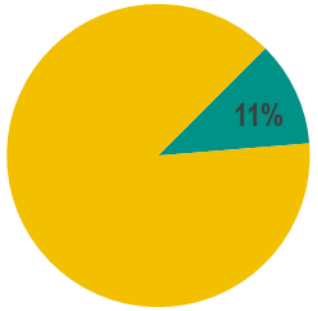
Energy costs vs. revenue:
(10yr average)
0.5%

Share in total water consumption:
0.9%

Energy costs vs. result:
(10yr average)
6.5%

Water usage by company per year:
(in litres)
104,912

Sector share in GHG emissions:



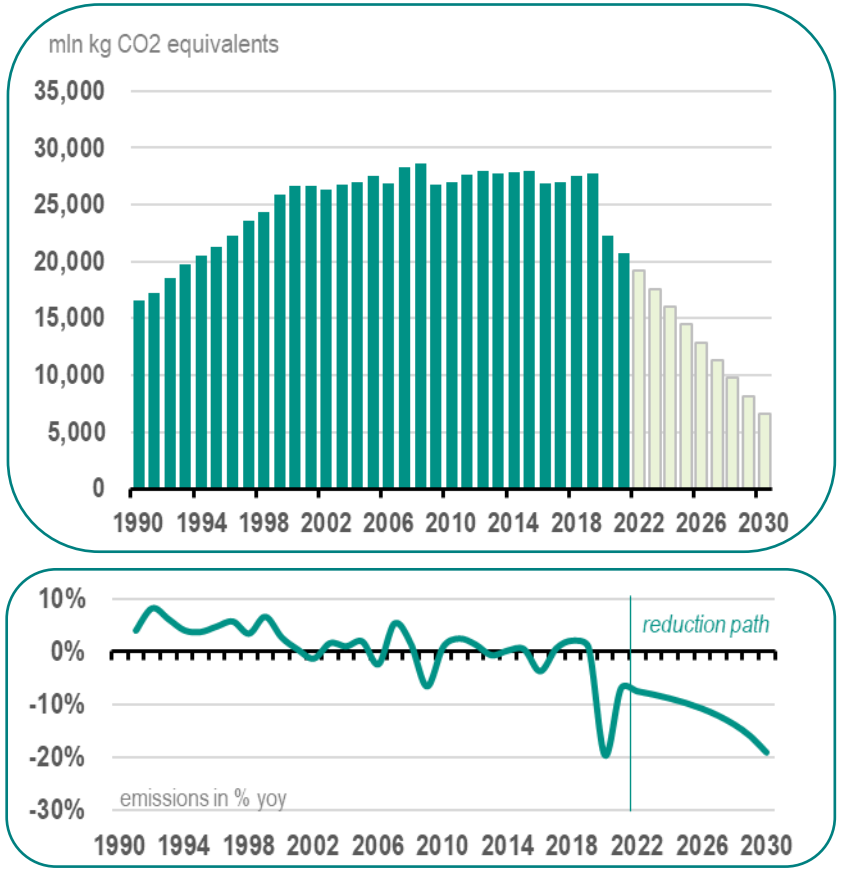
In terms of water use, the transport and storage sector plays only a marginal role, accounting for 0.9% of total water use. Energy costs by turnover are also relatively low compared to other sectors, however, the sector's share in total greenhouse gas emissions is significant at over 11%. This share has remained almost stable.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Transport & storage (total)

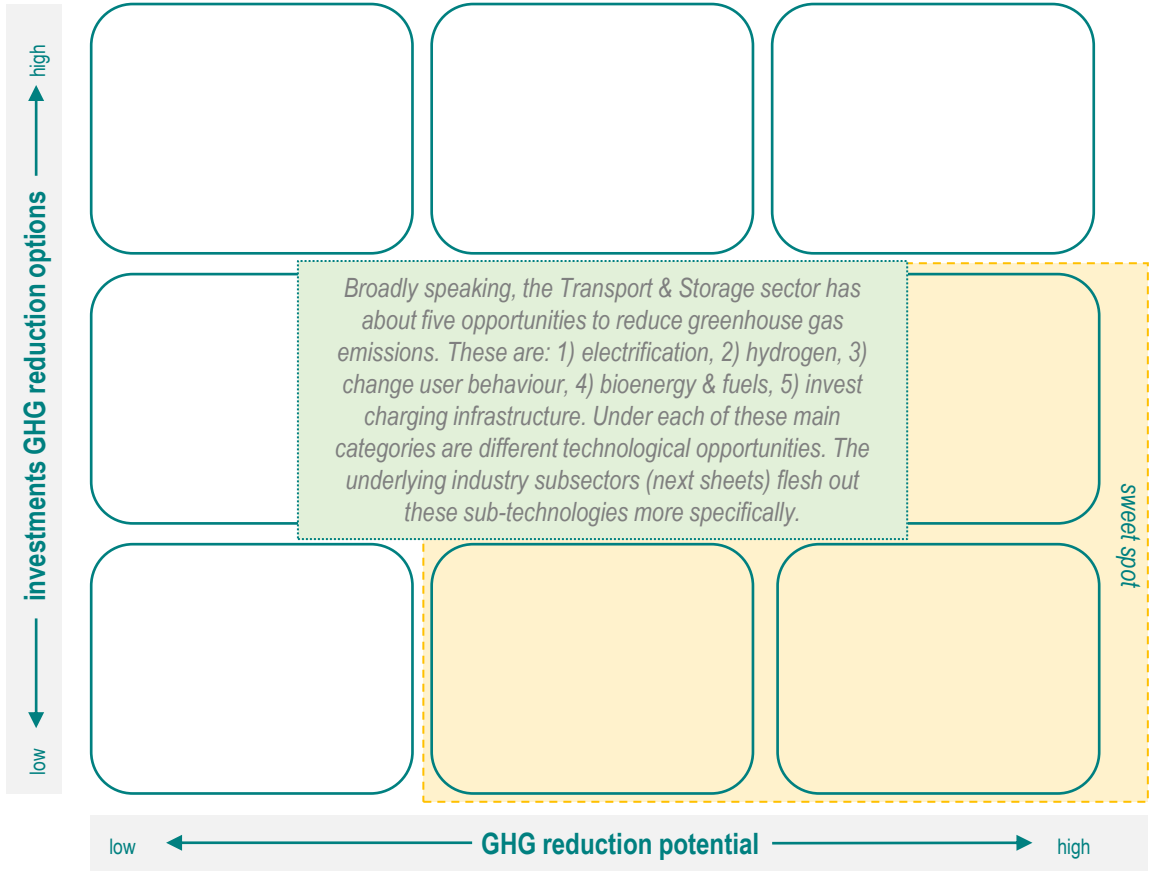
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



The sector's sustainability ambitions are high. They have to be because greenhouse gas emissions have increased sharply since 1990, by as much as 35%. While the past 10 years have seen a reduction in these emissions, this is mainly because of the disruption caused by Covid-19 lockdowns. On balance, the sector still has a long way to go to reach the 2030 target, as emissions in 2021 increased slightly again on a year-on-year basis. This is not yet visible in the figure above. The sector needs to achieve an annual reduction in emissions of 7.8%.

GHG reduction options: investment & effectiveness



The incentives to reduce emissions in transport sectors are there. Indeed, energy and fuel consumption in many of the subsectors is relatively high and then companies automatically already have a motivation to keep costs low or reduce them further. However, supportive and incentive policies from the government are an indispensable tool for investing in low-carbon technologies and meeting emission reduction targets in the transport sector, especially when it comes to charging infrastructure and also network capacity. It is also important to ensure a level playing field for transport companies that operate internationally so as not to compromise on competitiveness. In order to further reduce greenhouse gas emissions, switching from fossil fuels (diesel, petrol) to sustainable fuels is an important element where substantial steps can be taken. Electrification of transport also offers good opportunities, but at the same time is not always easy to implement.

Emission reduction target:

Minimum emission reduction through 2030:
15,681
(in mln kg CO_2 eq.)

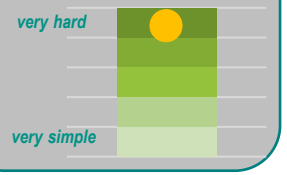
Minimum emission reduction through 2030 per year:
1,742
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-70%

Minimum % annually in emissions through 2030:
-7.8%

Average % annual change in emissions over last 20 years:
1.1%

Feasibility of emission target:



Source: CBS, CE Delft, PBL, ABN AMRO Group Economics

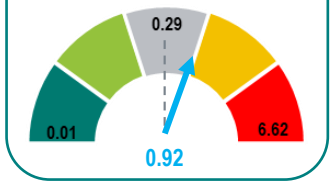
Emissions sector: Transport by land

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in land transport. This section includes: passenger and freight transport by road and rail.

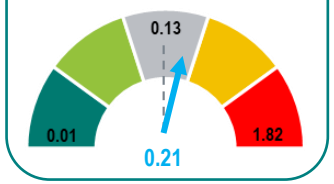
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

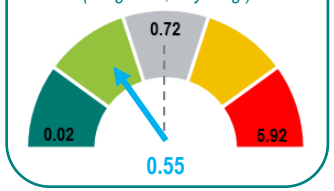
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

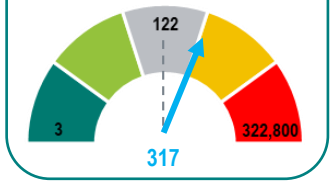


Emissions by tangible assets
(in kg/euro; 10yr avg.)

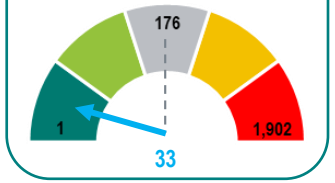


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



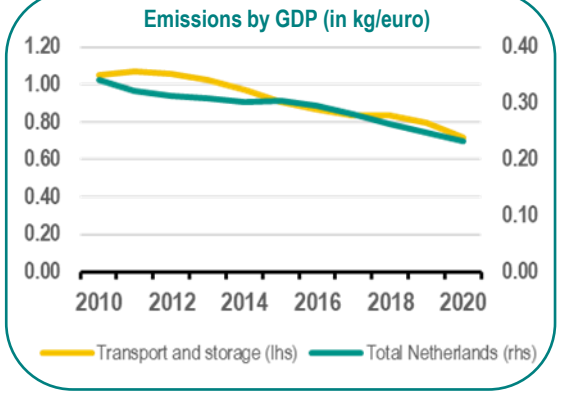
Emissions by job
(in ton/job; 10yr avg.)



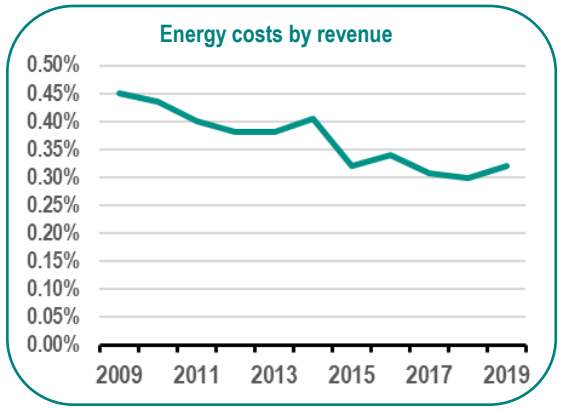
For emissions by GDP, by turnover and by company, scores are somewhat higher on average in this sector compared to the national average.. Emissions by job rank relatively low. This is because employment has increased strongly in the last 3-4 years, while emissions remained roughly stable. Greenhouse gas emissions have increased less in recent years (see next sheet) than the growth in the number of companies and value added. Thus, the indicators have improved.

Trend in emission indicators:

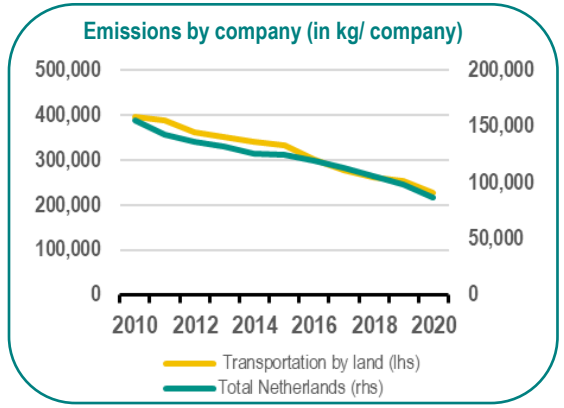
Emissions by GDP (in kg/euro)



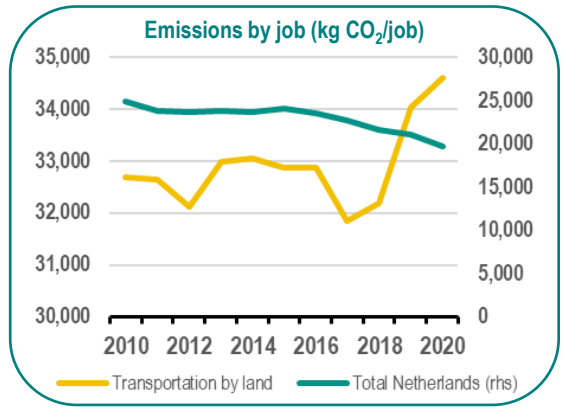
Energy costs by revenue



Emissions by company (in kg/ company)



Emissions by job (kg CO_2/job)



In the period since 2010, greenhouse gas emissions in the sector show an erratic. Overall, total greenhouse gas emissions in 2020 are at a slightly higher level than in 2010. Nevertheless, most emission indicators show a steady decline over the years. This is true for emissions by GDP and by company, where it is notable that the trend compared to the national average is closely followed. However, emissions by GDP relate to the main Transport & Storage sector. Energy costs by turnover are relatively low in this sector. This is because the costs of energy carriers utilised by means of transport are excluded from the energy cost item within the data set. If fuel costs are included, the score is significantly higher. Finally, energy costs have decreased by 4% since 2010, while turnover in the sector increased by 30% over the same period. Emissions to job show a much more erratic pattern compared to the national average.

Other indicators:

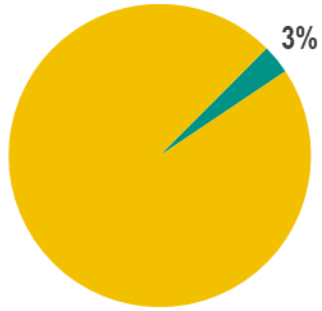
Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
- not available -

Energy costs vs. result:
(10yr average)
6.6%

Water usage by company per year:
(in litres)
- not available -

Sector share in GHG emissions:



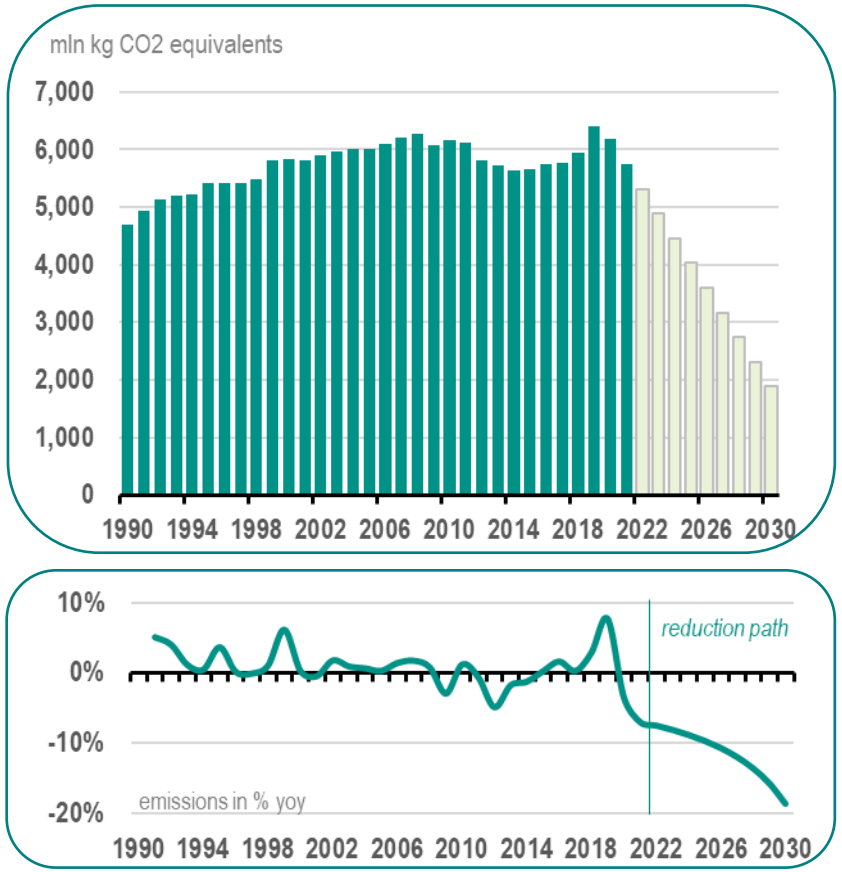
The sector is the 7th highest GHG emitter contributing 3.1% of total emissions. Energy costs by turnover are relatively low, while energy costs by results are higher.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Transport by land

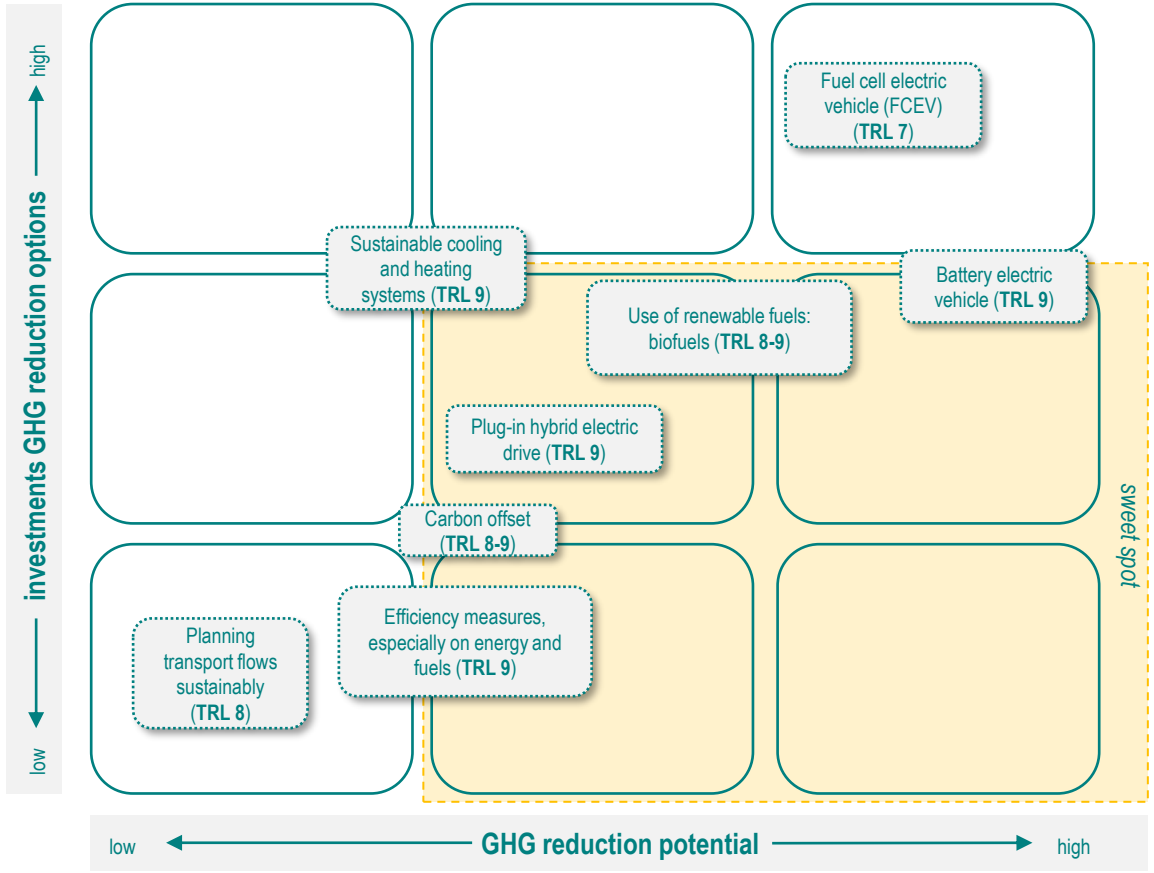
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Caninet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Between 1990 and 2020, greenhouse gas emissions increased by 31%, or about 1% per year. From 2010 onwards, the trend seems to have reversed, but in the last three years emissions have been increasing again. This means the sector still has a long way to go towards 2030 to meet the targets set. The gap between emissions in 2020 and the desired level in 2030 is 70%. This implies a 7.7% annual reduction in emissions. This seems a challenging task, especially given the historical trend.

