WWF

DIRTY DOZEN:
CHEMICAL INDUSTRY

Emissions from the 12 largest chemical parks in Germany

In cooperation with:

Öko-Institut e.V.
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Institute for Applied Ecology

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Foreword

Can the chemical industry protect the climate? The answer is quite clearly yes. However, in order to for this to come about, regulatory barriers have to be dismantled and renewable energies must be expanded as quickly as possible. The concepts needed for a climate-friendly transformation of the chemical sector are already available, but their implementation has been sluggish thus far. This is also because there has been a lack of insight into the sector. Where, for example, are the largest sources of emissions in the chemical industry? And what measures can be taken to reduce these high amounts of carbon dioxide?

In this report we looked at the "Dirty Dozen," the twelve chemical parks with the highest amount of emissions in Germany. These twelve heavyweights were responsible for a total of around 23 million tonnes of carbon dioxide in 2022. That is a full three percent of the overall greenhouse gas emissions in Germany – or 14 percent of emissions from the industrial sector as a whole. Germany reduced its greenhouse gas emissions by two percent between the years 2021 and 2022.[1] A climate-friendly conversion of the twelve largest chemical parks would thus make a significant contribution toward climate protection in Germany.

However, the chemical industry in Germany is still very dependent on natural gas and crude oil. The industry's heavy dependence on natural gas in particular led to challenges in recent years due to the increase in costs for natural gas during the energy price crisis. This is also shown in our report: a total of 40 percent of the Dirty Dozen's emissions do not come from the actual production processes, but rather from combined heat and power plants (CHP plants), most of which are operated with natural gas. These emissions can be reduced by making the power plants more flexible and by making direct use of electricity from wind or solar energy. In a second step, CHP plants should be replaced by the direct use of electricity and, where direct use is not possible, converted to green hydrogen.

Wind or solar energy is also needed in order to produce green hydrogen. The expansion of renewable energies in Germany is unavoidable, especially because the electricity demand on the part of the chemical industry is enormous. In order to reduce the demand for electricity from precious renewable energies, the chemical industry will have to focus on long-lasting products, alternative materials and optimum recycling.

The products in the chemical industry are manifold and supplied to a wide range of sectors in Germany and abroad. Plastics alone account for approximately 20 percent of sales in the chemical industry. Their production is based on crude oil. The replacement of fossil raw materials and crude oil for material use with green hydrogen and its derivatives (power-to-X products) will play

1 https://www.umweltbundesamt.de/daten/klima/treibhausgas-emissionen-in-deutschland#emissionsentwicklung

an increasingly important role in the medium and long term. Reducing the need for plastics, using them in long-lasting products and properly recycling them would not only prevent the pollution of our oceans, but also reduce the need for primary raw materials and thus protect the climate. The potentials of the circular economy when it comes to transformation of the chemical industry have yet to receive adequate attention.

Germany can remain a competitive and attractive place to do business. This requires sector-specific measures for the chemical industry. In our report we present measures to reduce emissions in the chemical industry. The focus is placed on measures that should be implemented as a priority. And, further medium- to long-term measures to reduce emissions are required in order to successfully defossilize the chemical industry:

Chemical companies have to get themselves in shape for climate neutrality:

- This means that companies will have to establish science-based climate and environmental targets, and submit medium-to-long-term transition plans.

Elimination of fossil fuel subsidies:

- In the last reform of the EU Emissions Trading System, an agreement was reached to end free allocation in the sectors covered by the carbon border adjustment mechanism (CBAM sectors) starting in the year 2034. This is too late. From WWF's point of view, a much earlier phase-out would have led more quickly to an effective price signal that would provide incentives for defossilization in the chemical industry as well. The abolition of free allocation and the resultant passing-on of the price signal would have a steering effect and give the industry planning certainty in order to make the right investment decisions in the long term.

Electrification:

- The direct electrification of process heat is essential for transformation of the chemical industry and makes a valuable contribution toward saving natural gas. The electricity required for electrification should come from renewable energies. Energy efficiency should be a top priority here as well; for example, by reusing waste heat in order to generate heat.[2]

Implementing a circular economy:

- When it comes to implementation, the chemical industry must make the circular economy in the value chain possible through materials and measures that reduce the consumption of resources and improve material efficiency.
- Binding resource targets that also follow climate targets must be agreed by policymakers and implemented and monitored within the legal framework of a resource protection law.[3]
- A financial and tax policy geared towards a circular economy that promotes investment in circular business models, reduces environmentally harmful subsidies and places a fiscal burden on resource-intensive production and consumption methods is urgently needed. In particular, this would reduce the advantages for resource-intensive technologies and practices that distort competition.
- A packaging resource tax and an obligation to offer unpackaged and reusable systems as well as a charge on packaging that is not highly recyclable should be introduced for the packaging sector. These instruments are particularly effective if they complement each other. They would thus help to reduce the consumption of resources.

Strict framework conditions for using Carbon Capture and Utilization (CCU) for the resource base in the chemical industry:

- As the known circular strategies (reduce, reuse, recycle) will presumably not suffice in order to achieve climate neutrality in the plastics industry, other approaches such as the production of plastics from carbon dioxide (CCU) and the use of biotic raw materials can contribute to the circular economy in the plastics sector.
- It is essential to observe a hierarchy between these strategies, one which should be based on energy demand and land use needs.
- In addition, permanent binding of CO_2 in the product should be ensured, particularly as CCU is a very energy-intensive process.[4]

2 https://static.agora-energiewende.de/fileadmin/Projekte/2022/2022-02_IND_Climate_Positive_Chemistry_DE/A-EW_299_Chemie_im_Wandel_DE_WEB.pdf
3 https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Unternehmen/WWF-Modell-Deutschland-Circular-Economy-Modellierung.pdf
4 https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/CCU-Position-Wie-klimaneutral-ist-CO2-als-Rohstoff.pdf

Creating green markets:

- The introduction of green public procurement can have a strong impact on climate protection, the circular economy and the creation of green lead markets in the chemical industry. Public procurement in Germany alone amounts to an annual investment volume of EUR 500 billion. Up to now, however, public contracts have been awarded primarily on the basis of economic efficiency, without taking the true environmental costs into account.

