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PBL Netherlands Environmental Assessment Agency

# MANUFACTURING INDUSTRY DECARBONISATION DATA EXCHANGE NETWORK – THE DATABASE (VERSION 0.4)

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**This document accompanies the MIDDEN database version 0.4. Previous versions of the MIDDEN database and this document were published on 21 November 2019, 16 March 2021, and 26 November 2021.**

MIDDEN

Manufacturing Industry Decarbonisation Data Exchange Network

# Colophon

**Manufacturing Industry Decarbonisation Data Exchange Network – The database (version 0.4)**

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## MIDDEN project coordination and responsibility

The MIDDEN project (Manufacturing Industry Decarbonisation Data Exchange Network) was initiated and is also coordinated and funded by PBL and TNO Energy Transition Studies. The project aims to support industry, policymakers, analysts, and the energy sector in their common efforts to achieve deep decarbonisation. Use of data from the database is entirely at your own risk and responsibility. PBL and TNO do not accept any liability or responsibility for the consequences of the use of the MIDDEN data or database.
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This document was previously published on 21 November 2019, 16 March 2021, and 26 November 2021, along with the previous versions of the MIDDEN database.

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# Summary


This document describes the database of the MIDDEN project (Manufacturing Industry Decarbonisation Data Exchange Network). This database contains information on current energy and material consumption of the manufacturing industry in the Netherlands and options for the decarbonisation of its processes.

The MIDDEN project aims to support industry, policymakers, analysts, and the energy sector in their collective efforts to achieve deep decarbonisation. The project will continue to update and elaborate further on options in the future, in close collaboration with the industry. In particular, this document also describes the 2024 update of the database. Important improvements and additions were made since version 0.3 was published in November 2021 that improve the coverage and usability of MIDDEN.

Data is aggregated, to a certain extent, and based on information from public sources and/or own calculations where required. It does not represent the actual situation at any of the locations, but is a rather high-level representation. No conclusions regarding an individual industry or company can be deduced from this dataset.

Our database depends on contributions and checks from our entire network and other stakeholders. If you wish to share any corrections or updates on the information in the database, please contact the project leaders (see the colophon or the website www.middenweb.nl).

# Purpose of the database

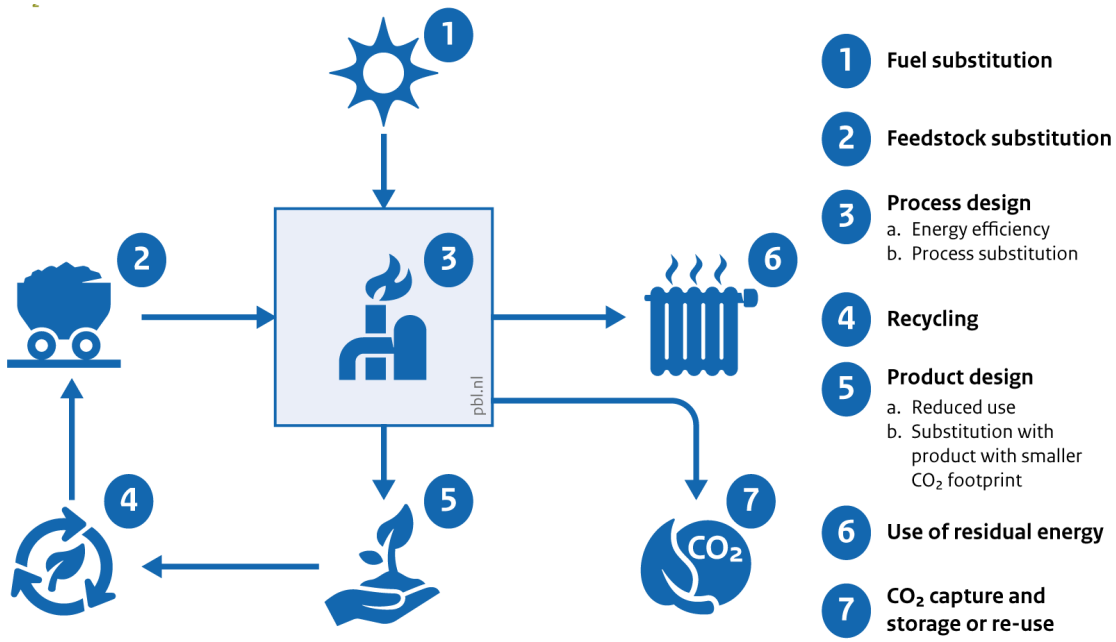
By co-signing the Paris Agreement (United Nations 2016), the Netherlands, as part of the EU, has committed to far-reaching greenhouse gas emission reduction targets for 2050, in order to mitigate global warming and the associated climate risks (Rijksoverheid 2015). For energy consumption and energy-consuming processes that currently rely heavily on fossil fuels, the consequences are extensive. One of the areas where many changes are required — with large uncertainties about what these entail — is the manufacturing industry. Many goods that we, as consumers, depend on are produced in industrial processes. Industry will need to make certain changes to those processes, in order to both provide the desired products and help the Netherlands reach its emission reduction targets.