GHG reduction options: investment & effectiveness



Land transport is probably the largest market for more electrification. As battery costs continue to fall, so will the initial costs of electric vehicles, making them competitive with conventional variants. In addition, electric vehicles have lower maintenance, higher energy efficiency and lower fuel costs. It is generally assumed that with the increase in energy efficiency, partly through further electrification, low-carbon road transport will accelerate. Not only low-carbon electricity, but also fossil-free fuels have a role to play in this transition. Road transport emissions are mainly driven by increasing demand for road transport. A shift to more sustainable forms of transport, an increase in the number of passengers per vehicle or a higher load factor of trucks can make a valuable contribution to reducing GHG emissions.

Emission reduction target:

Minimum emission reduction through 2030:
4,295
(in mln kg CO_2 eq.)

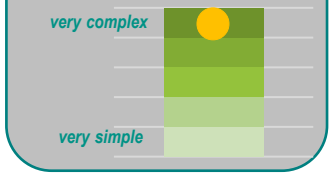
Minimum emission reduction through 2030 per year:
477
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-70%

Minimum % annually in emissions through 2030:
-7.7%

Average % annual change in emissions over last 20 years:
0.9%

Feasibility of emission target:

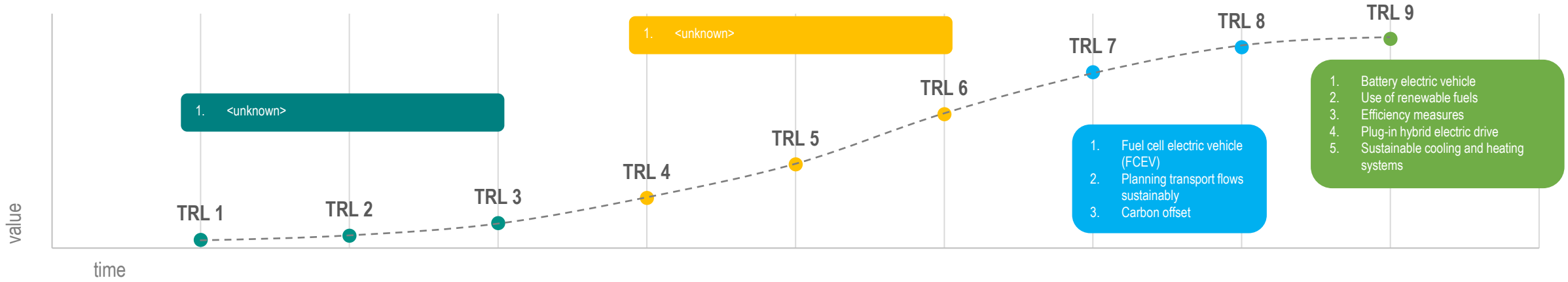


Source: CBS, CE Delft, PBL, ABN AMRO Group Economics

GHG emission reduction options explained: Transport by land

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Further sustainability of the sector is high on the agenda. But the level of investments of the sector remains a concern, especially in a post-corona era. Another hurdle that needs to be overcome is technology and in particular, affordable green transport..
Technology development is moving but still at a very early stage. That said, many of the emission reduction opportunities have the TRL 9 qualification which are already widely used or can be implemented easily.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

A fuel cell electric vehicle (FCEV) is powered entirely by electricity. This electricity is generated on board by a fuel cell that uses hydrogen. FCEVs have a longer range than electric cars powered by a battery (BEV). These BEVs also take a relatively long time to refuel. The disadvantages of FCEVs are their high purchase cost, mainly due to the expensive fuel cells, and their lower efficiency than BEVs.
Regulating transport flows sustainably is often complex and sometimes even impossible. The aim is to keep trucks continuously loaded. This is not easy to apply in every organisation.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein. On balance, it allows carriers and their customers to invest carbon offset capital in the freight transport sector itself, accelerating the transition to a more sustainable transport network.

Techniques commercial deployment phase:

Efficiency measures (especially to reduce energy consumption) and the substitution of fossil fuels for renewable variants are fairly obvious measures to reduce greenhouse gases.
Electrification of heavy trucks is complex, partly because of the challenge of competing with the long range of diesel trucks. For passenger cars, electrification is simpler.
Battery electric vehicle (BEV): powered solely by an electric motor, using electricity stored in a built-in battery that needs to be recharged, usually by connecting the vehicle to a charging point connected to the local grid.
The plug-in hybrid electric vehicle (PHEV) is powered by an electric motor and an internal combustion engine designed to work together or separately.

Source: KVN, CBS, CE Delft, PBL, ABN AMRO Group Economics

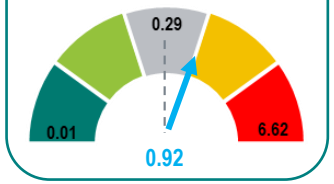
Emissions sector: Transport by water

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in water transport. This section includes: transport of cargo and passengers by sea and inland waterways.

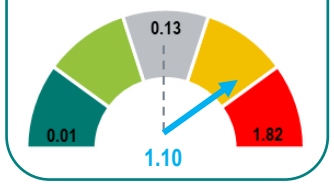
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

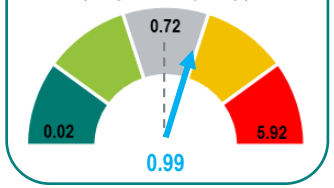
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

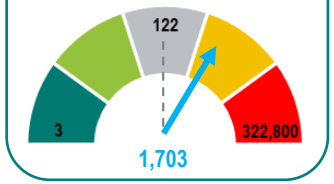


Emissions by tangible assets
(in kg/euro; 10yr avg.)

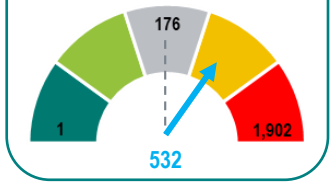


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)

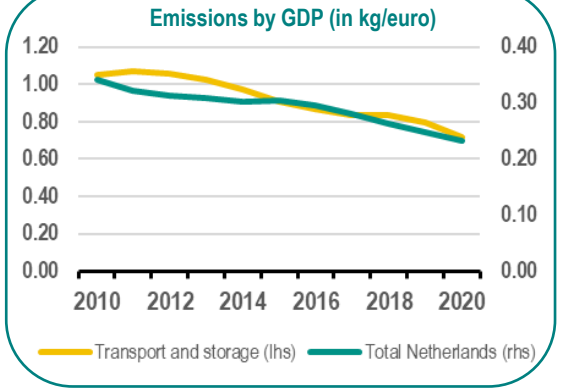


Emissions by job
(in ton/job; 10yr avg.)

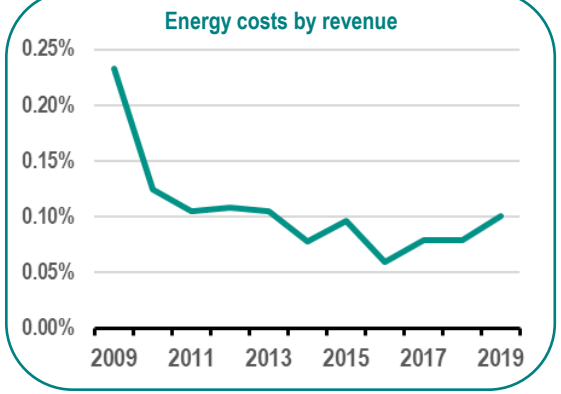


Trend in emission indicators:

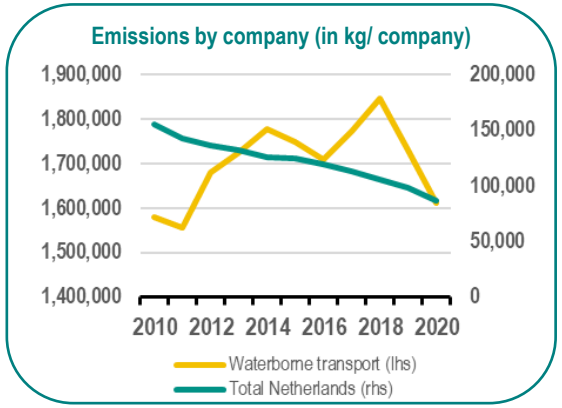
Emissions by GDP (in kg/euro)



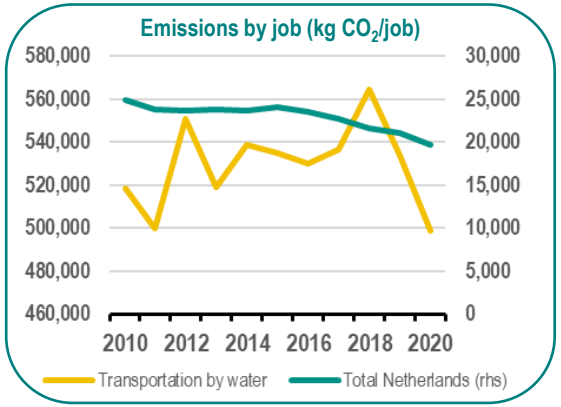
Energy costs by revenue



Emissions by company (in kg/ company)



Emissions by job (kg CO_2/job)



Other indicators:

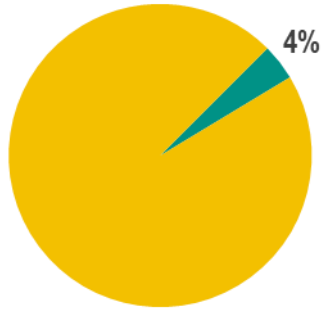
Energy costs vs. revenue:
(10yr average)
0.1%

Share in total water consumption:
- not available -

Energy costs vs. result:
(10yr average)
1.5%

Water usage by company per year:
(in liters)
- not available -

Sector share in GHG emissions:



The sector is relatively small, but large from the point of view of greenhouse gas emissions. In 2020, Dutch waterborne transport emitted some 7.6 billion kilos of CO_2. The contribution of waterborne transport (maritime and inland navigation) to the Dutch economy was less than 0.4% in 2020 but the sector scores poorly against the national average on important emission indicators. The GHG are emitted on domestic waters. As a result, the sector is among the top 10 high emission intensity sectors in Netherlands.

Emissions by company and also emissions by job show an erratic pattern since 2010 compared to the trend of the national average. The number of companies in the sector has declined annually from 2010 to 2018, but in the last three years the number of companies is growing again. The emissions to GDP refer to the main Transport & Storage sector, as data on added value by subsector are not available. The volume transported by water (excluding passenger transport) increased by about a quarter over the period 2000-2020, while greenhouse gas emissions fell by about 13% over the same period. Thus, an efficiency gain has been achieved over the years. Energy costs by turnover are low on average and have decreased considerably since 2010. Over the past five years, this indicator has fluctuated between 0.05% and 0.10%.

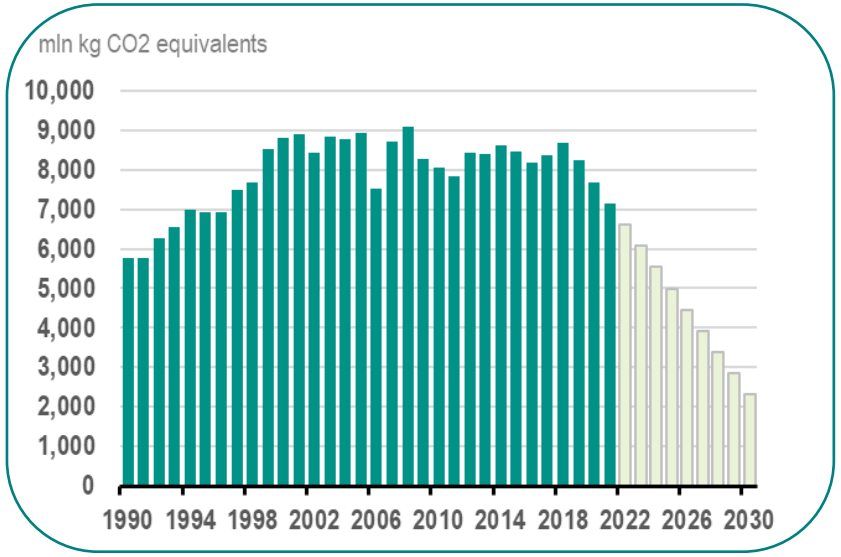
At 3.9%, the sector has a relatively high share of total emissions from companies in economic sectors. This share puts the sector just outside the top five largest emitting sectors. The sector nevertheless scores well on the energy costs to turnover and the energy costs by result ratios.

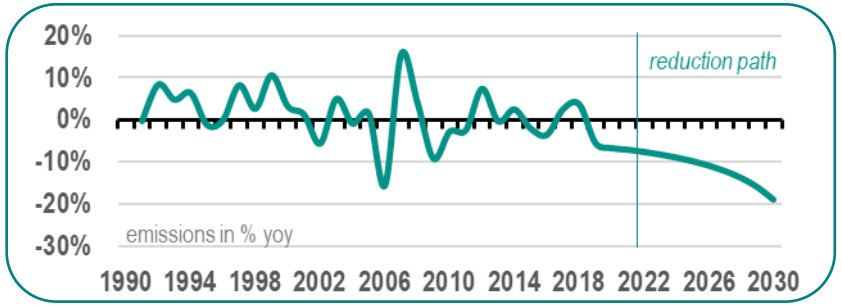
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Transport by water

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

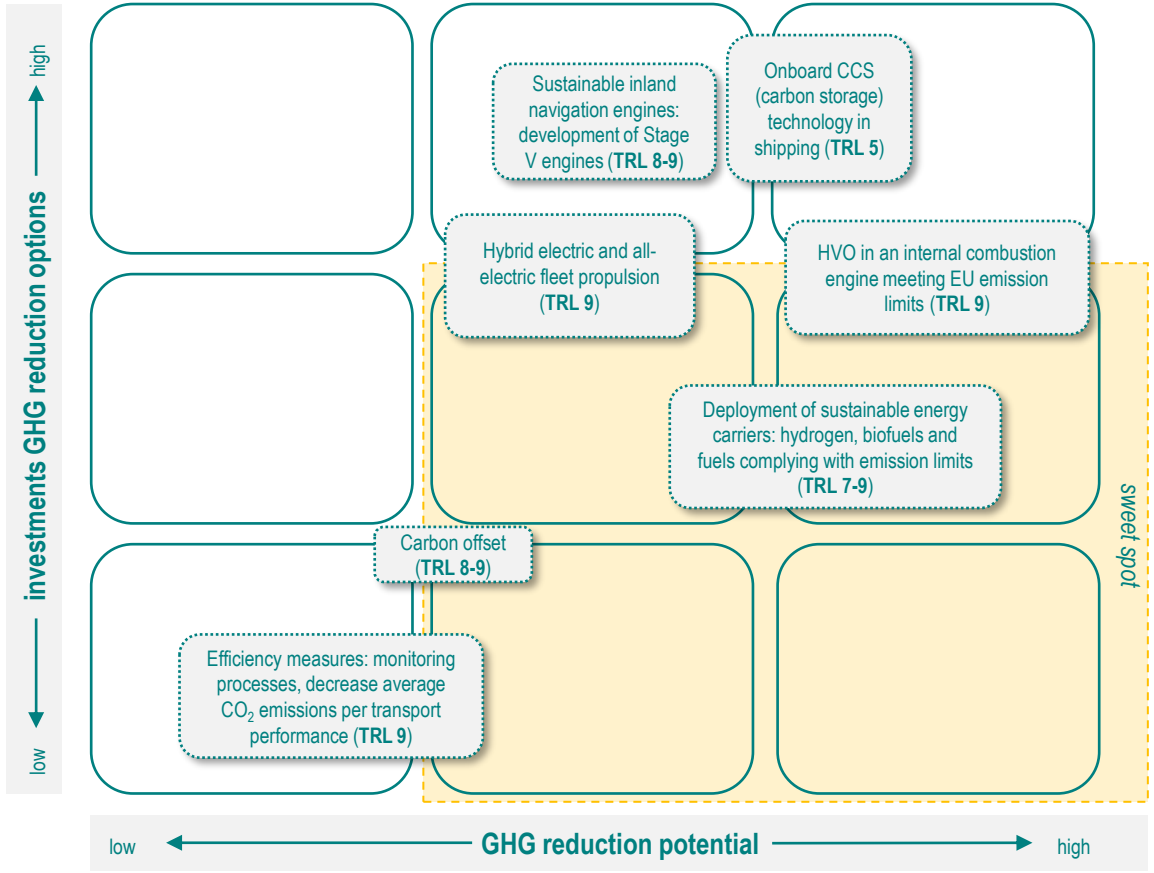
Emission pathway & projection:





Greenhouse gas emissions from domestic and maritime shipping combined have increased rapidly over the past three decades. Between 2010 and 2020, emissions increased by 33%, or over 1% per year. However, emissions show a volatile pattern over time. Since 2018, it seems that emissions have been on a more downward trend. This is dire given the long reduction path the sector still has to take. The sector still needs to reduce emissions by almost 8% annually to meet the 2030 target. Given the history in this sector, this will be a challenging target to achieve.

GHG reduction options: investment & effectiveness



Various transition solutions are available for the sector, but many emission-free technologies are still in their infancy and cannot yet be applied on a larger scale (see also next sheet). The inland shipping sector and the central government are aiming for at least 150 emission-free ships (based on modular energy supply) by 2030. In the run-up to emission-free vessels, a blending percentage of 30% biofuels for inland vessels is targeted (CE Delft, 2019). The CCNR Inland Shipping Roadmap clearly outlines the issues: due to the current uncertainties, a start needs to be made on mapping out a path to achieve the ambitious emission reduction target in the medium and long term. The uncertainties relate, in particular, to the development, cost, maturity level and availability of technologies that can contribute to the transition to emission-free inland navigation. In maritime shipping, few technologies with a high TRL are known.

Emission reduction target:

Minimum emission reduction through 2030:
5,368
(in mln kg CO_2 eq.)

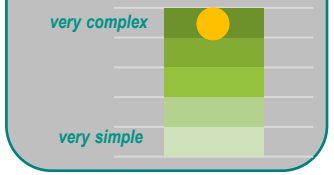
Minimum emission reduction through 2030 per year:
596
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-70%

Minimum % annually in emissions through 2030:
-7.8%

Average % annual change in emissions over last 20 years:
1.1%

Feasibility of emission target:

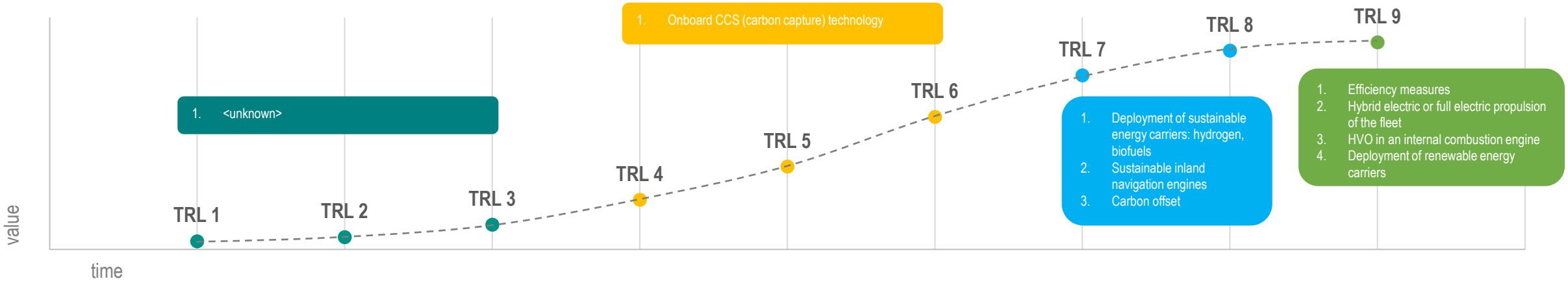


Source: CCR, CBS, CE Delft, PBL, ABN AMRO Group Economics

GHG emission reduction options explained: Transport by water

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Demonstration projects remain necessary in the sector, but they often involve high costs and risks. Through collaboration in the chain, with innovative business models and also government incentives, these costs and risk can be mitigated.
In the concept phase - but also in the test and prototype phase - there are still relatively few new technologies, to our knowledge. Nevertheless, innovation is not standing still here either. Some technologies are not yet advanced enough, mainly because of relatively high cost estimates. For instance, other technological options such as lithium-air batteries, LOHC (Liquid Organic Hydrogen Carrier), formic acid (hydrozine) or green ammonia in combination with fuel cells (FC) or internal combustion engines (ICE) could play a role in later stages of the energy transition (Roadmap CCR).

Techniques in test and prototype phase:

A capture mechanism captures CO_2 from the ship and uses the CO_2 to recharge batteries. The CO_2 storage facility can be charged and discharged. Such an on-board CO capture and storage facility can thus capture up to 100% of the ship's CO_2 emissions. This potentially has a major impact on the ship's CO_2 footprint.