Expanding renewable energies:

- The chemical industry must continue to lobby for the expansion of renewable energies, particularly wind and solar energy. The German government must initiate further steps towards the rapid and comprehensive expansion of wind and solar energy. The two percent land-use target for onshore wind energy systems in accordance with the German Wind Area Requirements Act [WindBG] should be met by the end of 2025.
- The competent authorities must be equipped with sufficient staff and funding in order to effectively handle the increase in approval procedures engendered by the huge expansion of renewable energies. In addition to the simplification and standardization of approval procedures, what is needed above all else is comprehensive digitalization.
- Subsidies for renewable energies must be reliably available up to the year 2030 – even after coal is phased out – in order to provide incentives for the necessary investments. If there is a switch to the Contracts for Difference model, then it must be ensured that flexibility incentives are maintained.
- Attractive conditions and the removal of barriers to power purchase agreements (PPAs) between operators of renewable energy plants and industry are needed. Access to such PPAs must be simplified, especially for small- and medium-sized enterprises.
- The industry is called upon to leverage its flexibility potential in order to make the best possible use of the cost advantages in periods when an abundance of electricity is generated from renewable energies. To this end, a reform of grid fees, for example, should provide incentives and work towards greater flexibilization. The comprehensive expansion of smart metering systems is also needed.
- When implementing the capacity mechanisms currently under discussion, it is essential to ensure that the plants are converted to hydrogen in the future in order to prevent fossil lock-in when it comes to the construction of gas-fired power plants. The capacity mechanism should also take storage technologies and flexibilization of demand into account.

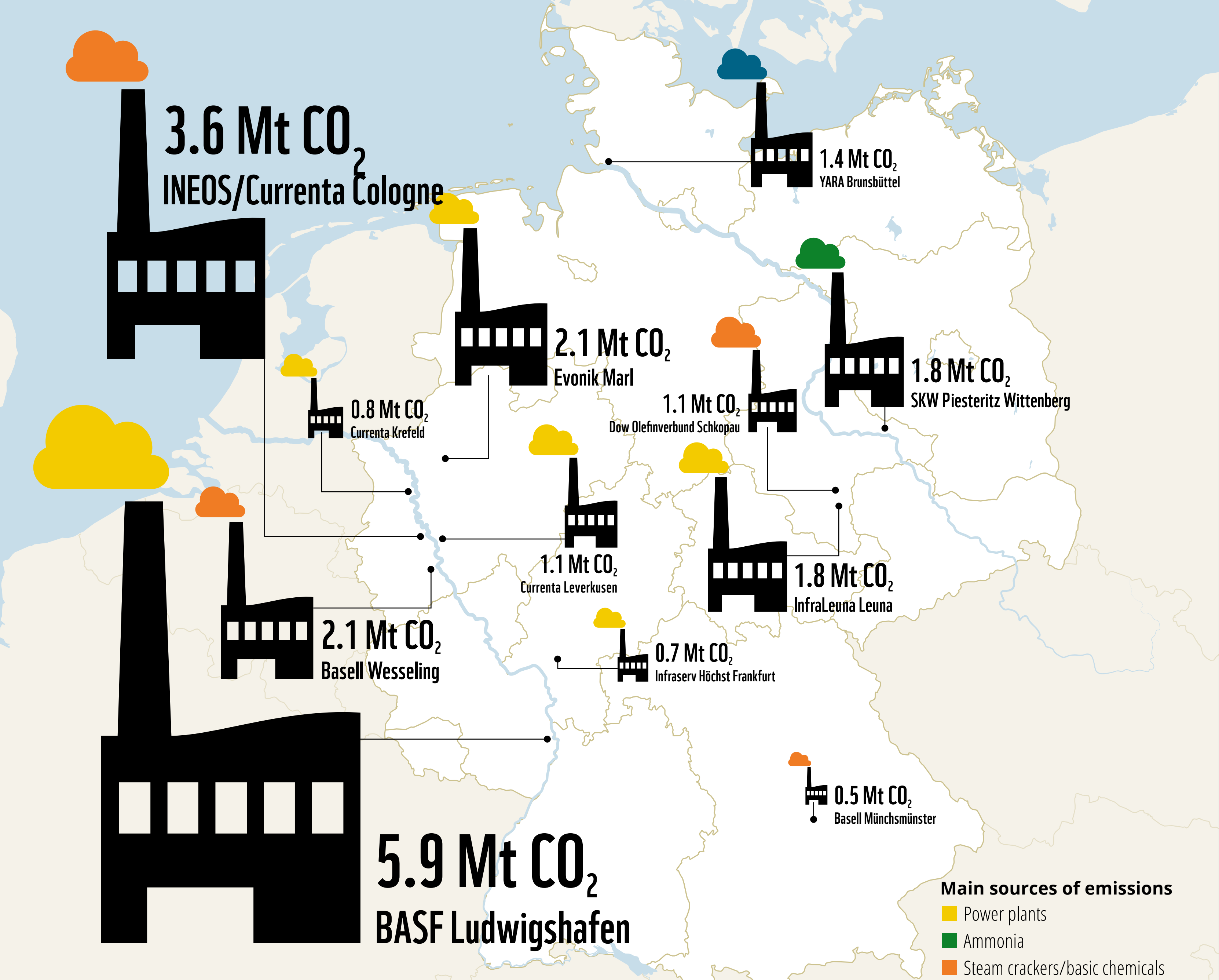


Figure 1-1: The twelve largest chemical parks in German industry

1 Introduction and overview

In June 2023, WWF published its report "Dirty Thirty – Emissions from the industrial sector in Germany". It examines the thirty most CO_2-intensive industrial plants from the iron and steel, and cement and chemicals sectors that are listed in the EU Emissions Trading System (EU ETS). However, the chemical industry has the particularity that it usually operates several ETS plants at one and the same location (a chemical park).

For this reason, we carried out an in-depth analysis of the composition of emissions from the largest chemical parks. This analysis was based on the verified emissions for the year 2022 as published within the scope of the EU Emissions Trading System. The industrial combined heat and power plants (CHP plants) operated at the respective sites were also taken into account.