The MIDDEN project aims to support industry, policymakers, analysts, and the energy sector in their common efforts to achieve deep decarbonisation. More specifically, in this project we look at the current situation of the manufacturing industry in the Netherlands and its options for producing the same products and/or functionality of products but with net zero greenhouse gas emissions. These options for reducing greenhouse gas emissions, now or in the future, are referred to as decarbonisation options, and may also include those that have an impact on indirect emissions or end-of-life emissions. None are automatically zero-emission options or produced without any emissions throughout the value chain. However, this aspect was outside of the scope of this project.

In order to determine whether options are feasible in a net zero-emission industry, we assumed future energy resources of electricity and biomass to have net zero emissions. This requires the electricity generation in the power sector to operate fully with net zero emissions, while for biomass, sustainability criteria are important.

Figure 1 illustrates the various categories of emission reduction, targeting either fuel, feedstock, or other options in process, recycling or product design. The categories include use of residual energy and end-of-pipe solutions (carbon capture and storage or reuse). In this respect, we look beyond merely the direct emissions.

**Figure 1**
CO2 reduction categories




Source: PBL

Consumption and production in 2050 will look very different to that of today. Other types of products may exist, companies may have started or ceased production in the Netherlands, and consumers may have other types of preferences. However, these are uncertain elements and scenario-dependent, and do not fall within the scope for this database. Moreover, in this project, we describe options and costs to the best of our ability, but please note that these may be incomplete or rapidly become out of date. Many of the short-term and smaller energy-efficiency options are not included. We are open to any corrections and updates, in order to keep data as accurate as possible.

Data is aggregated, to a certain extent, and based on information from public sources and/or own calculations where required. They may therefore not represent the exact circumstances in individual situations. Since options are listed per location, they may refer to the required infrastructure in the future or indicate possible synergies. No conclusions regarding individual industries or companies can be deduced from this database. Instead, it is our intention to illustrate the challenges that lie ahead, the types of energy sources that may be required, the innovation and infrastructure that is needed, and help to gain an understanding of where our industrial sector may be heading when it comes to energy and emissions.

More context on types of industries and how we arrived at the data presented in this database is provided in separate reports. These reports can also be found online, at www.middenweb.nl.

# Scope of the database

The scope of MIDDEN has been expanded for version 0.4. The starting point for previous versions of MIDDEN were entities that report their direct emissions to the Dutch Emissions Authority (NEa 2021, 2024). Furthermore, two selection criteria were applied:

- Annual emissions over the 2013–2017 period must average more than 10 kt $CO_2$ equivalents, and the entity is still active in 2021.
- The entities do not solely produce electricity. An exception to this criterion can be made if the entities are tightly linked to a major industrial site.

In version 0.4, the waste incineration industry is also included and several companies of the Botlek cluster, of which only three fall under ETS and report their emissions to the Dutch Emissions Authority.