Techniques in pre-commercial phase:

The development of sustainable inland waterway engines is a complex issue. The market for inland waterway engines is small and this makes engine manufacturers less enthusiastic about serving this industry. It puts a brake on necessary innovation. Subsidy schemes can still be used to put initiatives in the market, including, for example, Stage-V engines for inland vessels. Moreover, from 2022, newly built machines will have to comply with the Stage V standard for Non Road Mobile Machinery (or NRMM for short).
The use of hydrogen-based fuels and fuel cells in inland navigation, short sea shipping and long sea shipping where direct electrification is difficult is gaining momentum. However, it is not yet fully mature. DNV estimates that the technology still needs 4-8 years for commercial use.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Electric propulsion system with built-in batteries or interchangeable battery systems or electric drives (combustion engine generator (ICE) and electric motor)can be seen as a good investment for smaller vessels (retrofit and new). However, the lower power density and greater weight can be a limiting factor. As a result, hybrid variants are often looked at. As a standalone solution, the use of batteries in larger ships is often too complex.
The choice of energy carrier has a lot of impact on GHG emissions. Ships often still have diesel engines that use fuel oil. When deploying sustainable energy carriers and fuels, there are plenty of options for the sector. Think of liquid or gaseous hydrogen or methanol (from methane) or ammonia used in fuel cells or in internal combustion engines.
HVO is pure 'Hydrotreated Vegetable Oil' (i.e. without admixture of fossil fuels) and all similar drop-in-bio fuels (including e-fuels), as well as synthetic diesel made with captured CO_2 and renewable electric power.

Source: DNV, CCR, CBS, CE Delft, PBL, ABN AMRO Group Economics

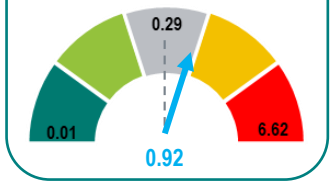
Emissions sector: Transport by air

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in aviation. This section includes: transport of passengers and cargo by air.

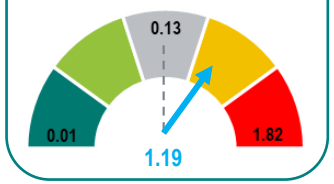
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

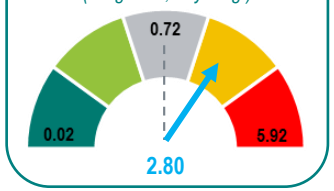
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

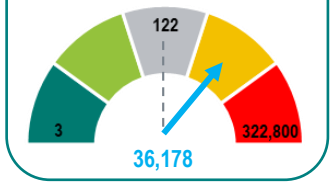


Emissions by tangible assets
(in kg/euro; 10yr avg.)

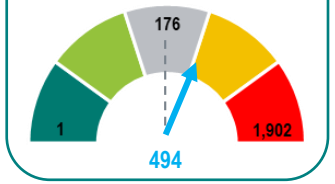


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



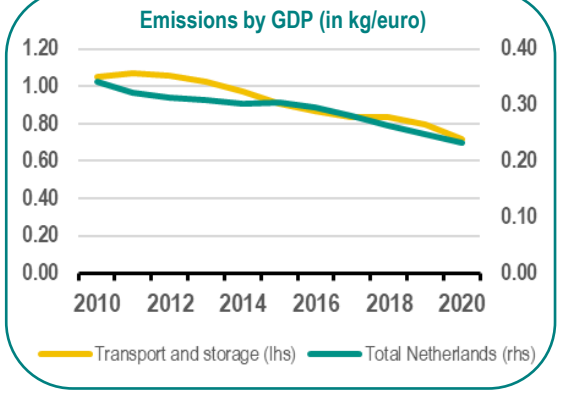
Emissions by job
(in ton/job; 10yr avg.)



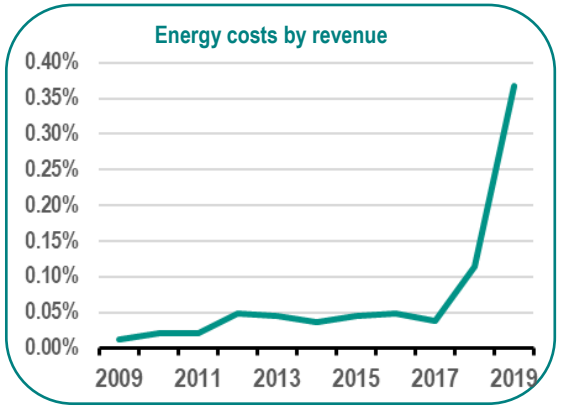
CO_2 emissions in this sector can be derived from the number of kilometres travelled and fuel consumption per kilometre. Like many other subsectors under the Transport & Storage sector, air transport scores relatively high on many emission indicators. Thus, the emissions intensity of this sector can be called high. The sector regularly ranks within the top 10 sectors with the highest emission intensity.

Trend in emission indicators:

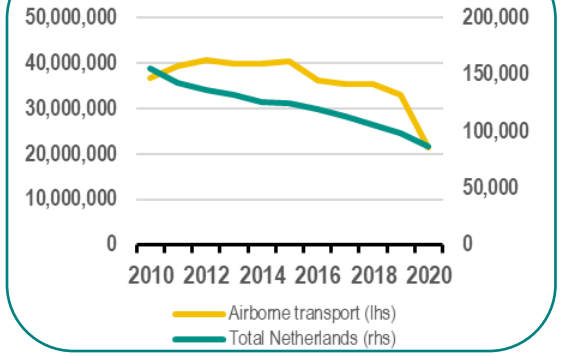
Emissions by GDP (in kg/euro)



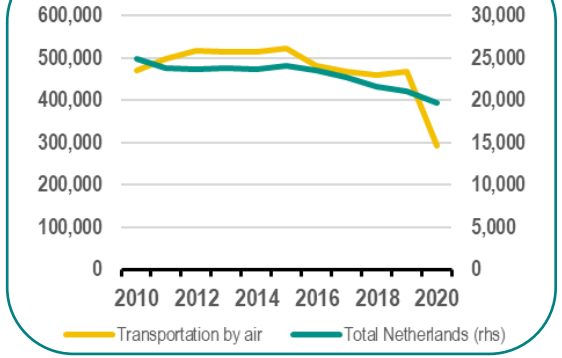
Energy costs by revenue



Emissions by company (in kg/ company)



Emissions by job (kg CO_2/job)



Emissions by GDP in the figure above refer to the main Transport & Storage sector, as data on added value by subsector are not available. On the other three emission indicators shown, the sector mostly shows a different pattern compared to the national average. Emissions increased by 3% in this sector over the period from 2010 to 2019 (i.e. excluding the corona year), while the number of companies increased by 14% over the same period in an annually erratic pattern. It kept emissions per company over the period 2010-2019 initially constant to declining from 2015. A clear tilt can be observed in the corona year, where the number of flight movements (and hence emissions) falls drastically and the number of companies also shrinks. Energy costs by turnover also rise sharply towards the corona year. This is because energy costs remain almost constant at the beginning but turnover plummets sharply.

Other indicators:

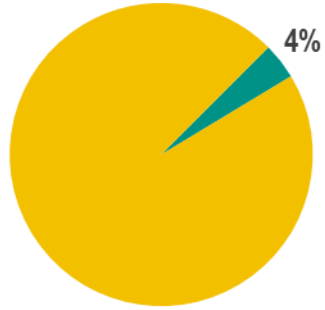
Energy costs vs. revenue:
(10yr average)
0.1%

Share in total water consumption:
- not available -

Energy costs vs. result:
(10yr average)
1.8%

Water usage by company per year:
(in litres)
- not available -

Sector share in GHG emissions:



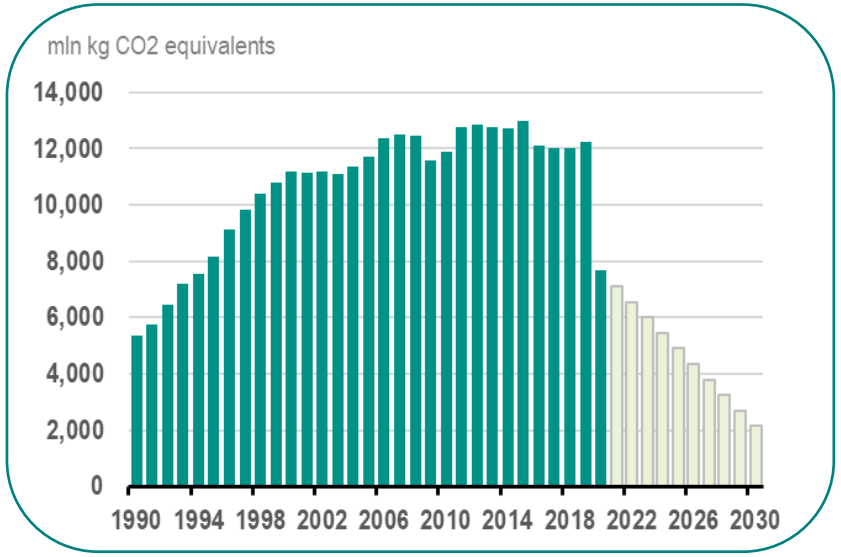
Energy costs are relatively low in this sector. This is mainly because the fuels consumed in the sector are not included in this item according to the CBS calculation method. As a result, the ratios of energy costs to turnover and profit are relatively low. The sector has a high share in total greenhouse emissions, occupying 7th position among the largest emitters with a share of 3.9%.

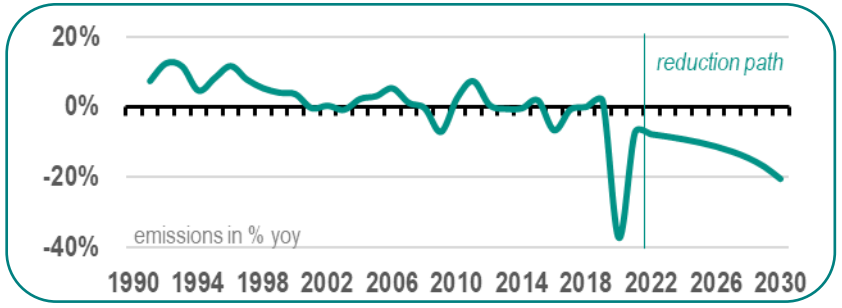
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Transport by air

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

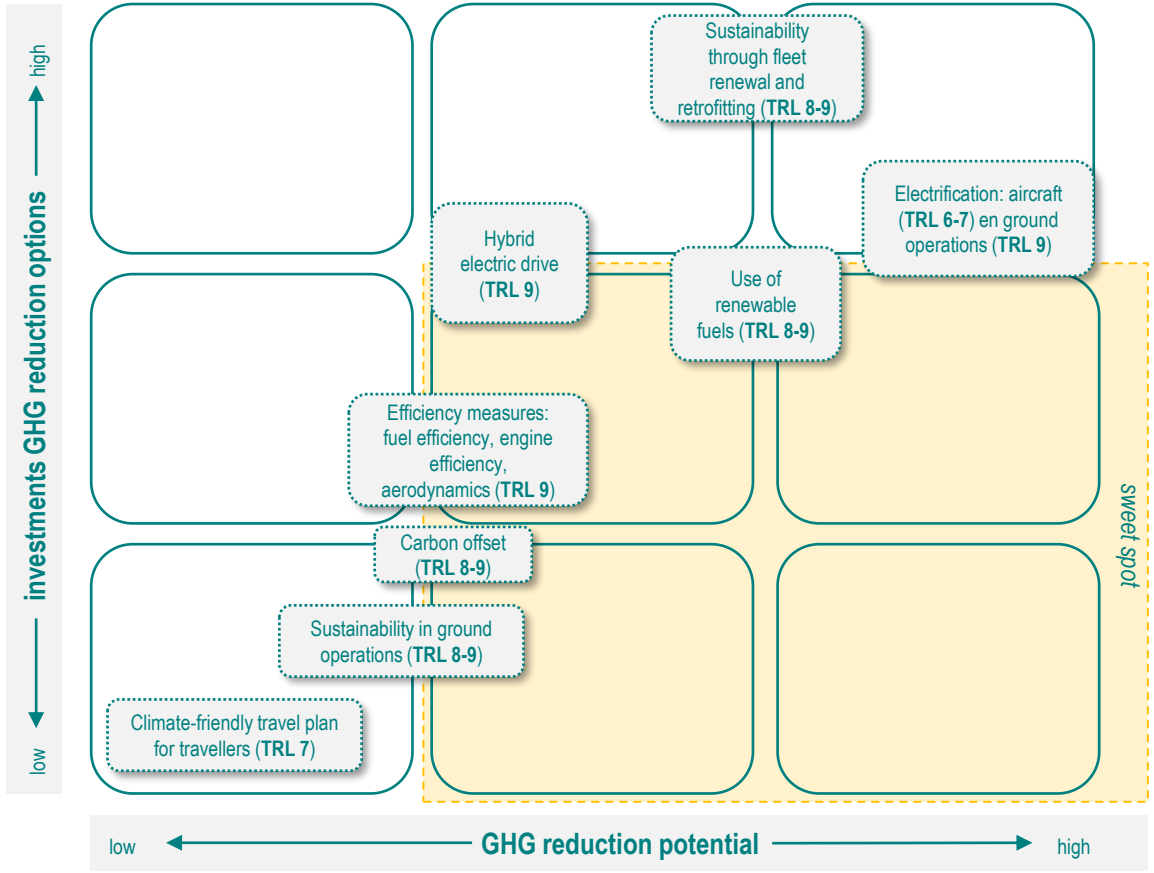
Emission pathway & projection:





Greenhouse gas emissions from international aviation have increased rapidly during the past three decades. This is mainly because the number of air passengers across Europe and air cargo transport has increased steadily since the 1990s. However, the number of air passengers in 2020 dropped significantly compared to 2019 due to Covid-19 restrictions, which also resulted in a sharp drop in greenhouse gas emissions. Greenhouse gas emissions increased by 43% from 1990 to 2020, or about 1.7% per year. This means the sector still needs to reduce a significant amount of greenhouse gases annually towards 2030. With a necessary reduction of 8% per year, the 2030 target is a long way off.

GHG reduction options: investment & effectiveness



Air transport as a whole accounts for about 2-3% of global CO_2 emissions, according to the International Air Transport Association (IATA). Aviation is also characterised by rapid growth in emissions, increasing by a factor of 6-7 between 1960 and 2018. This makes it one of the fastest-growing sources of emissions in the global economy (IPCC). There are two key low-carbon technologies that are regularly discussed in publications. These are electric flying and sustainable alternative fuels. Battery technology has its challenges. For renewable fuels, consider hydrogen, biomass-derived fuels or e-fuels (also called power-to-liquid or non-biogenic synthetic fuels). These options have a relatively high greenhouse gas reduction potential, while the necessary investments for this are higher than average. First and foremost, however, a higher carbon price is the least disruptive mechanism for a technology and fuel transition in aviation.

Emission reduction target:

Minimum emission reduction through 2030:
5,524
(in mln kg CO_2 eq.)

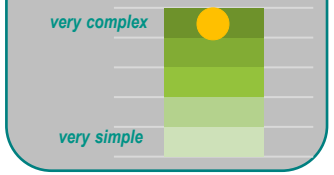
Minimum emission reduction through 2030 per year:
614
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-72%

Minimum % annually in emissions through 2030:
-8.0%

Average % annual change in emissions over last 20 years:
1.7%

Feasibility of emission target:

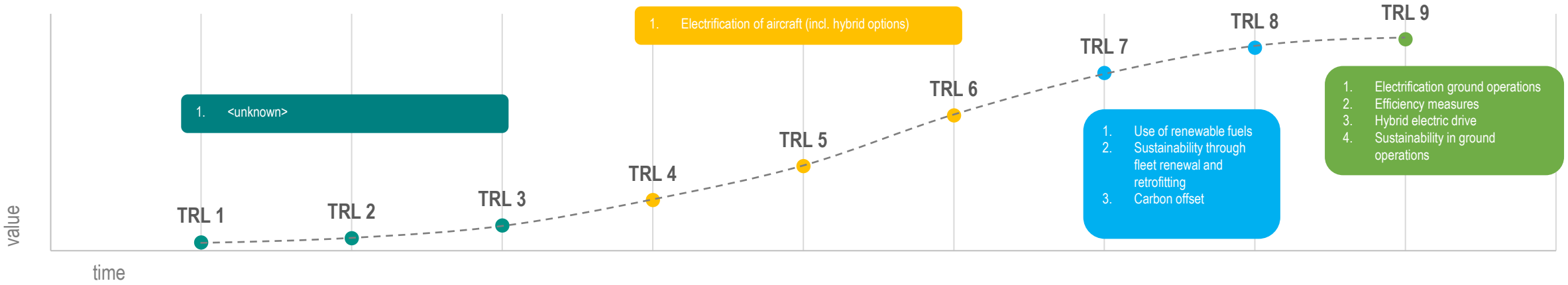


Source: IATA, IPCC, CBS, CE Delft, PBL, ABN AMRO Group Economics

GHG emission reduction options explained: Transport by air

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, as far as we are aware. Nevertheless, innovation is not standing still either. Some technologies are not yet advanced enough, mainly because of relatively high cost estimates.

Techniques in test and prototype phase:

There is a consensus among researchers that batteries will be too heavy for longer flights in the near future. Electric propulsion may be possible on shorter distances and for limited passenger numbers, though, and could avoid emissions at altitude entirely. Hybrid-electric options depend on aircraft designs because of lower energy density and significantly greater space requirements. Integrating electric propulsion with internal combustion engines can optimise engine performance and help reduce fuel consumption. Because hybrid-electric aircraft have smaller and lighter batteries than fully electric aircraft, weight gain compared to conventional aircraft is less of an issue for hybrid-electric aircraft. The decarbonisation potential of all-electric aircraft also largely depends on access to low-carbon energy sources.

Techniques in pre-commercial phase:

Sustainable Aviation Fuels (SAF), such as biofuels and synthetic fuels, can significantly reduce lifecycle greenhouse gas emissions from aviation fuels, provided they can be produced sustainably on a large scale. The use of hydrogen as an alternative fuel depends on aircraft designs because of its lower energy density and significantly greater space requirements. However, low-carbon hydrogen production is a strict prerequisite to achieve meaningful GHG emission reductions for aviation.
Increased use of composites (including carbon-reinforced polymers), lighter metal alloys and new manufacturing methods (including 3D printing), may enable the production of lighter and thus more fuel-efficient aircraft.
The high capital cost of new aircraft designs, slow fleet replacement times and the lagging pace of infrastructural change make the transition to more efficient, electric and hybrid-electric aircraft complex.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Each alternative aviation fuel has specific disadvantages compared to conventional jet fuel, due to differences in energy density, weight, storage volumes, land or water requirements or the potential to avoid greenhouse gases.
It appears that non-biogenic synthetic fuels as the most technically feasible option to replace jet fuel (IEA). These fuels have a high level of technological readiness, but are two to three times more expensive than conventional fuel. But of course, this also depends on fossil fuel price developments and technological advances in synthetic fuel production.
Electrification and further sustainability of ground operations helps to further reduce the carbon footprint. This mainly involves electrification of means of transport, but at the same time, sustainability options can also be implemented within the ground operations process.

Source: IATA, IEA, CBS, CE Delft, ABN AMRO Group Economics

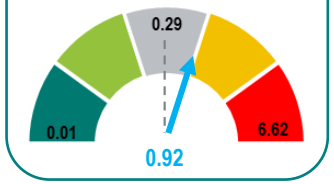
Emissions sector: Storage & services transport

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in Storage and services for transport.

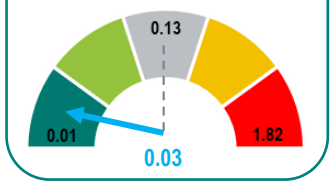
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

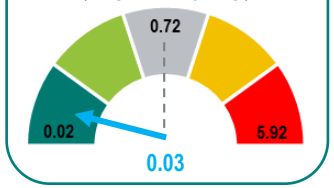
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

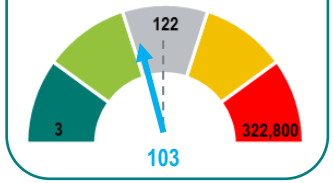


Emissions by tangible assets
(in kg/euro; 10yr avg.)

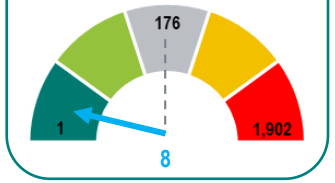


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



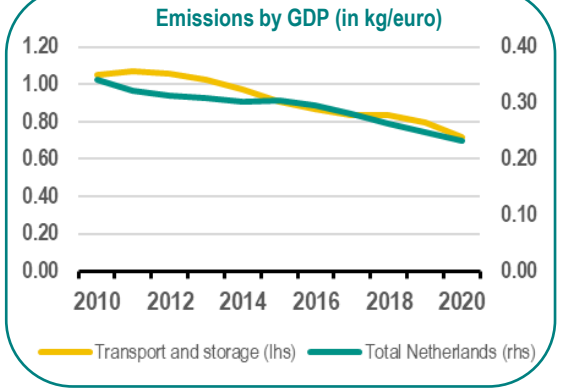
Emissions by job
(in ton/job; 10yr avg.)