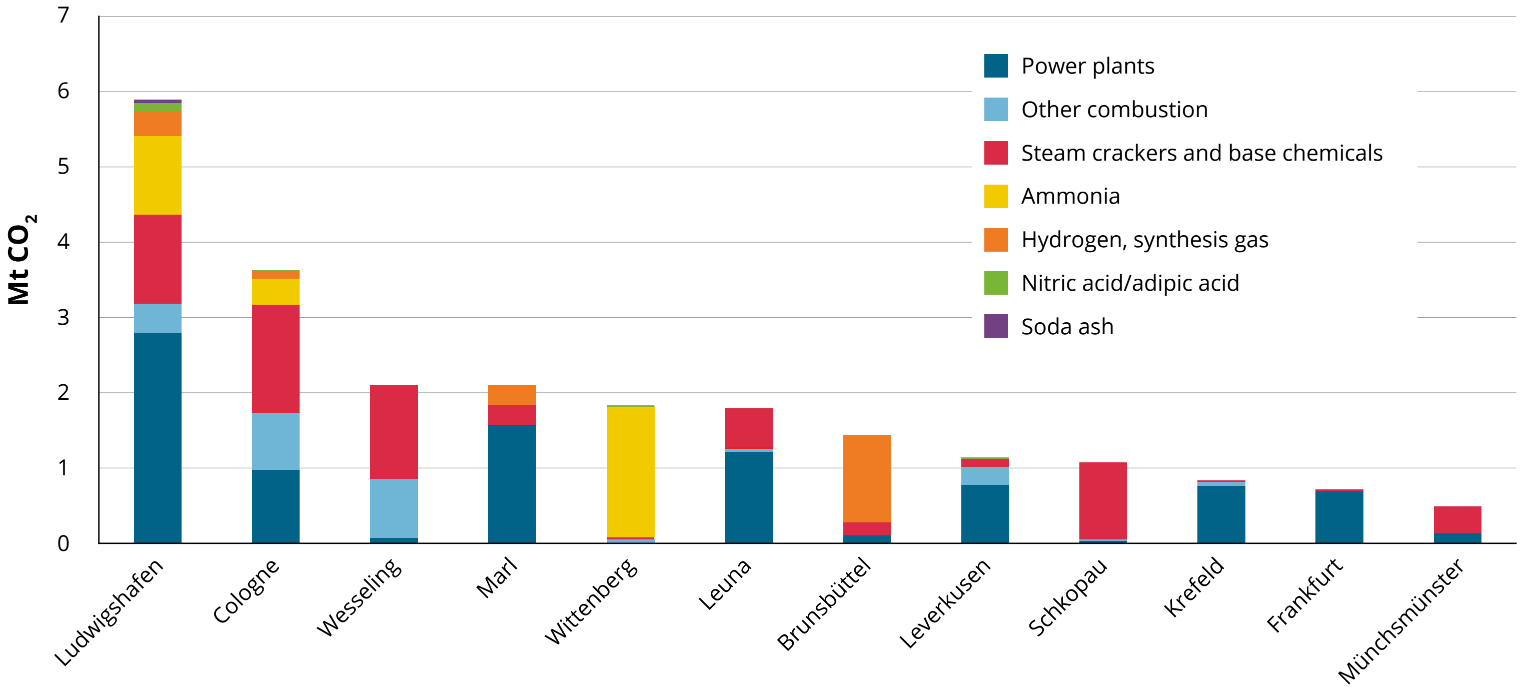
Table 1-1 provides an overview of the twelve largest chemical parks in Germany (as of 2022). The largest chemical park is represented by the BASF site in Ludwigshafen with a total of 5.9 million tonnes of CO_2 (Mt CO_2).[5] This BASF site is not only the largest emitter, but at the same time one of the few

5 In the main, EU emissions trading in the chemical industry only covers CO_2 emissions. N_2O emissions are also reported for adipic acid and nitric acid production. These are converted into CO_2 equivalents. For the sake of simplicity, emissions are always stated in tonnes of CO_2 in this report, even if the precise unit would actually be CO_2 equivalents.

integrated chemical parks where only a single company's facilities are operated. As a rule, plants from various companies are in operation at the other chemical parks. This is the case, for example, at Germany's second-largest chemical park. The INEOS/Currenta site in Cologne/Dormagen emitted a total of 3.6 Mt CO_2 in 2022.[6]

The EU ETS reports emissions broken down by business activity. Emissions in the twelve largest industrial parks are attributable to industrial CHP plants (40 percent), followed by steam crackers and base chemicals with 24 percent, ammonia with 14 percent and hydrogen and synthesis gas with ten percent. Other combustion plants (excluding power plants) account for ten percent of emissions, adipic acid and nitric acid for one percent and the production of soda ash for less than one percent. This clearly shows that the production of chemical base materials such as ethylene, ammonia and hydrogen results in high direct emissions. Further processing causes comparatively low emissions. The main source of emissions in the individual industrial parks differs significantly. In some chemical parks emissions from CHP plants dominate, while in others those from steam crackers or ammonia production (see Figure 1-2).

Figure 1-2: Largest chemical parks in Germany in 2022 (source: EUTL)



Altogether, the twelve largest chemical parks caused 23 Mt CO_2 2022. These emissions are significantly higher (11.7 Mt CO_2) than those of the 30 largest individual emitters reporting within the scope of the business activities of the chemical industry (see Table 3-3 in Oeko-Institut, 2023). They are also higher than the sum of direct emissions of all industrial ETS activities in the chemical industry (activities 38-44) as a whole. The latter added up to 14 Mt CO_2 in 2022 (see Table 3-1 in Oeko-Institut, 2023). This can be explained by the high amount of emissions from industrial CHP plants, which are not reported under the business activities of the chemical industry in EU emissions trading (Activities 38-44), but instead under Activity Code 20 "Combustion installations".