# Structure of the database

The database contains two supporting sheets (README and MIDDEN) and four sheets with data (GPD, PCD, TC, and CD):

README: Sheet with a summary of the current coverage of the database and where changes with respect to previous versions will be highlighted.

MIDDEN: This sheet consists of a list of entities regarded within the scope of the MIDDEN project. It provides certain basic information on the locations and indicates the report in which the particular entity is further discussed and whether data on the entity are available in the current database. The sheet also reports the emissions of the entity (if reported to the Dutch Emissions Authority) and the respective sectors of the specific entities.

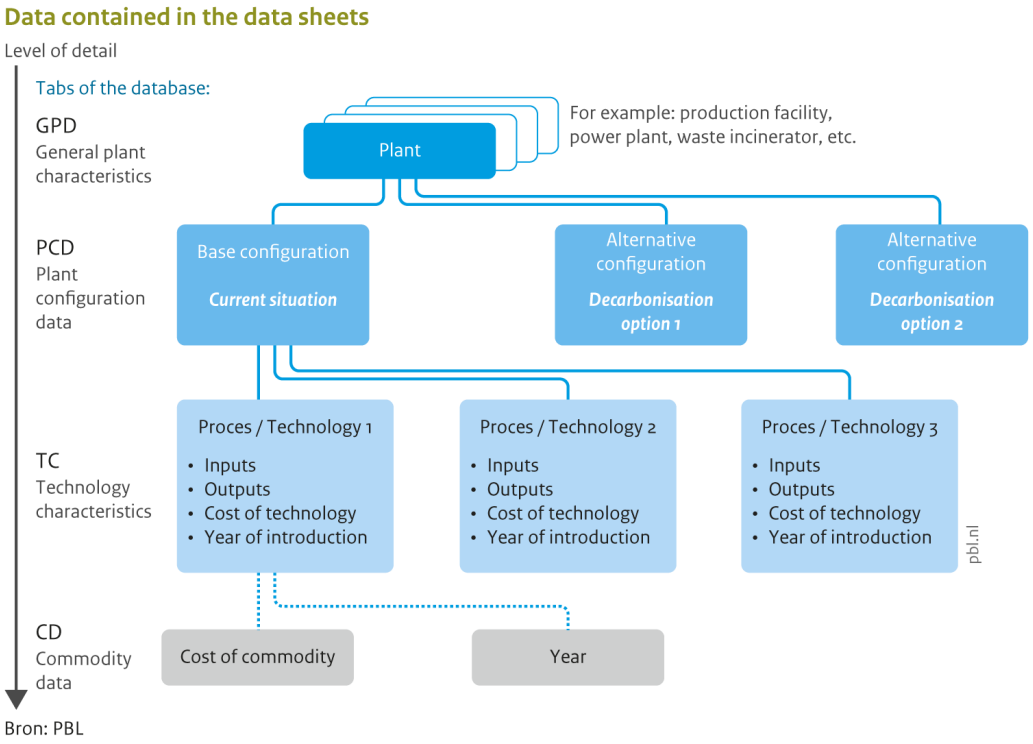
General Plant Data (GPD): This sheet contains basic information about the plants that are included in the dataset. Note that data regarding these plants in the dataset do not necessarily represent actual values for the company, but include high-level estimates based on publicly available data, average energy consumption values for certain processes, and our own assumptions and calculations. No conclusions for individual plants should be drawn on the basis of these data.

Plant Configuration Data (PCD): Plant configuration data link plants to the applied technologies. It provides information on which technologies are or can be applied, on annual production capacities, load factor/utilisation rates, and may include the total annual consumption of certain energy carriers. A base configuration may consist of multiple technologies, each in a separate row. For each site, decarbonisation options are listed in alternative configurations, and it is indicated which technology a decarbonisation option substitutes compared to the base configuration. Alternative configurations may indicate a single substitute technology, substitute the entire base configuration, or add another technology to the base configuration. In the case of substituting one technology or including an ‘add-on’ technology, this should be added to the base configuration to obtain the complete plant configuration.