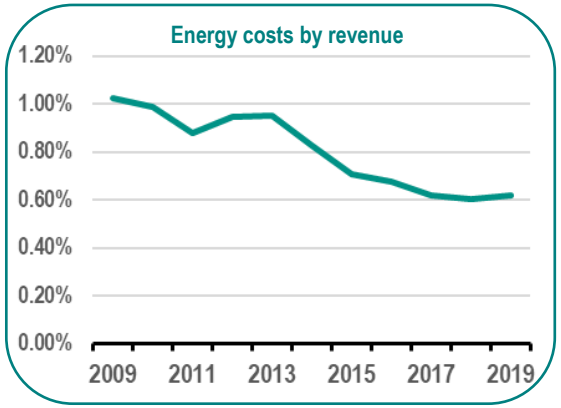
In the figure above, the indicator regarding emissions to GDP relates to the main sector Transport & Storage and therefore hits higher on the meter compared to all other emission indicators in this subsector. Only in emissions per company does the sector still score relatively high. Overall, it can be said that the emission intensity in this subsector is relatively low compared to other sectors.

Trend in emission indicators:

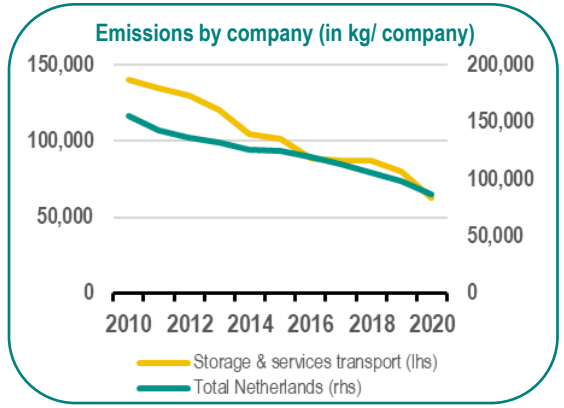
Emissions by GDP (in kg/euro)



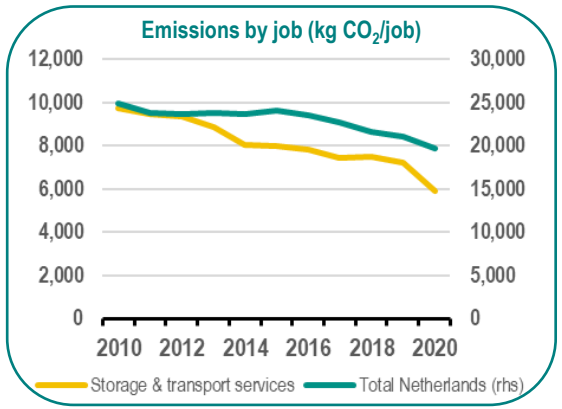
Energy costs by revenue



Emissions by company (in kg/ company)



Emissions by job (kg CO_2/job)



The number of companies in the storage & services subsector has almost doubled since 2010, while emissions have decreased by 18% over the same period. It contributes to the sharply declining trend in emissions by company. The ratio is at a comparable level to the national average and the trends in the two are largely parallel. This is also true for emissions by job, but it clearly shows that the rate of decline in the emissions indicator is faster than the national average. The number of jobs in this subsector increased significantly faster from 2010 to 2020 than the national picture (36% versus 7%). Energy costs by turnover have been moving between 0.6% and 1% since 2010, with a clear downward trend. Turnover has increased throughout the 2010-2020 period on a slightly declining and stable rate of energy costs during that period. However, a stabilisation can be seen in this in the last three years.

Other indicators:

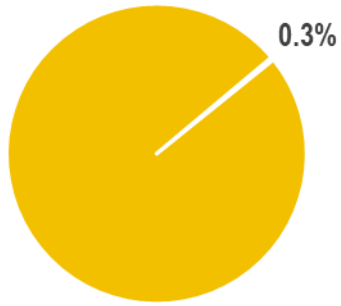
Energy costs vs. revenue:
(10yr average)
0.8%

Share in total water consumption:
- not available -

Energy costs vs. result:
(10yr average)
9.2%

Water usage by company per year:
(in litres)
- not available -

Sector share in GHG emissions:



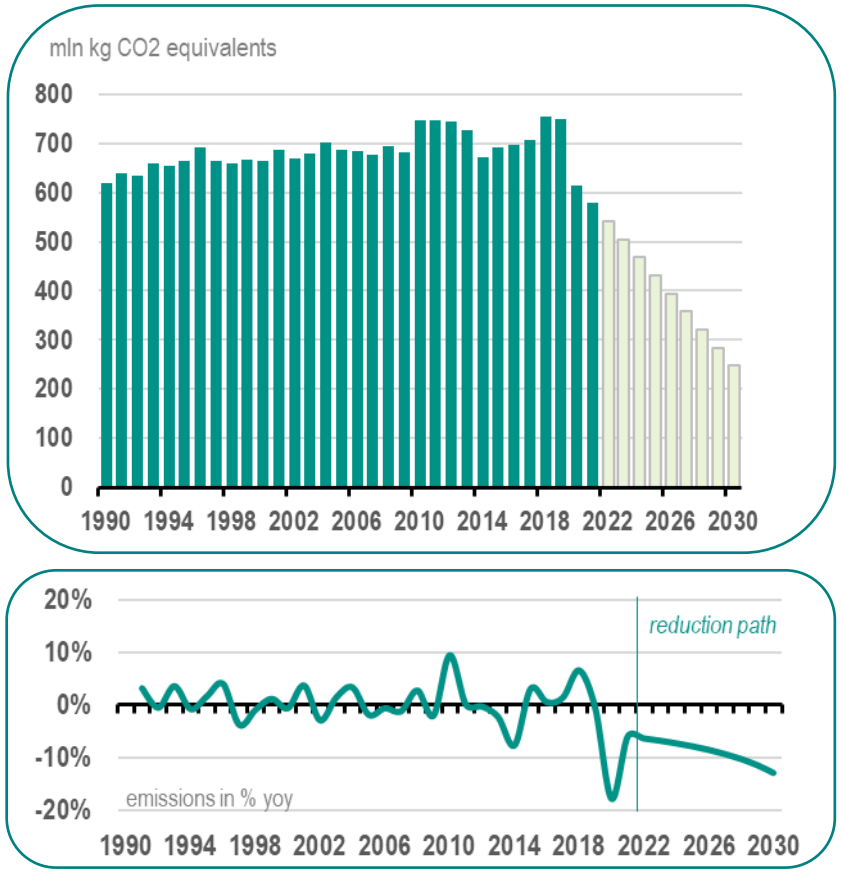
The subsector has a marginal share in total emissions from companies in economic sectors, making it one of the sectors with the lowest emissions. Energy costs by turnover are also low on average over the past 10 years, while energy costs by results are higher. This sector also has relatively low margins, giving the indicator its high level.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Storage & service transport

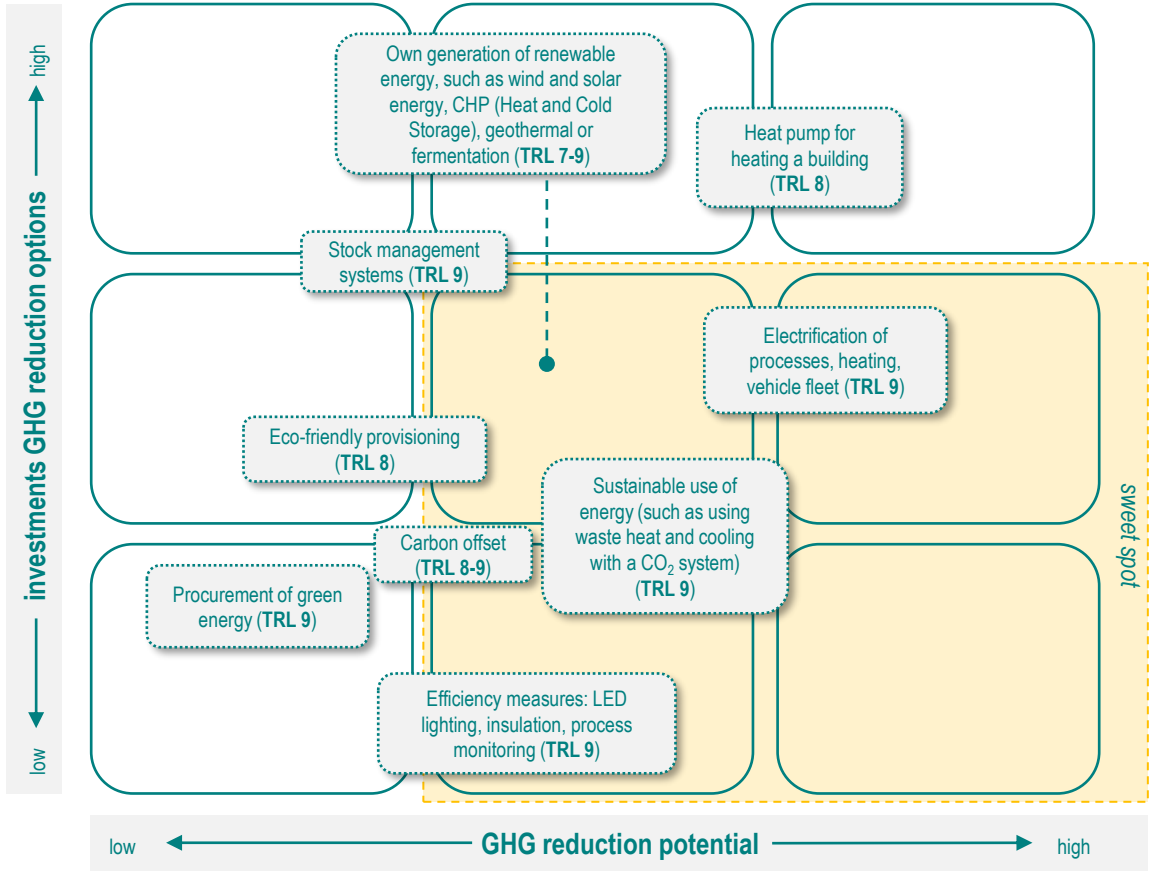
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



Greenhouse gas emissions show a slight upward trend in this subsector until 2019. In corona year 2020, the sector is hit hard by a sharp decrease in international transport movements. From 2010 to 2019, emissions increased by 21%. In 2020, emissions fall by 18%. Emissions will most likely rise sharply again after 2020 with an improving economy and ditto trade flows. So other than illustrated in the figure above, the emissions reduction path for the sector towards 2030 will be a lot more complex. Based on current data, the sector needs to reduce at least 6.6% in emissions per year to reach the 2030 target. This is undoubtedly a very difficult task for this subsector.

GHG reduction options: investment & effectiveness



The storage & services sector has several opportunities to reduce greenhouse gas emissions, as shown in the matrix above. The sector is associated with a multiple environmental impacts. These range from greenhouse gas emissions to noise and light pollution, as well as road safety. The sector recognises the shared responsibility to further reduce greenhouse gas emissions. Increasingly, therefore, renewable energy and energy efficiency are receiving attention in business operations. LED lighting has been the low-hanging fruit to reduce costs and energy consumption for years, but ambitious companies in the sector have already installed lighting upgrades with more savings potential. Cooling and heating remain major shareholders in overall energy consumption. Smart energy use is ideally a good starting point for more sustainable operations. This can be done through, for example, automatic lighting, taps with sensors, building insulation and installation of solar panels.

Emission reduction target:

Minimum emission reduction through 2030:
368
(in mln kg CO_2 eq.)

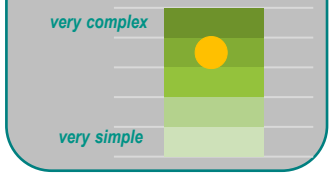
Minimum emission reduction through 2030 per year:
41
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-60%

Minimum % annually in emissions through 2030:
-6.6%

Average % annual change in emissions over last 20 years:
0.1%

Feasibility of emission target:



Source: Fenex, CBS, PBL, ABN AMRO Group Economics

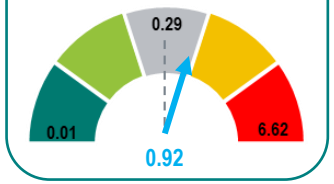
Emissions sector: Postal & courier services

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in postal and courier services. This section includes: national and local postal services; courier companies.

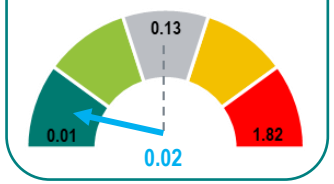
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

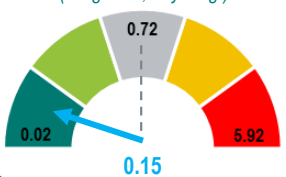
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

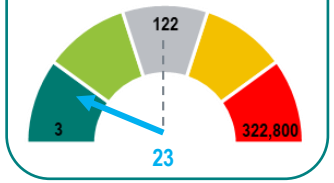


Emissions by tangible assets
(in kg/euro; 10yr avg.)

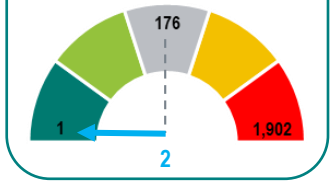


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



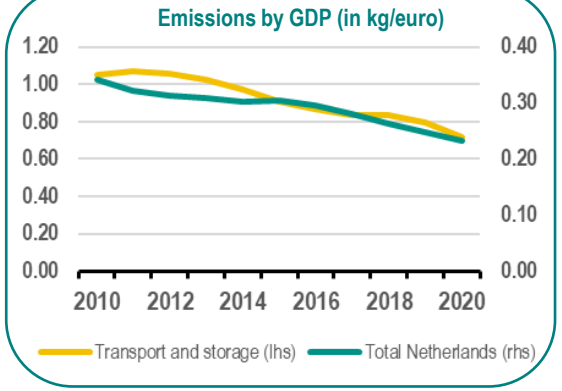
Emissions by job
(in ton/job; 10yr avg.)



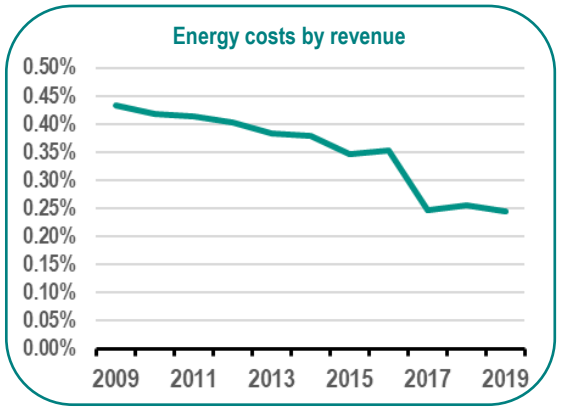
Unlike other subsectors under the Transport & Storage cluster, the post & courier subsector scores relatively low on all emission indicators. Emission intensity is thus limited in the sector. The indicator in terms of emissions to GDP in the figure above relates to the main Transport & Storage sector and therefore sets the meter higher.

Trend in emission indicators:

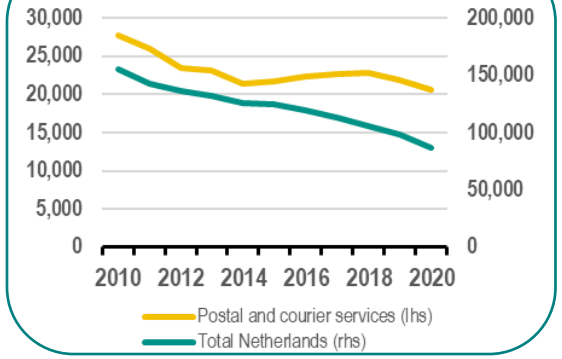
Emissions by GDP (in kg/euro)



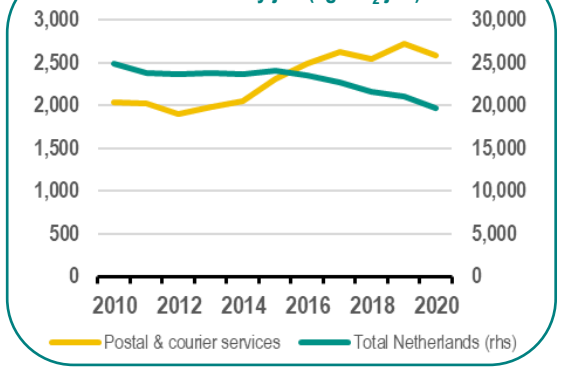
Energy costs by revenue



Emissions by company (in kg/ company)



Emissions by job (kg CO_2/job)



Emissions by GDP refer to emissions from the Transport & Storage cluster and broadly follow the trend in emissions by GDP of the national average. For post & courier services, emissions by company are significantly lower than the national average, but the trend in the indicator since 2010 is broadly in line with the decreasing trend we also see for the Netherlands as a whole. The 'energy costs by turnover' indicator has shown a declining trend since 2019, fluctuating between 0.25% and 0.45%. Compared to other sectors, this is relatively low. Energy costs have declined slightly every year since 2019, while turnover shows a more steady growth.

Other indicators:

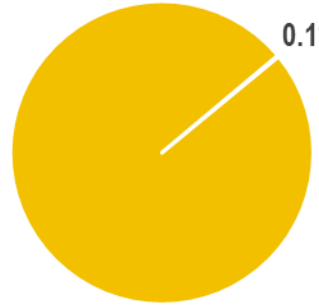
Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
- not available -

Energy costs vs. result:
(10yr average)
3.7%

Water usage by company per year:
(in litres)
- not available -

Sector share in GHG emissions:



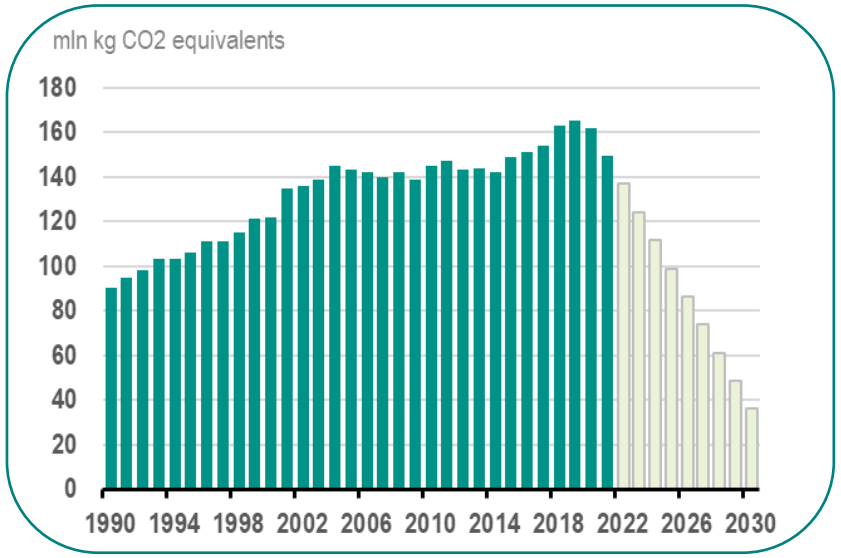
At 0.1%, the sector has only a marginal share in total greenhouse gas emissions from companies in economic sectors. Energy costs are low. Fuel costs are a high burden in this sector, but these are not included in energy costs in the CBS calculations. Margins in the sector are relatively low, which causes energy costs to be slightly higher by outcome.