Reporting under the EU ETS only includes the direct CO_2 emissions of the installations covered (Scope 1). Indirect emissions, such as from the purchase of electricity (Scope 2) and emissions from the use of products (Scope 3, for example waste incineration at the end of the life cycle) are not reported under the EU ETS and therefore cannot be taken into consideration in this report.

6 Predecessor companies go back to Bayer AG, which has restructured itself significantly since 2002 and, for example, spun off the production of base chemicals into independent companies.

Table 1-1: Largest chemical parks in Germany in 2022

Plant	Activity	BASF	INEOS/ Currenta	Basell	Evonik	SKW Piesteritz	Infra-Leuna	YARA	Currenta	Dow Olefin-verbund	Currenta	Infraserv Höchst	Basell	Total	Share
		Ludwigs-hafen	Köln	Wesseling	Marl	Witten-berg	Leuna	Bruns-büttel	Lever-kusen	Schkopau	Krefeld	Frankfurt	Münchs-münster		
		Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	
Power plants	20	2.80	0.97	0.07	1.57	0.00	1.22	0.10	0.78	0.03	0.76	0.70	0.13	9.13	40%
Other incineration	20	0.39	0.76	0.79	-	0.06	0.03	0.01	0.24	0.02	0.05	0.00	0.00	2.35	10%
Nitric acid/ adipic acid	38/39	0.11	0.00	-	-	0.02	0.01	-	0.02	-	-	-	-	0.15	1%
Ammonia	41	1.05	0.35	-	-	1.74	-	-	-	-	-	-	-	3.14	14%
Steam crackers and base chemicals	42	1.18	1.43	1.25	0.27	0.02	0.03	0.17	0.11	1.02	0.01	0.02	0.36	5.86	24%
Hydrogen, synthesis gas	43	0.33	0.10	-	0.26	-	0.51	1.16	-	-	-	-	-	2.37	10%
Soda ash	44	0.04	-	-	-	-	-	-	-	-	-	-	-	0.04	0%
Total		**5.89**	**3.62**	**2.10**	**2.10**	**1.83**	**1.80**	**1.44**	**1.14**	**1.07**	**0.83**	**0.71**	**0.49**	**23.03**	**100%**

Source: EUTL

2 Methodological approach

The starting point for the analysis was the list of the thirty largest ETS plants in the chemical industry presented in the study “Dirty Thirty – Emissions from the industrial sector in Germany”. For each of these thirty ETS plants the authors checked the European Union Transaction Log (EUTL) to determine whether other plants are operated at the site. The respective plant lists of the chemical parks are presented in the following chapter. A “broad” definition of chemical parks was used. In the following, neighbouring industrial plants within a city are also grouped together as one park as there are usually supply relationships between neighbouring chemical plants.

This report also investigated the question as to whether or not there are any other large chemical parks in Germany whose facilities are not on the chemical industry’s Dirty Thirty list. Chemical parks with more than 8,000 employees were included here. Thus the Currenta sites (formerly Bayer) in Leverkusen and Krefeld/Uerdingen and Infraserv’s chemical park in Frankfurt-Höchst were able to be identified. The chemical park in Bitterfeld also has a high number of employees, but no major emitters were determined at this site.

The following chapter presents the production facilities of the twelve largest chemical parks (sorted by CO_2 emissions in descending order). Plants that did not report any emissions in 2022 are not shown. There may be differences between the individual emissions and the total due to rounding to one decimal place.

3 Chemical parks in detail

Table 3-1: Emissions from the BASF Ludwigshafen chemical park in million tonnes of CO_2

EUTL ID	Operator	Plant	Activity	Emissions
DE 1855	BASF SE	Combined gas and steam turbine plant A 800	20	1.4
DE 1484	BASF SE	Combined gas and steam turbine South (C200)	20	0.9
DE 201960	BASF SE	Ammonia plant 4	41	0.8
DE 2299	BASF SE	Steam cracker 2	42	0.5
DE 1116	BASF SE	North power plant	20	0.4
DE 201962	BASF SE	Ammonia plant 3	41	0.3
DE 1117	BASF SE	Steam boiler U 160	20	0.2
DE 2298	BASF SE	Steam cracker 1	42	0.2
DE 201955	BASF SE	Hydrogen plant	43	0.2
DE 201954	BASF SE	Synthesis gas plant as of 2013	43	0.2
DE 1692	BASF SE	Quick-start reserve boiler	20	0.1
DE 201957	BASF SE	Nitric acid plant	38	0.1
Plants < 0.1 Mt CO_2				**0.6**
Total				**5.9**

Source: EUTL

Table 3-1 shows the emissions from BASF's industrial park in Ludwigshafen, which consists of a total of 42 plants. The twelve largest plants are shown in Table 3-1; plants with emissions of less than 0.1 Mt CO_2 are included in Annex 1. The largest emitters there are two CHP plants, followed by an ammonia production plant and a steam cracker. A total of three natural gas power plants are operated at this site.