Technology Characteristics (TC): Technology characteristics specify information on the technologies applied in the plant configurations. They contain information on the inputs and outputs of the processes. For decarbonisation options, it may also provide information on TRL (technology readiness level), expected year of introduction, investment and operation and maintenance (O&M) costs. This information, especially regarding more innovative options, may require regular updating.

Commodity Data (CD): This sheet contains a list of all the raw material, energy, and product inputs and outputs represented in the database.

**Figure 2**
Schematic of the data contained in the data sheets GPD, PCD, TC, and CD of the MIDDEN database



Bron: PBL

# Changes compared to version 0.3

The MIDDEN database was last updated in November 2021 with the release of version 0.3. Since then, multiple important improvements and additions have been made to MIDDEN.

## Improvements to existing sectors/processes

Over the years, the MIDDEN team as well as the MIDDEN users noticed several inconsistencies and points for improvement that required attention. The most important improvements to existing sectors and processes with respect to version 0.3 are:

- Improvement of energy use data at Tata Steel alternative processes, particularly those based on Direct Reduction of Iron.

- Since November 2021, several of the plants included in MIDDEN have been closed. These were removed from the dataset.
- In version 0.3, Shell Moerdijk produced, among other products, High Value Chemicals. HVC is an umbrella-term for several chemicals, including ethylene. For better comparison with other chemical processes, the unit of capacity of Shell Moerdijk was changed to kilotonne ethylene per year in both the PCD sheet (PCD 0748-PCD0751) and the TC sheet (TC263-TC266).
- Based on the MIDDEN update report about the fertilizer industry from February 2024, the production capacities of Yara Sluiskil for ammonia and nitric acid were updated in the PCD sheet (PCD0105-PCD0110). Using more recent data on the nitrous oxide emissions of Yara Sluiskil and OCI N.V., the emission intensity of nitric acid production has been updated (TC0075). The nitrous oxide emissions are now also reported in kilotonne CO2 equivalent.

## Addition of new sectors

Three new sectors are included in version 0.4:

- Decarbonisation options for the waste incineration sector were added based on the MIDDEN report from July 2022.
- Decarbonisation options for the asphalt sector are now also included following the MIDDEN report published in December 2022.
- The Botlek cluster is also more widely covered in version 0.4. The larger companies in the Botlek, such as Air Liquide B.V. and Shell Pernis, were already included in version 0.3. Based on the Botlek cluster report from August 2022, 10 smaller Botlek companies and their industrial processes were added to MIDDEN. The report included information about 22 companies (including 6 terminal companies) in the Botlek cluster. Several of these companies are only storage facilities without any industrial activity beyond that. For other companies, information was missing or the emissions were already marginal in the base configurations. Due to this, twelve Botlek companies were left out of MIDDEN.

## Updated $CO_2$-emissions

In version 0.3, the $CO_2$-emissions in the MIDDEN-sheet were based on 2020 ETS-emissions reported by the Dutch Emissions Authority (NEa 2021). For version 0.4, the most recent ETS-emission accounts of 2023 were used (NEa 2024). However, these accounts no longer include specifications between different Greenhouse Gas installations (BKGs in MIDDEN). This specification is only relevant for a small number of plants in MIDDEN of which the production processes are divided into different BKGs (such as Yara Sluiskil, DOW Chemical, etc.) in the database. For these plants, all emissions are attributed to the first BKG installation in version 0.4.

## Harmonisation of units

The MIDDEN database has expanded over the years to include a large part of the Dutch heavy industry with a wide-array of different production processes. To improve useability for MIDDEN-users and comparability between sectors all units have been harmonized in version 0.4. Megawatts thermal (MWth) or Megawatts electric (MWe) are used in the PCD-sheet to express the capacity of processes that produce steam/heat or electricity. The units of all other capacities, inputs or outputs in MIDDEN are now expressed in Terajoule (TJ) or kilotonne (kt). An exception is the beer and

malting industries, in particular the processes with a unit of capacity of hectolitre/year. These processes remain unchanged compared to version 0.3. Additionally, all investment costs specified in the TC-sheet are now expressed in million Euro (MEUR) per unit of capacity.

# References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