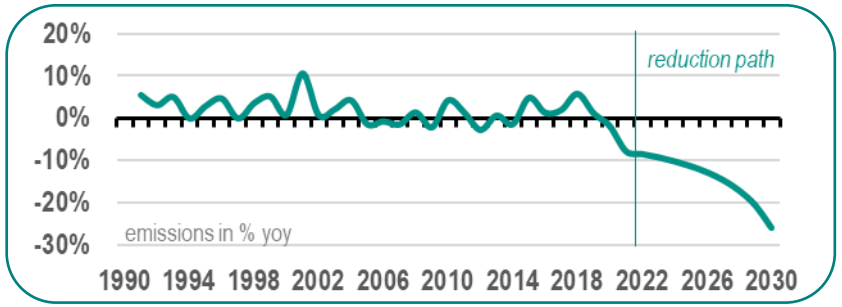
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Postal & courier services

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

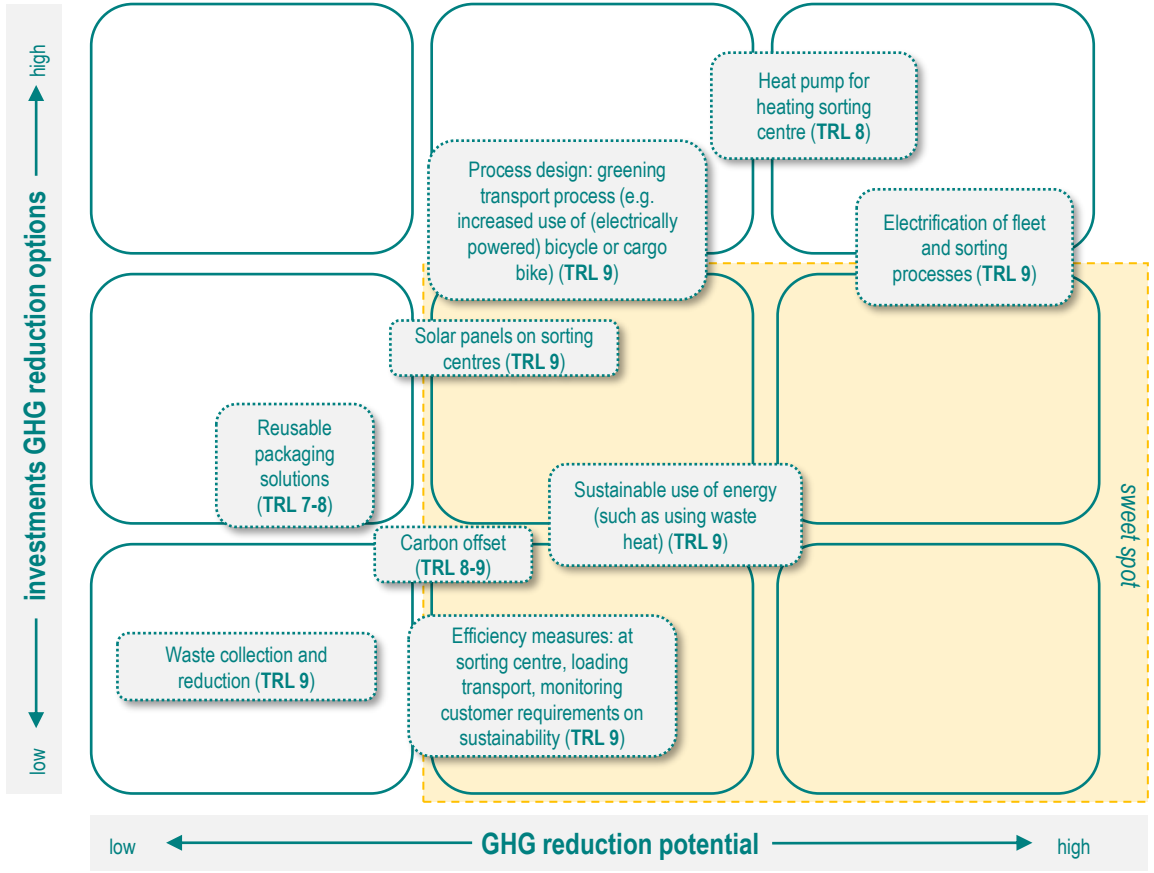
Emission pathway & projection:





Greenhouse gas emissions in the post & courier subsector have increased annually, with some exceptions from 2005-2008 and in 2013-2015. Emissions have been increasing in recent years and are historically high. Over the entire period from 1990 to 2020, greenhouse gas emissions increased by 80%, which is the strongest growth in emissions of all subsectors within the Transport & Storage cluster. The corona years have done no favours for this subsector with a sharp increase in parcel deliveries. Due to the sharp increase in emissions, the sector has a large amount of emissions to reduce annually. This needs to be at least 8.6% per annum and given the historical trend, this seems very difficult to achieve.

GHG reduction options: investment & effectiveness



Within the post & courier sector, a number of initiatives are already underway to make existing processes more sustainable. This can be done, for instance, by making more use of (electrically powered) bicycles or cargo bikes. Although door-to-door delivery is still the norm today, the focus might shift to pick-up points in the future. Currently, around 30% of parcels are already picked up. This saves considerable transport kilometres for postal companies and couriers and is also much more efficient. A condition is that consumers are encouraged to pick up their parcels by bicycle at the pick-up points. Some companies in the sector also offer and finance, for example, the planting of new trees. Reusable packaging solutions are also on the rise, such as sustainable shipping boxes that customers return and that last several shipping cycles.

Emission reduction target:

Minimum emission reduction through 2030:
126
(in mln kg CO_2 eq.)

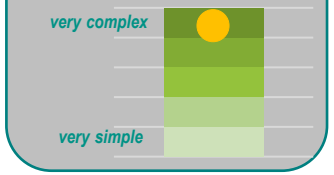
Minimum emission reduction through 2030 per year:
14
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-78%

Minimum % annually in emissions through 2030:
-8.6%

Average % annual change in emissions over last 20 years:
2.0%

Feasibility of emission target:



Source: CBS, PBL, ABN AMRO Group Economics

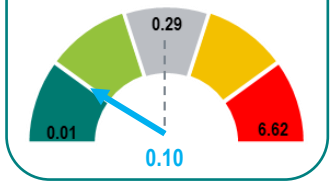
Emissions sector: Hospitality

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in accommodation, meal and beverage services. This section includes: providing guests with accommodation and/or prepared meals, snacks and beverages for immediate consumption.

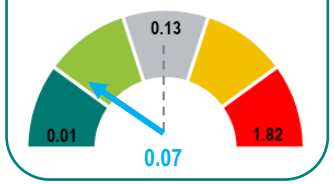
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

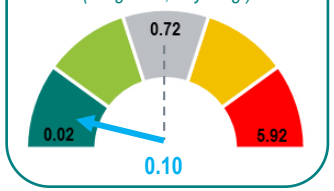
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

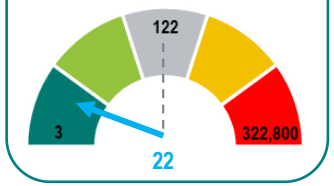


Emissions by tangible assets
(in kg/euro; 10yr avg.)

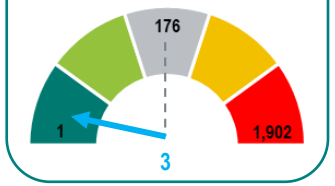


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



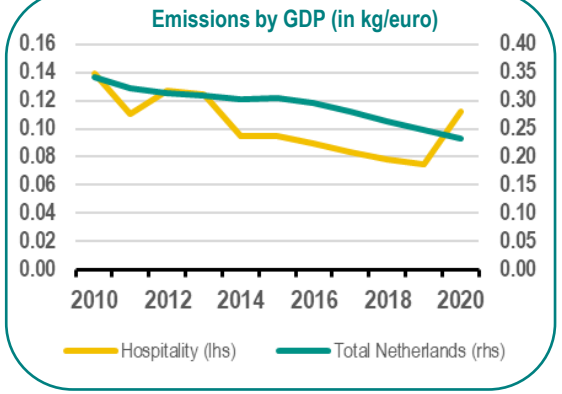
Emissions by job
(in ton/job; 10yr avg.)



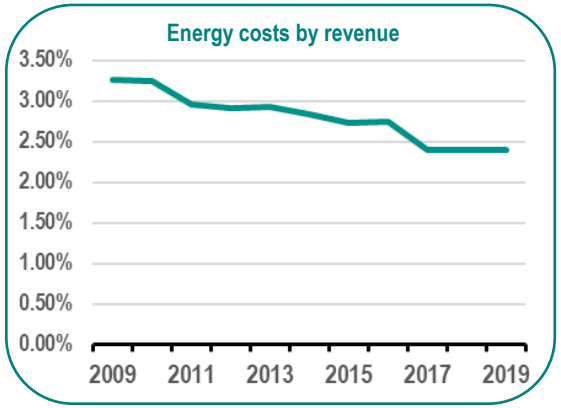
Compared to other sectors, the hospitality sector scores low on almost all emission indicators. Only on emissions by GDP and by turnover is the indicator slightly higher. This sector has both a relatively small share in total greenhouse gas emissions. Material assets in the sector more than doubled from 2010 to 2020, while the number of businesses increased by half over the same period. GHG emissions fell by 16% over this period. It indicates that low-carbon solutions are also taken into account here.

Trend in emission indicators:

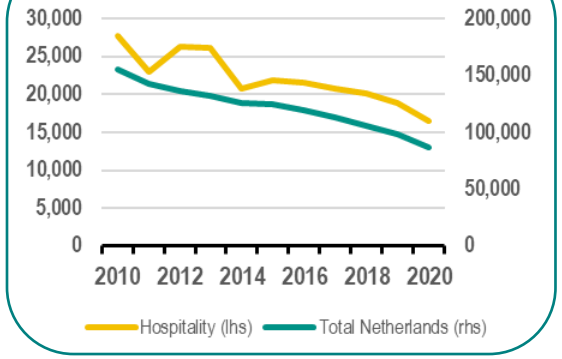
Emissions by GDP (in kg/euro)



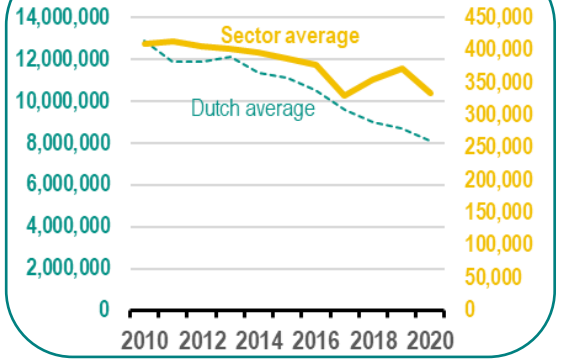
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



The hospitality sector has managed to reduce GHG emissions over the past 10 years, by about 1.6% per year on average. Value added and the number of businesses have continued to grow in the sector, and this opposite movement is further reducing emissions to GDP and to businesses. However, the trend in the indicators is more erratic than the national average. Nevertheless, they do run largely parallel to each other. Energy costs to turnover have declined over 10 years from 3.3% to 2.4% by 2020. While the pace is still relatively slow, the trend is positive. In terms of water use, the sector has shown slight improvement over the period 2010-2020. Water use per company fell by 18% over that period. This is because the number of companies in the sector increased much faster (+48%) than total water use (+16%) over the same period. However, it does indicate that per-company water efficiency increased slightly.

Other indicators:

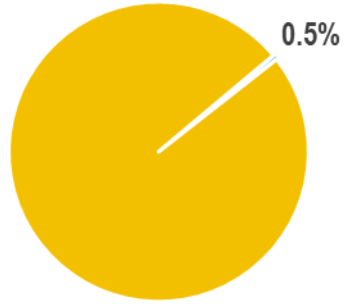
Energy costs vs. revenue:
(10yr average)
2.8%

Share in total water consumption:
0.1%

Energy costs vs. result:
(10yr average)
22.2%

Water usage by company per year:
(in litres)
380,168

Sector share in GHG emissions:



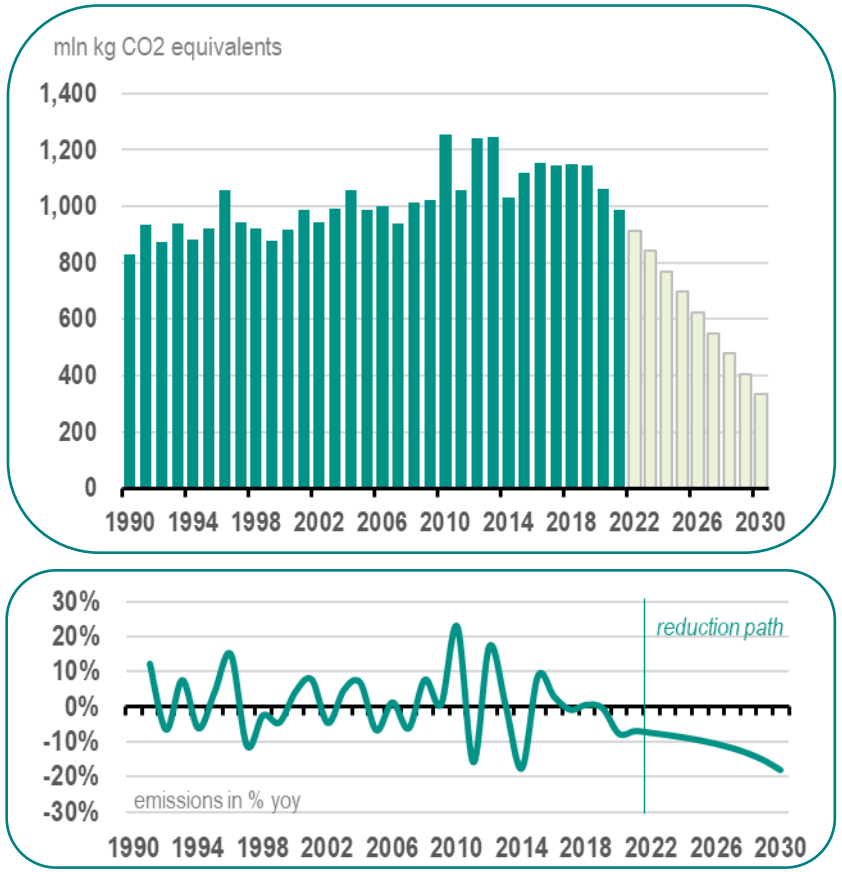
Energy costs by turnover are at an average of 2.8% over the past 10 years. This is relatively high, putting the sector in the top 5 (out of 34 sectors). Despite this relatively high energy consumption, its share in total emissions is low. Companies in the hospitality sector use about 380,000 litres of water on average every year. This concerns drinking water and its share in total drinking water use is low.

Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Hospitality

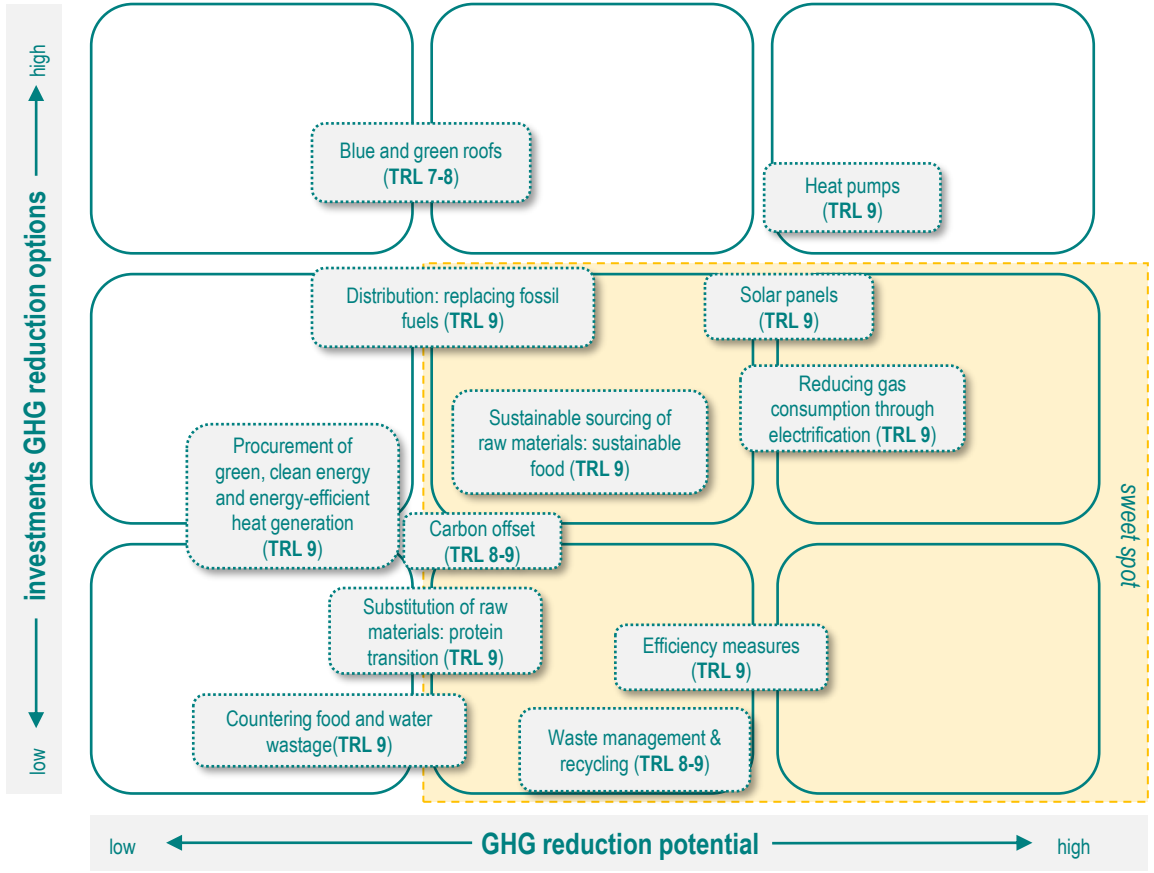
In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

Emission pathway & projection:



From 1990 to 2010, total GHG emissions in the sector increased by as much as 50%. Despite the fact that the trend towards reduced emissions seems to be getting a bit more serious from 2010 onwards, the emission reduction pathway for the hospitality sector through 2030 remains a major challenge. Historically, emissions over 20 years have increased by 1.2% annually on average, while the sector faces quite a task to tilt this into a 7.6% annual reduction in emissions. From 1 January 2024, medium-sized companies will also have to comply with the *Corporate Sustainability Reporting Directive* (CSRD). This will lead to more questions about the environmental footprint at conference hotels in particular. Hotels need to prepare for this in the coming years.

GHG reduction options: investment & effectiveness



Many of the emission reduction options in this sector are at the TRL 9 stage and have already proven themselves amply. The technologies or options that on balance have the highest emission reduction potential also tend to require relatively large investments. These include, for example, the installation of heat pumps, solar panels and electrification. Other measures in the matrix make a lot of sense, but have a slightly lower reduction potential. Consider, for instance, efficiency measures and counteracting food waste. Especially at the breakfast buffet in hotels, a lot of food is still wasted. Tackling food waste with *Orbisk* or *Winnow's* smart cameras makes sense. From 1 July 2017, the *Approved Measures List* for the hospitality industry will apply. This list contains measures entrepreneurs must take to save energy. From 1 July 2019, a registration obligation applies. Companies that consume more than 50,000 kWh of electricity or more than 25,000 m3 of gas per year must report all energy-saving measures to the RVO.

Emission reduction target:

Minimum emission reduction through 2030:
728
(in mln kg CO_2 eq.)

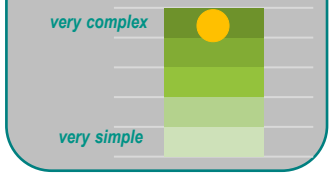
Minimum emission reduction through 2030 per year:
81
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-69%

Minimum % annually in emissions through 2030:
-7.6%

Average % annual change in emissions over last 20 years:
1.2%

Feasibility of emission target:

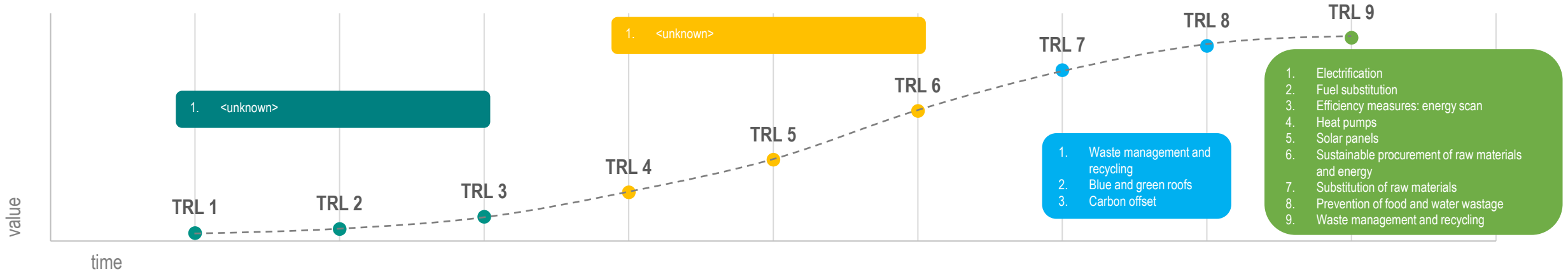


Source: KHN, CBS, ABN AMRO Group Economics

GHG emission reduction options explained: Hospitality

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new technologies, as far as we are aware. Many of the emission reduction opportunities have the TRL 9 qualification and are already widely used. This is the low-hanging fruit. With this, the best practices are now well established in the sector. Nevertheless, innovation is not standing still either.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Blue and green roofs help reduce environmental impact. With blue roofs, rainwater is captured and less water flows through to the sewer system. It can also be used for flushing toilets. Green roofs promote biodiversity.
Less waste also starts with proper screening of raw material procurement. Smart procurement and requirements on packaging materials can reduce waste and lead to a lower carbon footprint. Moreover, many waste streams released in the catering industry can be well recycled and this requires an optimal waste separation process. And so, for example, old frying fat and oil can be made into biodiesel.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Electrification of kitchen equipment and avoiding gas-based patio heaters contributes to a lower carbon footprint. An energy scan - offered by several municipalities for catering entrepreneurs - provides insight into energy consumption and shows opportunities for savings. According to KHN, this has led to considerable reductions in CO_2 emissions. Raw material substitution can also reduce greenhouse gas emissions. The protein transition is about more vegetable and less animal products. Fewer animal products leads to fewer greenhouse gas emissions. Efficiency measures cover a wide range of possibilities. Examples include an energy scan to properly map out energy consumption, LED lighting systems, censoring (in relation to unnecessary lighting), measures for more efficient indoor and outdoor lighting, insulation measures, efficient key card system and timer functions. Hospitality operators are becoming more environmentally conscious and are switching to organic and/or seasonal dishes, which makes purchasing raw materials a lot more sustainable. In addition, the logistics process in the hospitality industry can be electrified and sustainable suppliers and other chain partners can be consciously chosen.