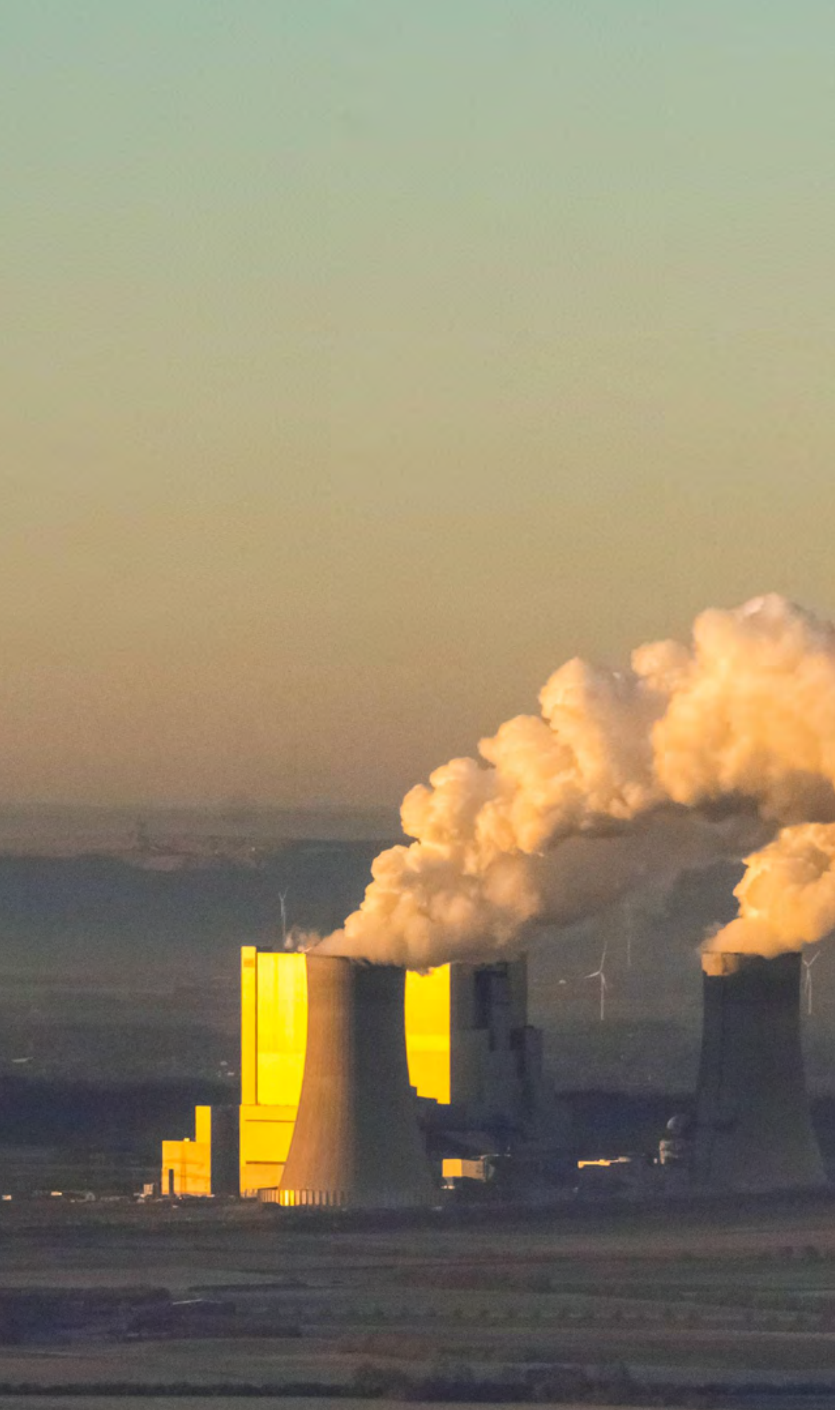


Table 3-2: Emissions from the chemical park in Cologne/Dormagen in million tonnes of CO_2

EUTL ID	Operator	Plant	Activity	Emissions
DE 1485	RWE Generation SE	Dormagen power plant	20	1.0
DE 2294	INEOS Manufacturing	Cracker 4, Building T21	42	0.8
DE 860	INEOS Manufacturing	Power plant O10 – Boiler 3-5	20	0.7
DE 2095	INEOS Manufacturing	Cracker 5, Building S03	42	0.6
DE 205274	INEOS Manufacturing	Ammonia plant, Building O 07	41	0.4
DE 207007	AIR LIQUIDE	SMR DOR III	43	< 0.1
DE 208944	Currenta GmbH & Co. OHG	Steam boiler Dormagen M 75	20	< 0.1
DE 202468	Currenta GmbH & Co. OHG	TVA Dormagen	20	< 0.1
DE 202346	Linde Gas	Dormagen	43	< 0.1
DE 205271	INEOS Manufacturing	Ethylene oxide plant, Building Q 20	42	< 0.1
DE 205276	INEOS Manufacturing	Acrylonitrile plant III, building O 08	42	< 0.1
DE 205275	INEOS Manufacturing	Acrylonitrile plant II, building O 17	42	< 0.1
DE 205321	Covestro Deutschland AG	TAD plant	42	< 0.1
DE 204322	Nippon Gases	CO plant Dormagen	43	< 0.1
DE 205273	INEOS Manufacturing	Nitric acid plant, Building O 04	38	< 0.1
DE 209683	Currenta GmbH & Co. OHG	Dormagen B735 steam procurement	20	< 0.1
DE 205983	INEOS Manufacturing	Aromatics plant, Building W14	42	< 0.1
Total				**3.6**

Source: EUTL

Table 3-2 shows the plants at the industrial park in Cologne/Dormagen. The industrial park is located north of Cologne on the Rhine and consists of two parts: the INEOS facilities and those on the Currenta premises in Dormagen. Various operators are involved in production at this chemical park (e.g. Covestro as a plastics manufacturer). The Dormagen power plant is operated by RWE.