Source: KHN, CBS, ABN AMRO Group Economics

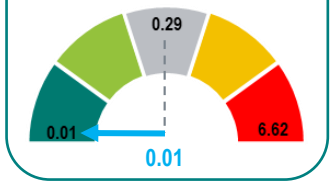
Emissions sector: Information & Communication Technology (ICT)

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in information and communication. This section includes: the production and distribution of information, the provision of the infrastructure to transmit that information, as well as data and communication information technology activities and the processing of data and other information.

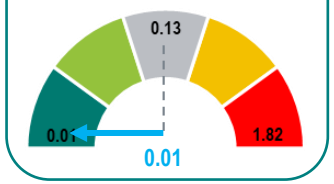
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

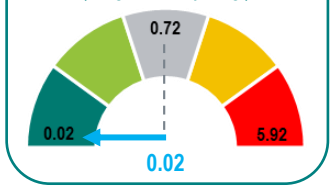
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

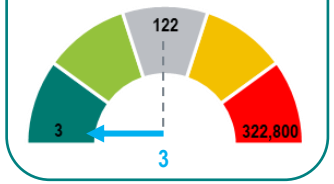


Emissions by tangible assets
(in kg/euro; 10yr avg.)

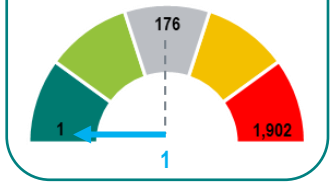


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



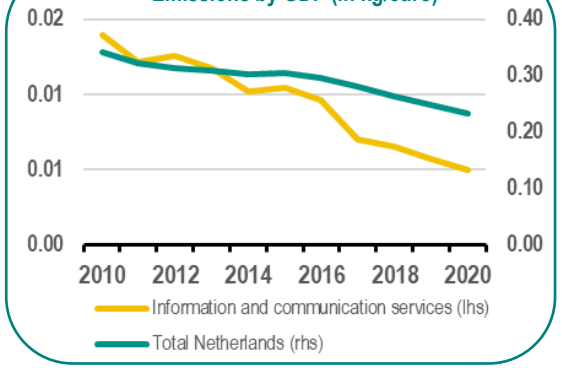
Emissions by job
(in ton/job; 10yr avg.)



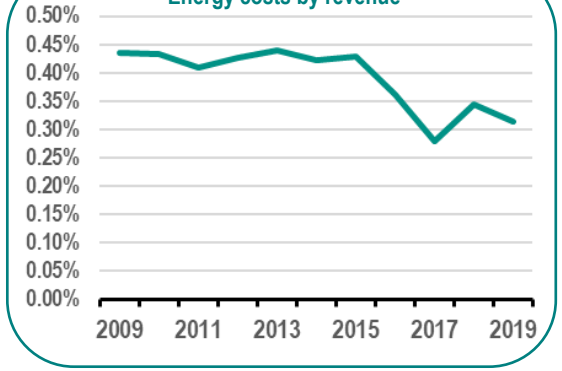
The sector consists of a multitude of sectors and, broadly speaking, the sector shows the lowest possible score on all emission indicators. In fact, it is the sector with the lowest emission intensity of all sectors active within the Dutch economy. It is mainly concerned with information distribution and data processing. These are activities that result in very few greenhouse gas emissions and thus automatically score low on the emission indicators.

Trend in emission indicators:

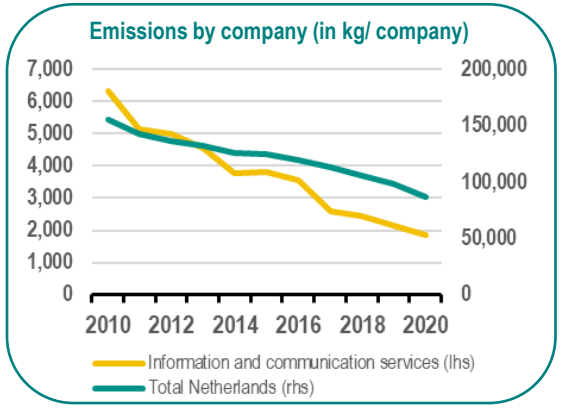
Emissions by GDP (in kg/euro)



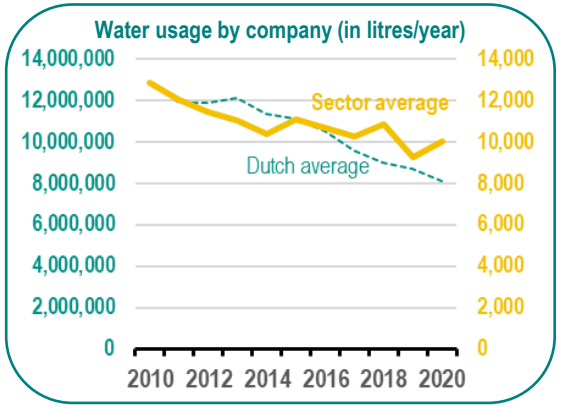
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Despite having low greenhouse gas emissions, the sector is able to show improvements on this front. Since 2010, both emissions by GDP and emissions by company have decreased more than the national average. This is mainly because since 2010, value added in the sector has increased (by 33%), the number of companies has grown (by 62%) and greenhouse gas emissions have fallen (by 53%). Energy costs by turnover have fallen sharply in since 2014, after a five-year period of stability in the indicator. However, the improvement will not contribute much in a stronger result, for that the costs are marginal. Finally, the sector's water use should not have a name and, with just under 11,000 litres of water per company on average, it is the sector with the least water use of all sectors in the Dutch economy.

Other indicators:

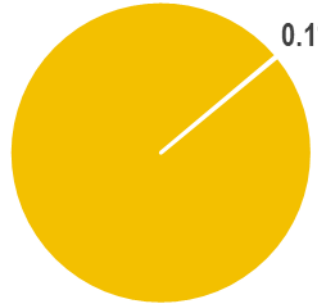
Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
3.4%

Water usage by company per year:
(in litres)
10,914

Sector share in GHG emissions:



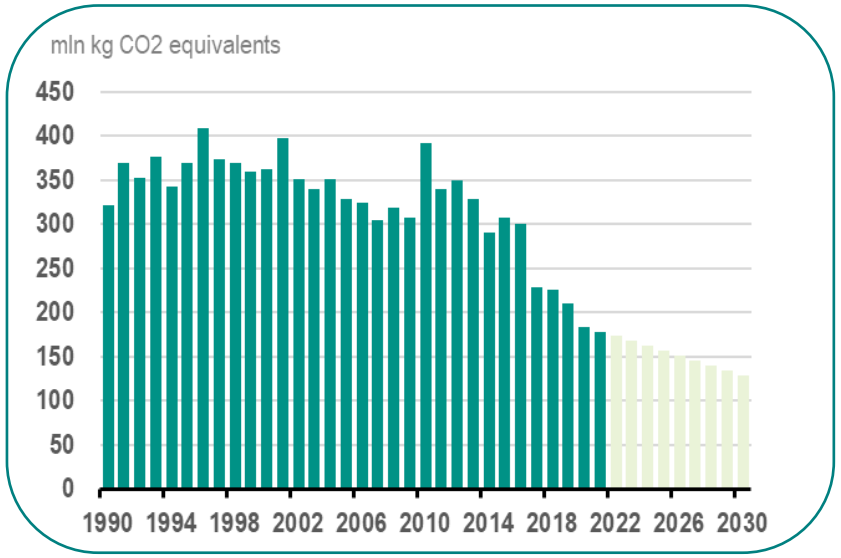
On all the above indicators, the sector scores relatively low. In many cases, it is the sector that occupies the last position. To boost the market for green IT, not only government intervention is needed, but also more cooperation and knowledge exchange between IT companies throughout the chain. See also the report 'Making IT sustainable needs push'.

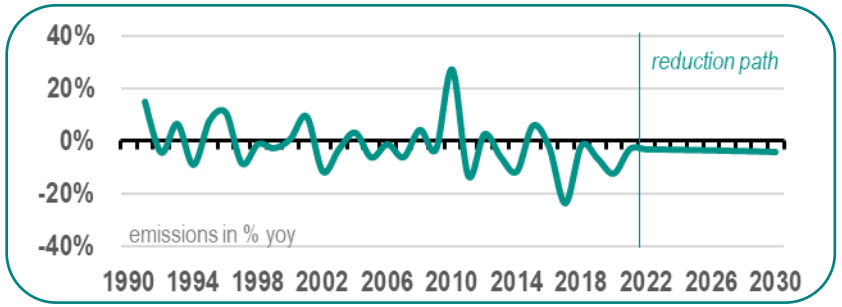
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Information & Communication Technology (ICT)

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

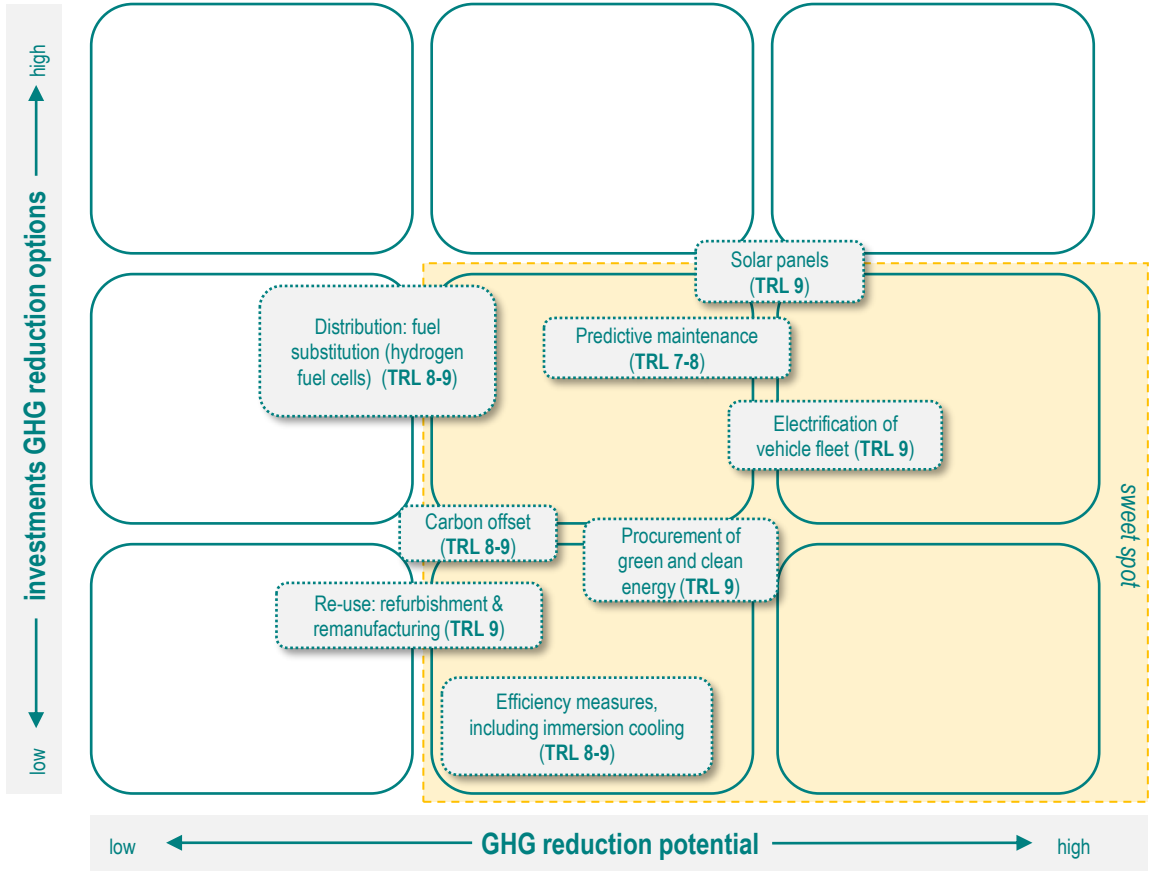
Emission pathway & projection:





While the sector's greenhouse gas emissions are relatively low compared to other sectors, they have continued to fall by as much as 43% since 1990. Specifically, this means a decrease of about 3.4% in greenhouse gas emissions on average per year over the past 20 years. However, the volatility in greenhouse gas emission figures is high. The 1996 peak is far behind us and is also no longer being reached. Before that, the efficiency of the equipment used has increased over the years. Until 2030, the sector still needs to reduce emissions by about 1.4% per year to reach the target. This seems a fairly straightforward task beforehand.

GHG reduction options: investment & effectiveness



Technology plays a fundamental role in tackling climate change and reducing emissions. In doing so, the ICT sector itself facilitates emission reductions in other sectors. It ultimately improves the effectiveness and efficiency of many processes. The major technology companies in the sector are already largely consumers of clean energy. In the sector, it is mainly about creating low-carbon and sustainable processes, which relate to reducing energy consumption. As a major consumer of IT hardware such as data servers and storage devices, the ICT sector indirectly contributes to greenhouse gas emissions caused by the energy-intensive production process of this equipment. The sector can help reduce these emissions by extending the life of IT hardware, and opting for circular equipment - including 'refurbished' hardware and hardware based on an 'as-a-Service' model.

Emission reduction target:

Minimum emission reduction through 2030:
56
(in mln kg CO_2 eq.)

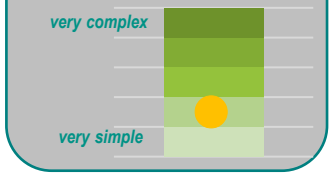
Minimum emission reduction through 2030 per year:
6
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-30%

Minimum % annually in emissions through 2030:
-3.4%

Average % annual change in emissions over last 20 years:
-1.4%

Feasibility of emission target:

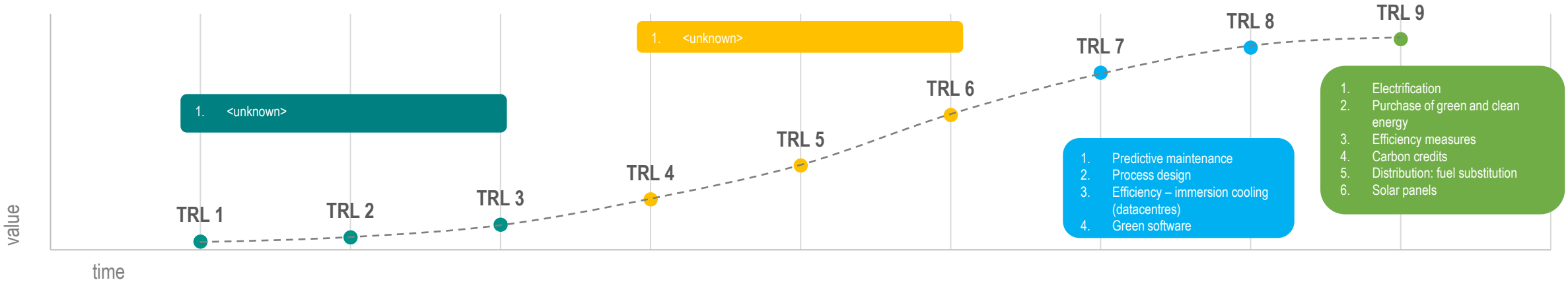


Source: NLdigital, CBS, ABN AMRO Group Economics

GHG emission reduction options explained: Information & Communication Technology (ICT)

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

Telecommunication networks and data centres consume a lot of energy, and most data centres are still powered by electricity generated by fossil fuels. As the digital ecosystem is mainly energy dependent, it remains important for ICT companies to engage in far-reaching energy efficiency measures to reduce the carbon footprint. The share of renewable energy is already over 80%.

The concept phase - as well as the test and prototype phase - still contains relatively few new technologies, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation does not stand still here either. Cooperation remains important in this sector. Not only in the chain, but also, for instance, in public-private partnerships. That way, future-proof systems and new initiatives can be worked on effectively.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Predictive maintenance enables insight into the condition of equipment. As a result, service life can be extended. With data collection, it is possible to predict maintenance needs in time. This benefits reliability and availability. An additional major advantage is that it also allows a close monitoring of energy consumption. In process design, the incorporation of data centres in the built environment is handled smarter in advance. The digital infrastructure needs to become more sustainable. According to the Amsterdam Economic Board - a network of organisations working together on the Metropolis of Tomorrow - the current data energy landscape is fragmented and this hinders sustainability. It is also looking at alternatives to air cooling, such as immersion cooling. This involves immersing critical equipment in a non-conductive coolant. A technique that is still relatively little deployed. For more on this, see the ABN AMRO article 'Need for alternative cooling data centres increases'. 'Green software' can also be used to reduce the negative effects of software on the climate by reducing its carbon emissions. Read the entrepreneurial story on this here.

Techniques commercial deployment phase:

Efficiency measures include, for example, monitoring processes to understand which part of the process is responsible for the largest carbon footprint. Data centres can take efficiency measures in cooling, temperature (through air conditioners) and accurate fine tuning of existing IT equipment and services. For a comprehensive inventory of opportunities, the European Commission has produced a Best Practices Guideline for efficiency in data centres.
And by understanding where emissions come from, companies can quickly identify opportunities for emissions reduction in different parts of the value chain and take more targeted action. The sector has already made great strides in circularity and reuse of raw materials. In addition, cooperation and knowledge sharing also indirectly provides a lot of valuable information to further reduce the carbon footprint. Finally, vehicle fleets can also be electrified. A business sustainable fleet not only helps to reduce the carbon footprint, but it also saves costs on balance.

Source: NLdigital, Amsterdam Economic Board, CBS, ABN AMRO Group Economics

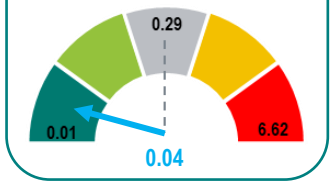
Emissions sector: Business services

Emissions involve greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in business services. This category is an aggregation of categories: consultancy, research and other specialist business services and rental of movable property and other business services.

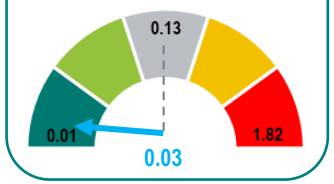
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

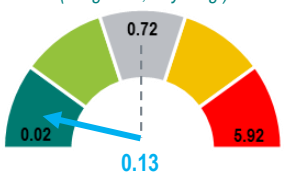
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

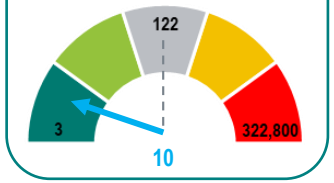


Emissions by tangible assets
(in kg/euro; 10yr avg.)

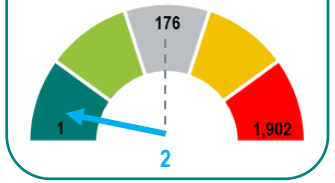


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



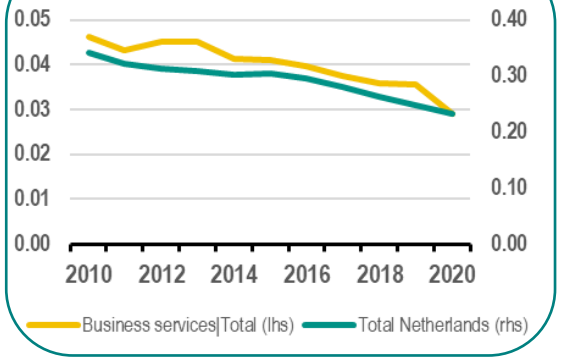
Emissions by job
(in ton/job; 10yr avg.)



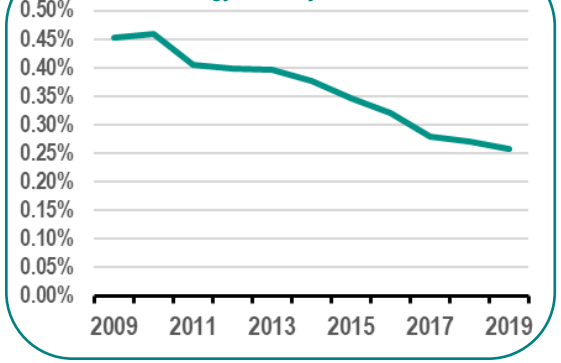
The business services sector scores low on all the above emission indicators. For instance, per euro of added value and per euro of turnover, only 0.04 kg and 0.03 kg of CO_2 are emitted, respectively. In relation to the amount of emissions to job, the score is also low. Per company, about 10,000 kg of CO_2 is emitted annually on average.