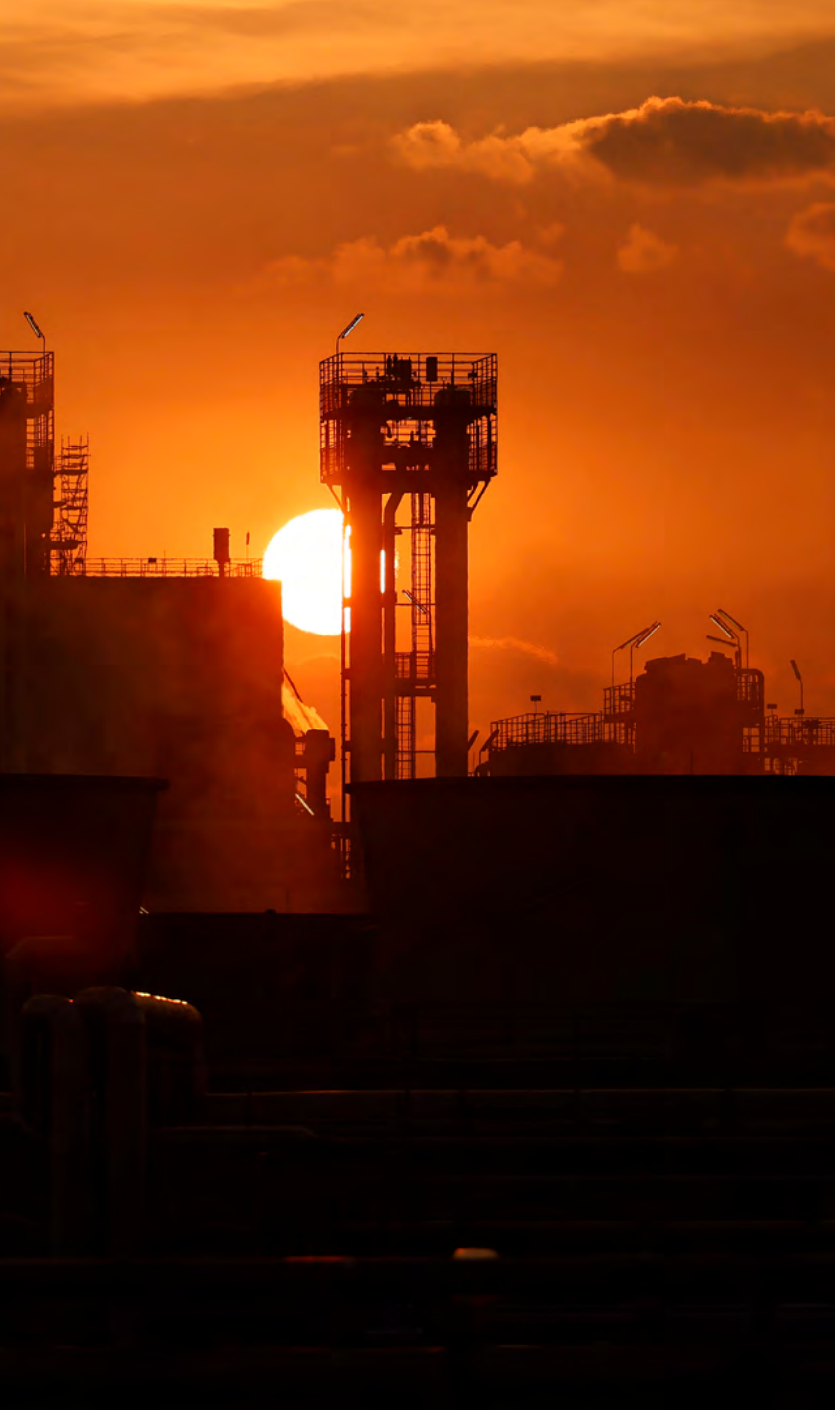


Table 3-3: Emissions from the chemical park in Wesseling in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 1027	Basell Polyolefine GmbH	Ethylene plant OM6	42	0.8
DE 202035	Basell Polyolefine GmbH	Steam boiler Wesseling	20	0.6
DE 202537	Basell Polyolefine GmbH	Ethylene plant OM4	42	0.3
DE 203657	Röhm GmbH	SK-MMA plant	42	< 0.1
DE 203658	Basell Polyolefine GmbH	Tank farm D/E field and J500 field	20	< 0.1
DE 210185	Evonik Operations GmbH	Segment Performance Silica	20	< 0.1
DE 1418	Basell Polyolefine GmbH	Gas turbine	20	< 0.1
DE 202847	Evonik Operations GmbH	Acrolein plant	42	< 0.1
DE 202848	Röhm GmbH	BMA plant	20	< 0.1
DE 1702	Evonik Operations GmbH	Power plant – Wesseling plant	20	< 0.1
DE 209764	Basell Polyolefine GmbH	OT4 (LDPE plant OT4)	42	< 0.1
DE 206013	Braskem Europe GmbH	Braskem Europe Wesseling	42	< 0.1
DE 209763	Basell Polyolefine GmbH	OL4 (HDPE plant OL4)	42	< 0.1
DE 209762	Basell Polyolefine GmbH	OG2 (HDPE plant OG2)	42	< 0.1
DE 210184	Basell Polyolefine GmbH	OH (HDPE plant OH)	42	< 0.1
Total				**2.1**

Source: EUTL

Table 3-3 shows the facilities at the industrial park in Wesseling between Cologne and Bonn. Shell operates a refinery at this site, but its emissions are not shown in Table 3-3. Basell produces plastics (e.g. polypropylene) at the location. Röhm GmbH manufactures products such as Plexiglas at the site.

Table 3-4: Emissions from Evonik's chemical park in Marl in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 1747	Evonik Operations GmbH	Power Plant I – Unit 4 and Unit 5	20	1.2
DE 201896	Evonik Operations GmbH	Hydrogen plant	43	0.2
DE 215781	Evonik Operations GmbH	Power plant VI	20	0.2
DE 202878	Evonik Superabsorber	Acrylic acid/acrylic acid ester plant	42	0.1
DE 207227	Evonik Operations GmbH	Power Plant IV	20	0.1
DE 202606	Sasol Germany GmbH	Ethylene oxide plant	42	< 0.1
DE 203190	Vestolit GmbH	VC plant	42	< 0.1
DE 1749	Evonik Operations GmbH	Power Plant III - Unit 311 + 312	20	< 0.1
DE 201897	Evonik Operations GmbH	Synthesis gas plant	43	< 0.1
DE 217380	Evonik Operations GmbH	Power Plant VII Marl	20	< 0.1
DE 205544	INEOS Solvents Marl	Butanediol plant	42	< 0.1
DE 210628	Vestolit GmbH	PVC plant	42	< 0.1
DE 210104	Evonik Operations GmbH	Vestamide plant	42	< 0.1
DE 201900	Evonik Operations GmbH	Oxo plant	42	< 0.1
DE 201898	Evonik Operations GmbH	Butadiene plant (Marl)	42	< 0.1
Total				**2.1**

Source: EUTL

In the past, hard coal-fired CHP plants were predominant in the emissions from the Evonik chemical park in Marl (Table 3-4). A new natural gas-fired power plant (Power Plant VII) was commissioned in 2022 to replace the hard coal-fired CHP plants. The use of hard coal was due to be phased out at the end of 2022. However, due to the natural gas crisis, the hard coal plants are not expected to be decommissioned until spring 2024. Thus major reductions in emissions can be expected in the years ahead. Vestolit produces PVC at its site in Marl.

Table 3-5: Emissions from the chemical park in Wittenberg in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 202455	SKW Stickstoffwerke Piesteritz GmbH	Ammonia plant 2	41	0.9
DE 202457	SKW Stickstoffwerke Piesteritz GmbH	Ammonia plant 1	41	0.9
DE 764	SKW Stickstoffwerke Piesteritz GmbH	Wittenberg industrial power plant	20	< 0.1
DE 204785	Borealis Agrolinz Melamine	Piesteritz melamine plant	42	< 0.1
DE 202454	SKW Stickstoffwerke Piesteritz GmbH	Nitric acid	38	< 0.1
Total				**1.8**

Source: EUTL

Table 3-5 shows the emissions from the Piesteritz nitrogen plant chemical park in Wittenberg. Two ammonia plants predominate in these emissions. Nitric acid production is also carried out in Wittenberg.

Table 3-6: Emissions from the chemical park in Brunsbüttel in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 205626	YARA Brunsbüttel GmbH	Ammonia plant	43	1.1
DE 206021	Sasol Germany GmbH	Ziegler, TAM, NFA	42	0.2
DE 1118	Covestro Deutschland AG	BMS power plant SH	20	< 0.1
DE 808	Sasol Germany GmbH	Brunsbüttel combined heat and power plant	20	< 0.1
DE 205246	Covestro Deutschland AG	Reformer BRU	43	< 0.1
Total				**1.4**

Source: EUTL

Table 3-6 shows the emissions from the chemical park in Brunsbüttel. Here too, the greater share of emissions is attributable to the production of ammonia.[7] The ammonia plant is operated by YARA. The companies Sasol (e.g. detergents and cleaning agents) and Covestro (plastics) also operate smaller plants in Brunsbüttel.

7 However, emissions from the ammonia plant are reported under hydrogen activity.

Table 3-7: Emissions of the InfraLeuna Chemical Park in Leuna in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 1367	RKB Raffinerie-Kraftwerk	Leuna refinery power plant	20	1.0
DE 206057	Linde Gas	Plant 939,Leuna, Unit 824	43	0.3
DE 202349	Linde Gas	Leuna SR 1,2	43	0.2
DE 1497	InfraLeuna GmbH	Combined gas and steam turbine generating plant plant	20	0.2
DE 210167	InfraLeuna GmbH	Gas turbine 4	20	< 0.1
DE 203665	Domo Caproleuna GmbH	Cumene-phenol plant	42	< 0.1
DE 1368	InfraLeuna GmbH	Leuna combined gas and steam turbine generating plant	20	< 0.1
DE 203663	Domo Caproleuna GmbH	HAS plant	38	< 0.1
DE 210520	Xentrys Leuna GmbH	Polymerization plant	42	< 0.1
DE 210619	Dow Olefinverbund GmbH	Polyethylene plant / Train 4	42	< 0.1
DE 203820	Domo Caproleuna GmbH	Sulphuric acid plant	20	< 0.1
DE 210620	Dow Olefinverbund GmbH	Polyethylene plant / Train 5	42	< 0.1
Total				**1.8**

Source: EUTL

Table 3-7 shows the emissions from the chemical park in Leuna. Just over half of the emissions are attributable to the refinery power plant on the chemical park site, which is operated by a subsidiary of STEAG. The power plant also supplies the neighbouring Total refinery. In addition, the production of grey hydrogen causes emissions that amount to 0.5 Mt CO_2.

Table 3-8: Emissions from Currenta's chemical park in Leverkusen in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 824	Currenta GmbH & Co. OHG	G power plant NW 1054088 206	20	0.8
DE 202632	KRONOS TITAN GmbH	Leverkusen plant	20	0.1
DE 202858	LANXESS Deutschland GmbH	Phthalic anhydride operation (PSA)	42	< 0.1
DE 202855	LANXESS Deutschland GmbH	Iron oxide operation	20	< 0.1
DE 828	Currenta GmbH & Co. OHG	X power plant NW 1054088 207	20	< 0.1
DE 202854	LANXESS Deutschland GmbH	Sulphuric acid plant	20	< 0.1
DE 202856	LANXESS Deutschland GmbH	Adipic acid plant	39	< 0.1
DE 202864	LANXESS Deutschland GmbH	Hydrogenation plant	42	< 0.1
DE 202861	LANXESS Deutschland GmbH	ASM operation	42	< 0.1
DE 202865	LANXESS Deutschland GmbH	TMP operation	42	< 0.1
DE 202862	LANXESS Deutschland GmbH	PHD operation	42	< 0.1
DE 202853	LANXESS Deutschland GmbH	Cracking plant	20	< 0.1
DE 210525	Momentive Performance Materials	Silicone plant	42	< 0.1
DE 202769	LANXESS Deutschland GmbH	Hexane oxidation	42	< 0.1
Total				**1.2**

Source: EUTL

At the Currenta Chemical Park in Leverkusen many plants are operated by LANXESS (the former specialty chemicals division of Bayer). Here, too, a power plant is the largest emitter at the chemical park.

Table 3-9: Emissions from the Dow Olefin Verbund chemical park in Böhlen/Schkopau in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 3596	Dow Olefinverbund GmbH	Ethylene plant (cracker) Böhlen	42	1.0
DE 202180	Dow Olefinverbund GmbH	EDC/VC plant Schkopau	42	< 0.1
DE 1461	Dow Olefinverbund GmbH	Power plant I72 Schkopau	20	< 0.1
DE 202208	Dow Olefinverbund GmbH	Polyethylene plant in Schkopau	20	< 0.1
DE 210606	TRINSEO Deutschland GmbH	Polystyrene plant	42	< 0.1
DE 210639	Braskem Europe GmbH	Polypropylene plant in Schkopau	42	< 0.1
Total				**1.1**

Source: EUTL

A steam cracker in Böhlen (south of Leipzig) supplies the chemical park in Schkopau (south of Halle) with propylene and ethylene. The steam cracker is thus listed here and is shown together with the chemical park in Schkopau. The chemical park in Schkopau is supplied with process steam from the Schkopau lignite-fired power plant. The power plant's emissions amounted to a total of 4.4 Mt CO_2 in 2022. However, they are not listed in Table 3-9 because the emissions from the Schkopau power plant are primarily generated during the production of electricity. Dow produces plastics at the Schkopau site, for example.