Trend in emission indicators:

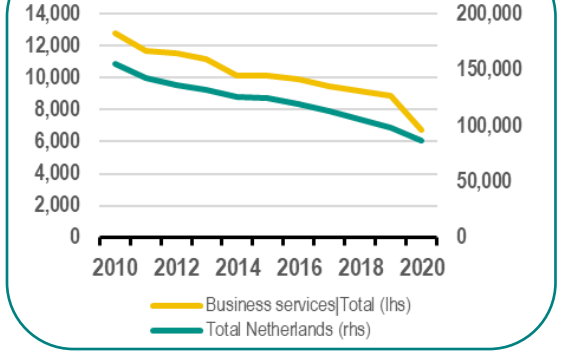
Emissions by GDP (in kg/euro)



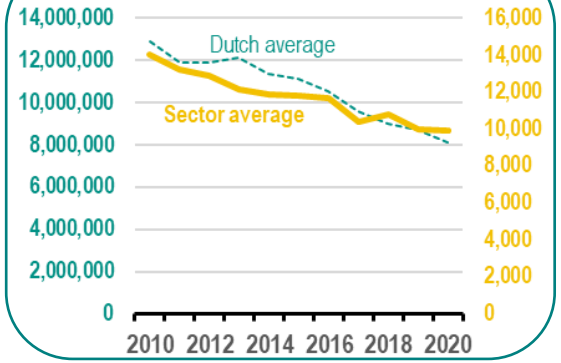
Energy costs by revenue



Emissions by company (in kg/ company)



Water usage by company (in litres/year)



Emissions by GDP and by company are much lower compared to the total Dutch economy. In 2021, emissions by GDP are factor 23 lower than the national average, while this is factor 12 for emissions by business. The trends in both emission indicators closely follow the trend in the Dutch economy. Energy costs by turnover are very low and have even fallen in 10 years from 0.45% to 0.25%. The impact of this decline on the industry's final margins is marginal. And even though water efficiency has increased in the sector - driven by declining water use and an increase in the number of companies - this will ultimately have little effect on the bottom line.

Other indicators:

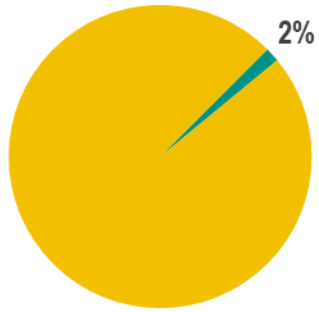
Energy costs vs. revenue:
(10yr average)
0.4%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
3.1%

Water usage by company per year:
(in litres)
11,701

Sector share in GHG emissions:



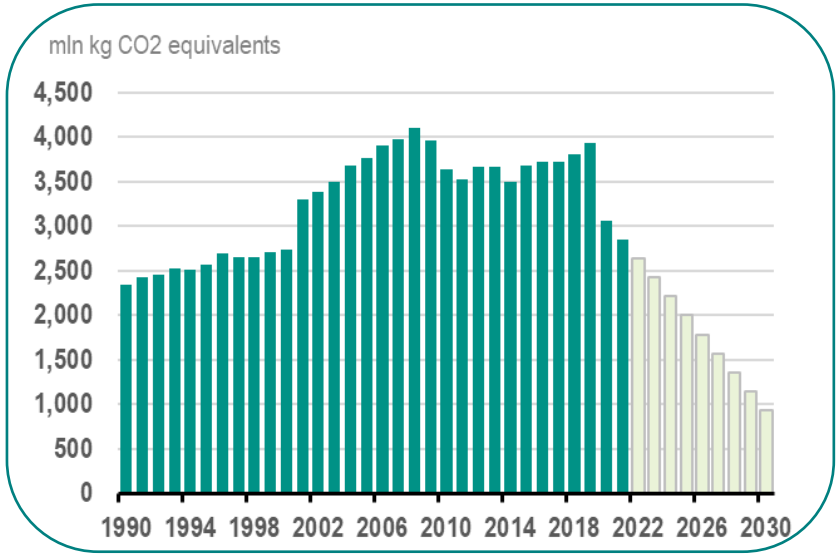
The sector has a 1.5% share of total emissions. On balance, the specialised business services subsector has a much lower share of these emissions (0.4%) than the rental and other services subsector (1.2%). The provision of knowledge typically emits very little CO_2. In terms of energy costs and water use, this sector also shows relatively low values.

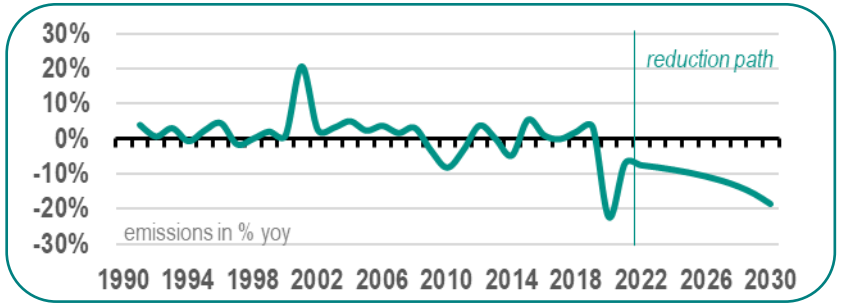
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Business services

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

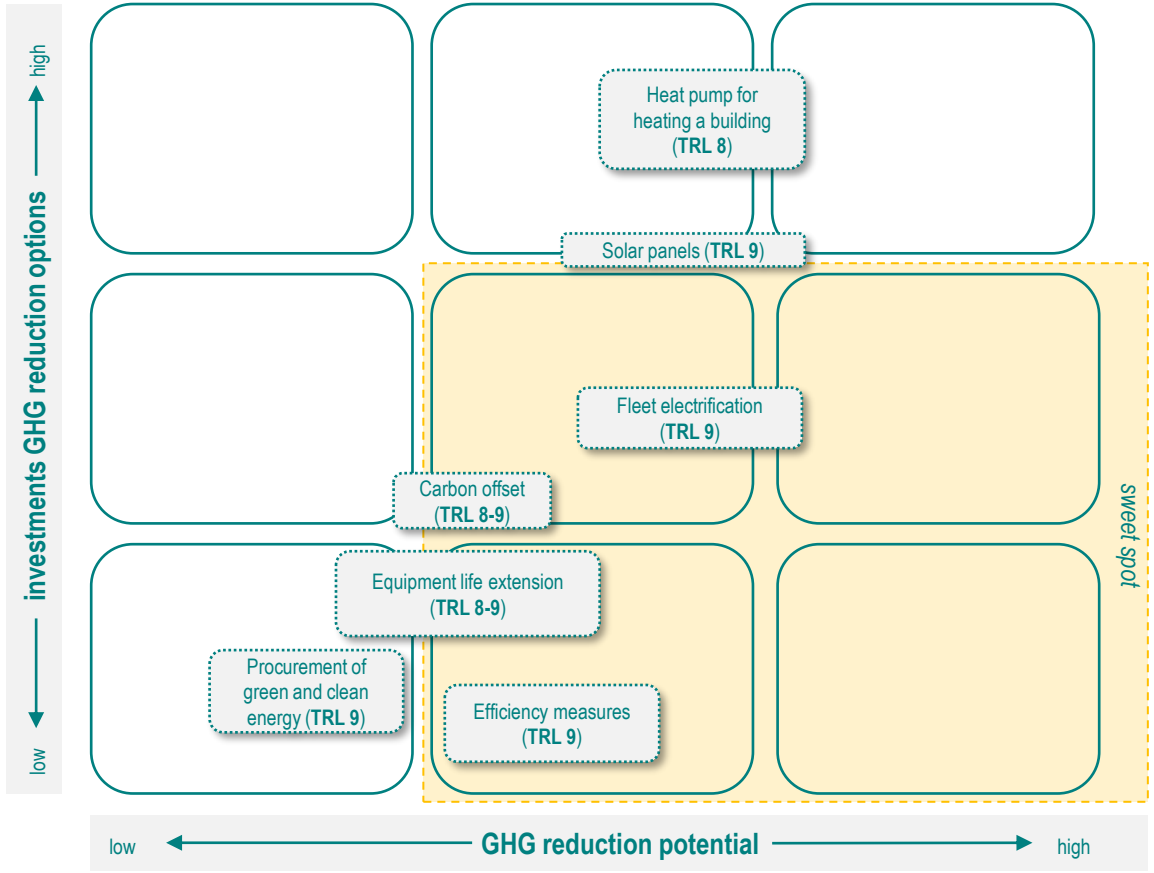
Emission pathway & projection:





Emissions increased by 31% in the sector compared to 1990. Specialist services - such as consulting and research - have had a marginal share in this. It is the rental and other services subsector - activities that support business users in running their businesses - that is entirely responsible for this increase. The corona year had a sharp downward effect on total emissions in the sector, partly due to lockdowns and a lot of working from home. The recovery period after the corona years is expected to see another increase in emissions, different from what is shown in the figure above. Up to and including 2030, the sector needs to cut around 7.7% in emissions annually.

GHG reduction options: investment & effectiveness



Business service providers have several emission reduction options. These range from sustainable purchasing (e.g. computers or other equipment with a green label or other equipment with a green label or purchasing green energy) or implementing all kinds of efficiency measures for business processes or energy consumption. of business processes or energy consumption. The opportunities for the sector usually have a relatively low emission reduction potential, but all measures together can still reduce the carbon -footprint is still quite substantial. Within business services, fixed workplaces have given way to flexi-places, quiet rooms and central function rooms in recent years. Employees have started to work a lot from home. As a result, waste flows within companies have become less intensive and the carbon footprint has been reduced slightly. Also less paper has been used and many more digital information carriers. On balance, the CO_2 -impact of this is relatively low, but any initiative to reduce emissions of GHG helps.

Emission reduction target:

Minimum emission reduction through 2030:
2,123
(in mln kg CO_2 eq.)

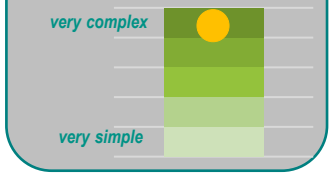
Minimum emission reduction through 2030 per year:
236
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-69%

Minimum % annually in emissions through 2030:
-7.7%

Average % annual change in emissions over last 20 years:
1.1%

Feasibility of emission target:

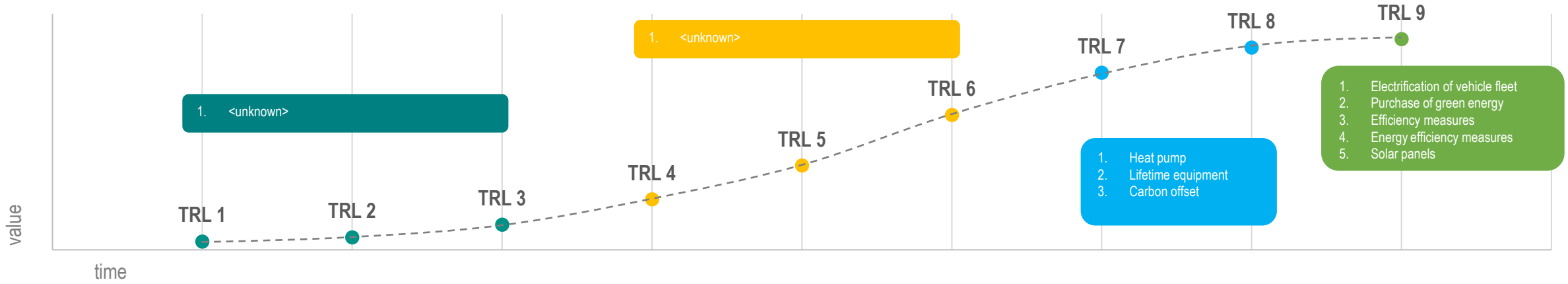


Source: CBS, ABN AMRO Group Economics

GHG emission reduction options explained: Business services

The abbreviation 'TRL' stands for 'Technical Readiness Level' (see previous sheet for a general explanation of concept and scale). The TRL 1,2 and 3 (dark green) stands for idea, concept and validation phase. The TRL 4, 5 and 6 (orange/yellow) represents testing and prototyping. TRL 7 and 8 (blue) represent pre-commercial presentation. The TRL 9 (light green) represents commercial deployment on a larger scale.

Emission reduction options for the sector by TRL:



Techniques in concept and validation phase:

The concept phase - as well as the test and prototype phase - still contains relatively few new techniques, to our knowledge. The best practices are now well established in the sector. Nevertheless, innovation is not standing still here either. Cooperation and knowledge sharing remain important in this sector. That way, future-proof systems and new initiatives can be worked on effectively.

Techniques in test and prototype phase:

Techniques in pre-commercial phase:

Life extension of equipment is not always useful or easy. But encouraging lifetime extension contributes to a lower carbon footprint. Ideally, it is about procuring electronics in a circular way and then managing them in a way that extends their lifespan and avoids e-waste.
For business service providers, the energy bill is a major cost pocket. Since office buildings are heated or cooled throughout the year, installing a heat pump can reduce the burden. For offices, a heat pump is relatively economical and provides heating and cooling for meeting rooms, kitchen, reception, office spaces, etc. Not only does it reduce the carbon footprint, but in some cases it sometimes drops energy costs by up to 40 per cent.
Carbon credit is a market mechanism that allows an organisation to offset its CO_2 emissions. When the number of carbon credits obtained equals the organisation's carbon footprint, that organisation is considered carbon neutral. The revenue generated from the purchase of the carbon credit is mostly invested in environmentally friendly projects, such as in green technologies or the R&D therein.

Techniques commercial deployment phase:

Of the total CO_2 emissions in business services, around 70% are due to business travel. Therefore, a large number of energy-saving measures and initiatives are aimed at reducing car use. For example, the company encourages the use of public transport and therefore gives every employee an NS business card. In addition, energy efficiency measures help to reduce the carbon footprint. Especially in buildings because energy consumption accounts for a large part of the total carbon emissions/energy consumption. Examples include energy-efficient laptops, green IT-settings, automatic switch-off/sleep mode of equipment (e.g. coffee machines, etc.), but also the purchase of green electricity. Regular efficiency measures can also contribute to the reduction, such as the installation of LED lighting instead of fluorescent tubes, insight into energy consumption, insulation of buildings.

Source: CBS, ABN AMRO Group Economics

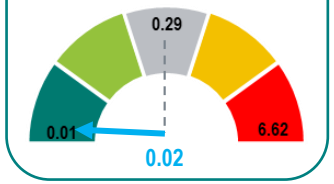
Emissions sector: Specialist business services

Emissions refer to greenhouse gas (GHG) emissions, scope 1. This sector includes companies active in consulting, research and other specialised business services. This section includes: specialised professional scientific and technical activities. These activities require high training and provide specific knowledge.

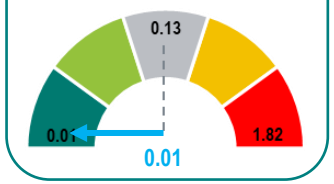
Emission indicators & intensity:

(grey dotted line = average NL score; blue arrow = sector score)

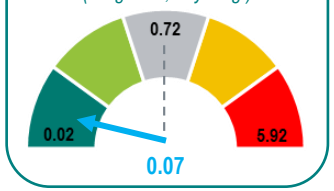
Emissions by GDP
(in kg/euro; 10yr avg.)



Emissions by revenue
(in kg/euro; 10yr avg.)

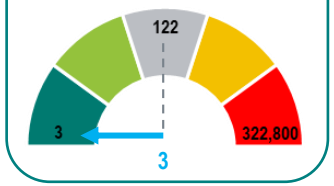


Emissions by tangible assets
(in kg/euro; 10yr avg.)

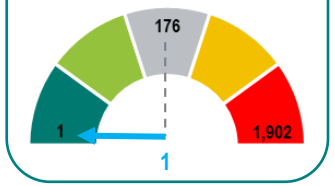


Emission intensity:

Emissions by company
(in ton/company; 10yr avg.)



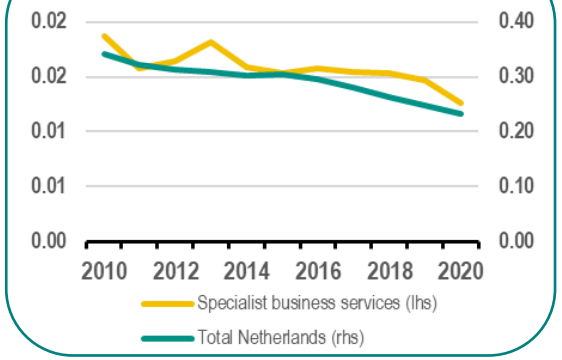
Emissions by job
(in ton/job; 10yr avg.)



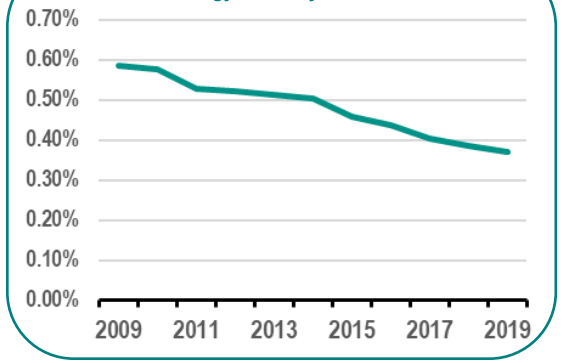
The emission intensity in this sector is relatively low. This sector involves activities that support business users in their operations and is primarily focused on transferring expertise and knowledge. This typically requires very little energy and thus the sector is responsible for a limited amount of greenhouse gas emissions. All emission indicators shown above are in the lowest rankings and the sector is even responsible for the lowest score in some cases.

Trend in emission indicators:

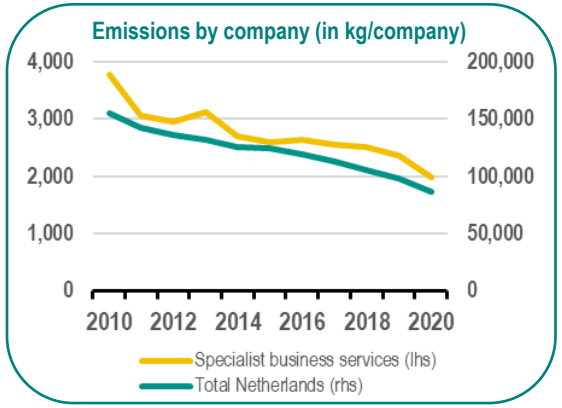
Emissions by GDP (in kg/euro)



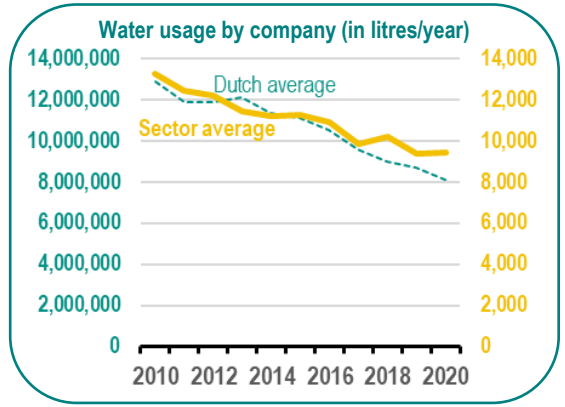
Energy costs by revenue



Emissions by company (in kg/company)



Water usage by company (in litres/year)



Emissions to GDP are on average factor 18-19 lower in the sector than the national average. However, it is clear from the figure above that the trends in the indicator closely follow each other over the years. The parallel in the trend also applies to the indicator emissions by company, except that emissions per company in the sector are almost factor 45 lower than the national average. Energy costs by turnover are low on average, fluctuating in a range of 0.60% and 0.35% over the period 2010-2020. Over the past decade, the indicator is in a downward trend, indicating an increase in energy efficiency. Water consumption has also declined over ten years per company. In 2020, water consumption per company is almost 30% lower compared to the level of water consumption per company in 2010.

Other indicators:

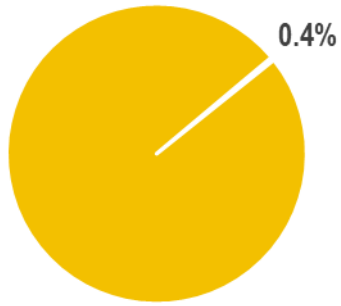
Energy costs vs. revenue:
(10yr average)
0.5%

Share in total water consumption:
0.0%

Energy costs vs. result:
(10yr average)
3.6%

Water usage by company per year:
(in litres)
11,063

Sector share in GHG emissions:



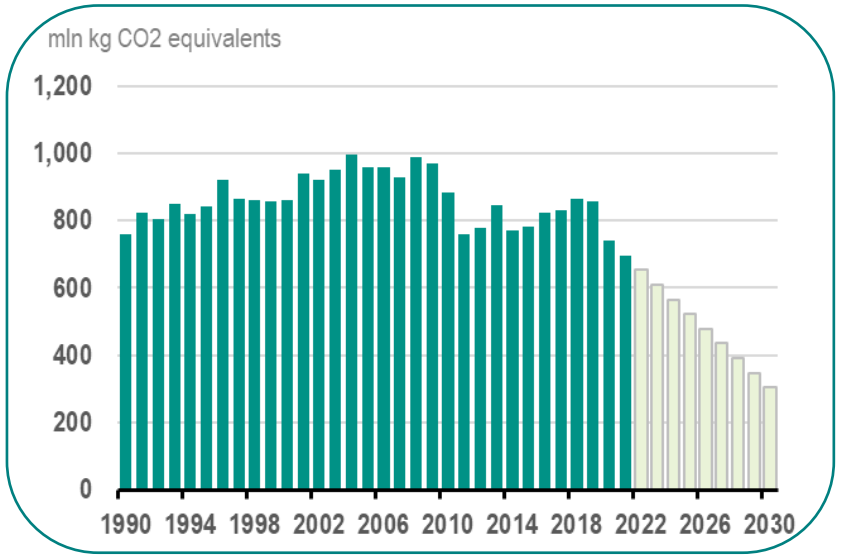
On all other indicators, specialised services also score relatively low. Both the sector's share of greenhouse gas emissions and total water consumption are marginal. Like the other service sectors, water consumption is low, ranking at the bottom of the rankings with an average of about 11,000 litres of water per company per year.

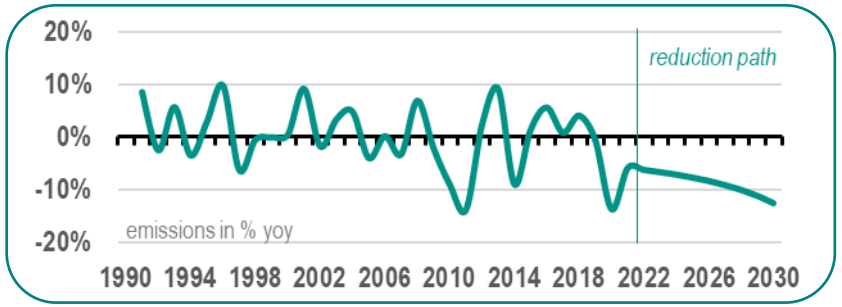
Source: CBS, ABN AMRO Group Economics

GHG emission reduction options: Specialist business services

In some sectors, separate sector agreements have been made on the emission reduction path towards 2030/50. For the sake of simplicity and comparability, we only consider here a GHG reduction of 60% of 1990 levels (Cabinet Rutte IV's climate target). Ultimately, the entire Dutch economy should aim for this level and thus all economic sectors have been given this same reduction target in this publication. The abbreviation 'TRL' in the GHG sector matrix stands for 'Technical Readiness Level'. The TRL scale represents the stage in which a new decarbonisation or emission reduction technique is at. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technique and that the technique can be deployed on a larger scale.

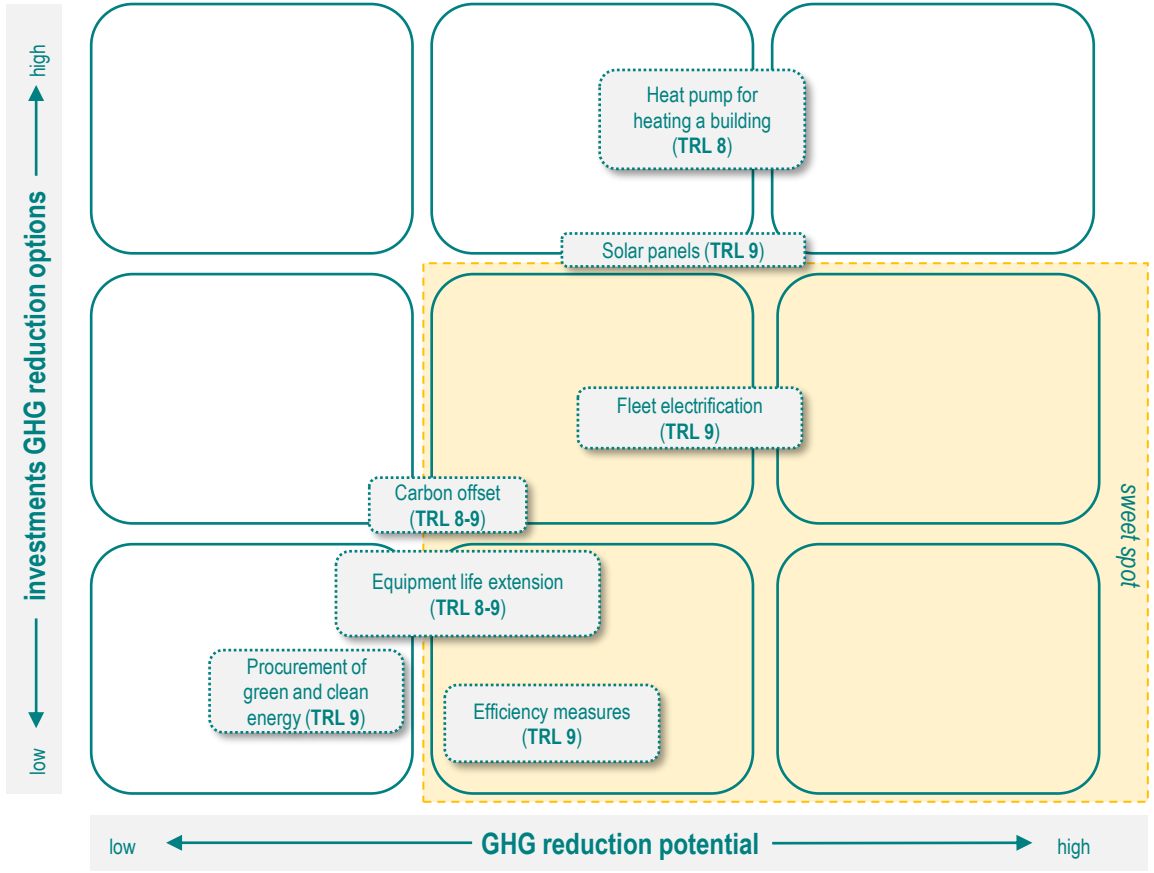
Emission pathway & projection:





The level of greenhouse gas emissions in 2020 is only 3% below 1990 levels. Thus, despite being responsible for only a marginal share of total greenhouse gas emissions, the sector has done little to reduce emissions. Over the past 20 years, the average increase in emissions has been 0.1% year-on-year. At this rate, the 2030 emissions target is still far away for the sector. Indeed, the sector still needs to reduce emissions by at least about 6.5% annually to reach the 2030 target.

GHG reduction options: investment & effectiveness



The measures in specialised business services are no to marginally different from the emission reduction options possible in business services (see previous three sheets). For a more detailed analysis of decarbonisation options, refer to the business services sheets.

Emission reduction target:

Minimum emission reduction through 2030:
436
(in mln kg CO_2 eq.)

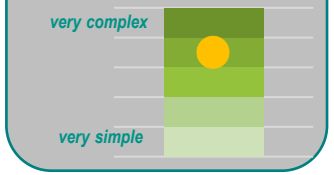
Minimum emission reduction through 2030 per year:
48
(in mln kg CO_2 eq.)

Reduction in % in emissions 2030 vs 2020:
-59%

Minimum % annually in emissions through 2030:
-6.5%

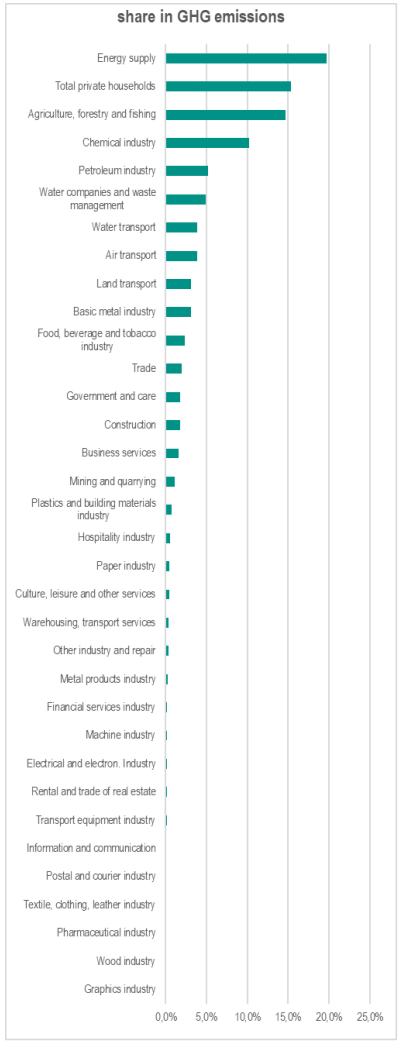
Average % annual change in emissions over last 20 years:
0.1%

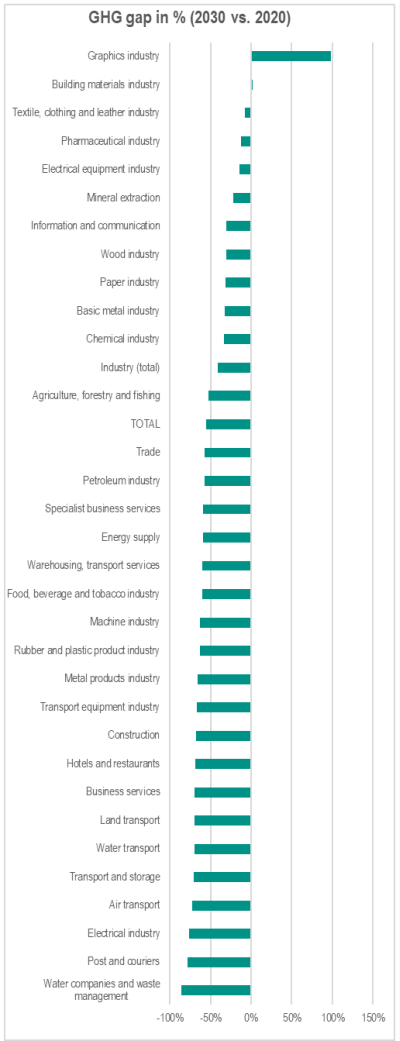
Feasibility of emission target:

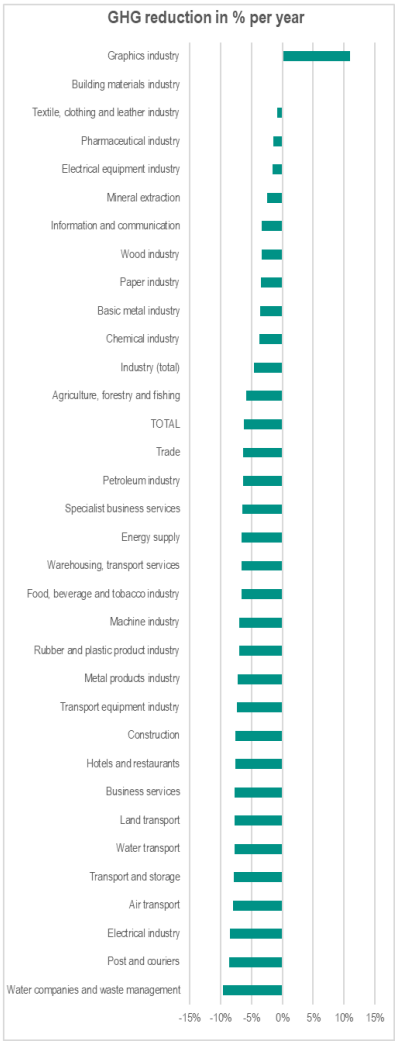


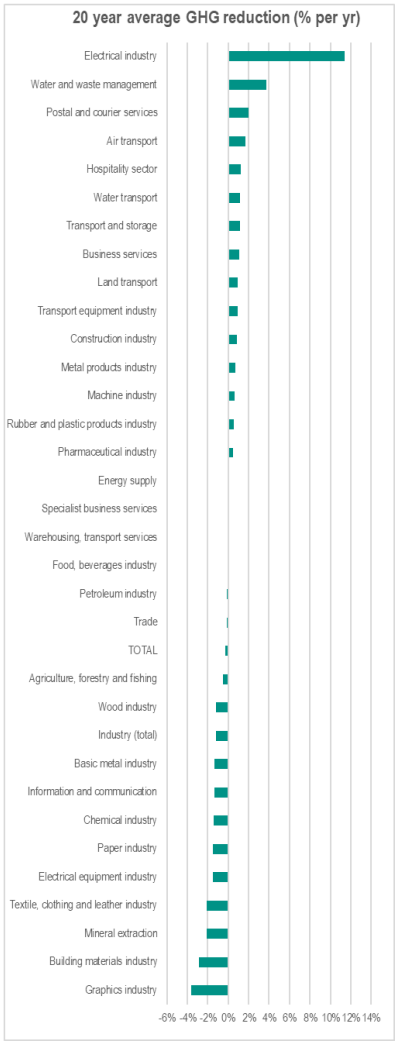
Source: CBS, ABN AMRO Group Economics

Annex - I



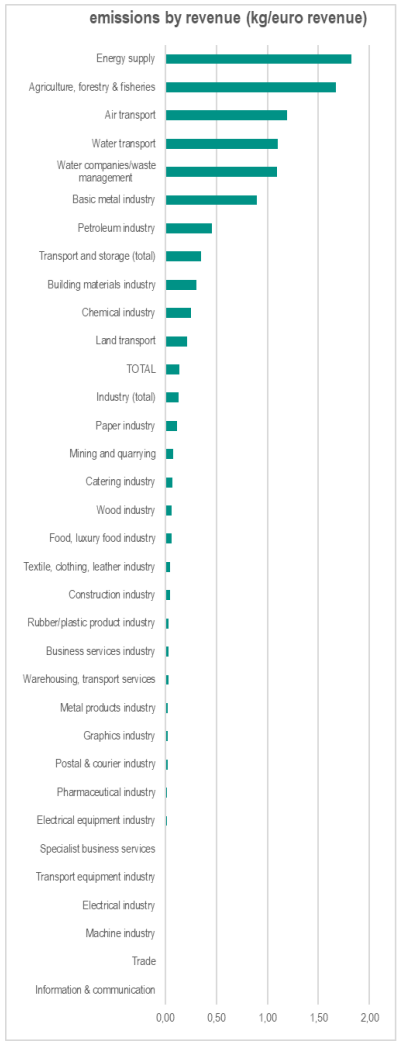


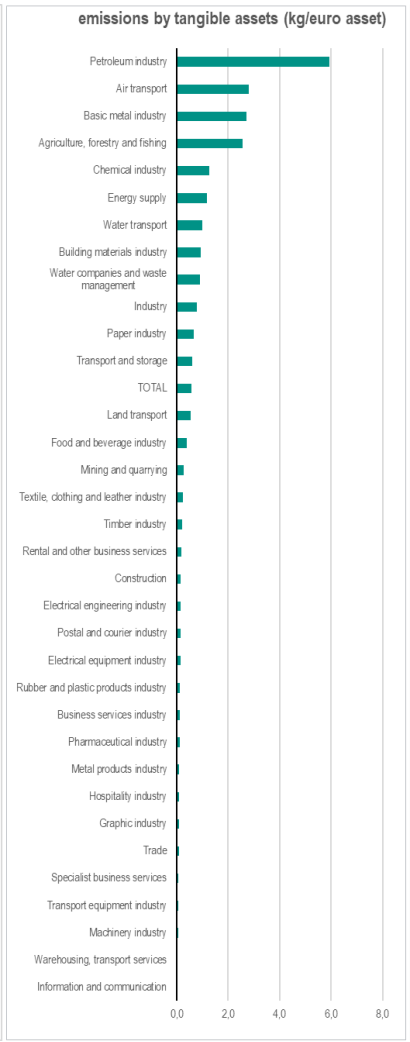


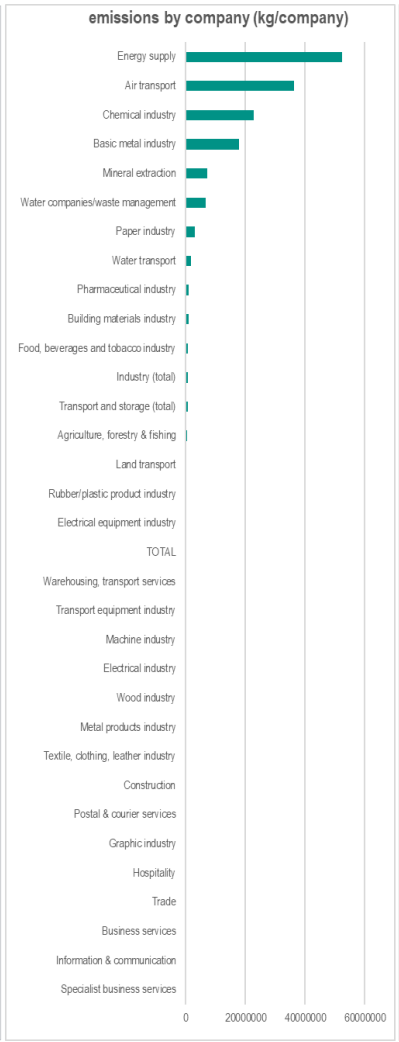


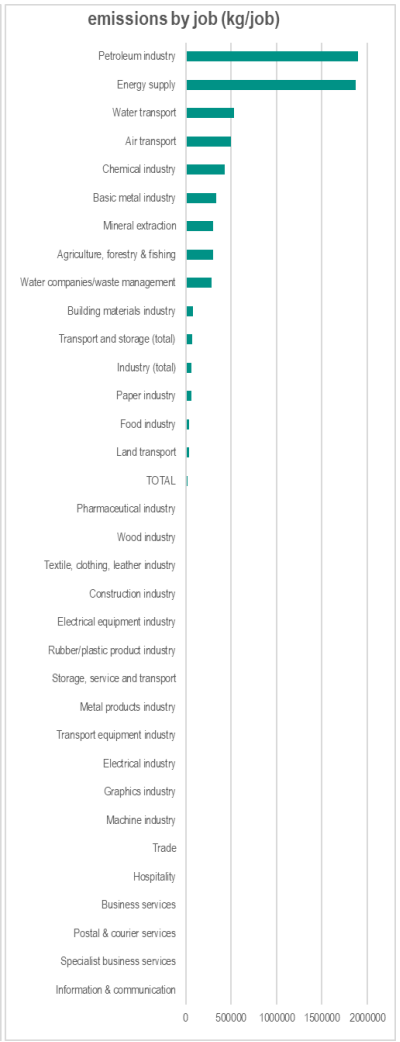
to table of contents

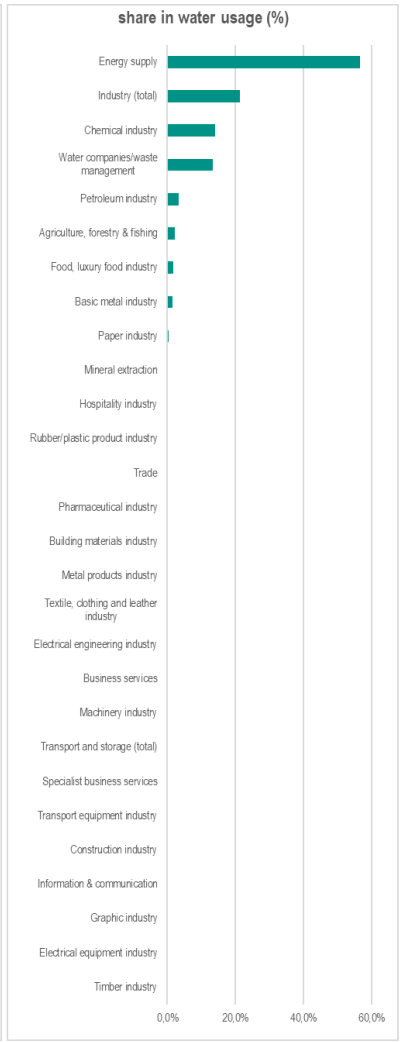
Annex - II

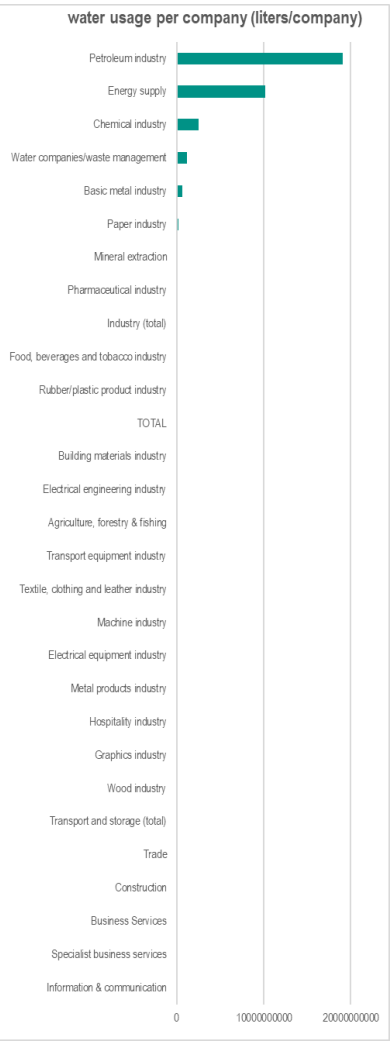












to table of contents

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The content of this report has been checked with colleagues at ABN AMRO Sector Advisory (Sector Bankers, Sector Economists and Sector Analysts)

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