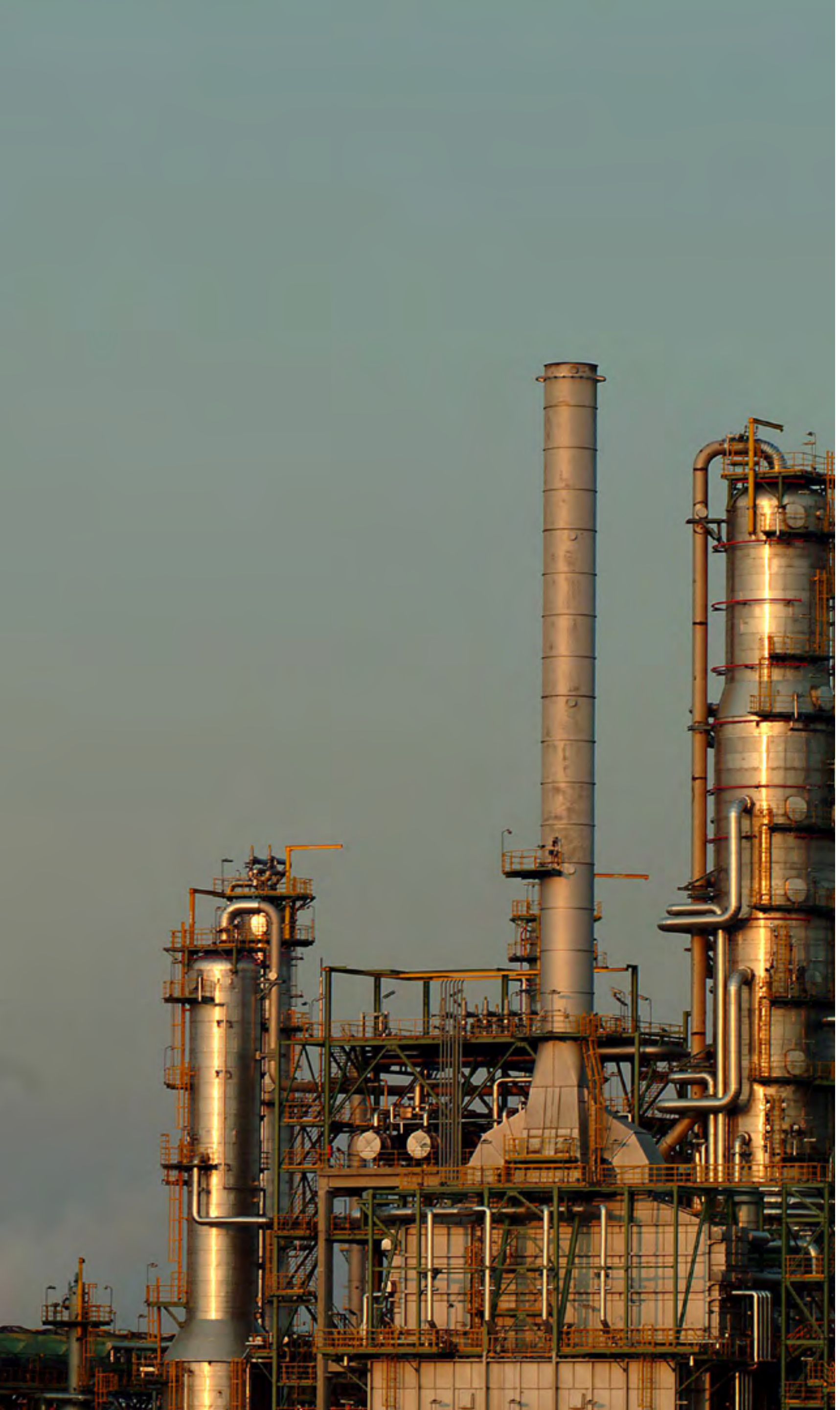


Table 3-10: Emissions from the Currenta/Covestro chemical park in Krefeld Uerdingen in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 833	Currenta GmbH & Co. OHG	Power plant N 230 NW 0019136 84	20	0.5
DE 809	Currenta GmbH & Co. OHG	Power plant L 57 NW 0019136 83	20	0.2
DE 203612	Venator Uerdingen GmbH	Uerdingen Titanium plant	20	< 0.1
DE 203613	Venator Uerdingen GmbH	Uerdingen fission plant	20	< 0.1
DE 205241	Covestro Deutschland AG	Formalin plant	42	< 0.1
DE 210025	Covestro Deutschland AG	Makrolon plant	42	< 0.1
DE 205322	Covestro Deutschland AG	Bisphenol A plant	42	< 0.1
Total				**0.8**

Source: EUTL

The emissions from the chemical park in Krefeld-Uerdingen – with its numerous plants operated by Covestro (the former plastics division of Bayer) – are also primarily attributable to CHP plants.

Table 3-11: Emissions from Infraserv Höchst's chemical park in Frankfurt-Höchst in million tonnes of CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 1027	Infraserv GmbH & Co. Höchst KG	Combined heat and power plant – Building D 580	20	0.7
DE 203657	Celanese Production Germany GmbH & Co. KG	Vinyl acetate plant	42	< 0.1
DE 210185	Basell Polyolefine GmbH	PE-HD production plant	42	< 0.1
DE 202537	Grillo-Werke Aktiengesellschaft	Production of sulphur trioxide	20	< 0.1
Total				**0.7**

Source: EUTL

The electricity generation plant predominates in the emissions from the chemical park in Frankfurt-Höchst (Table 3-11). The other production facilities have only low direct emissions.

Table 3-12: Emissions from the Basell chemical park in Münchsmünster in million tonnes CO_2

EUTL ID	Company	Plant	Activity	Emissions
DE 2198	Basell Polyolefine GmbH	Petrochemical plant	42	0.4
DE 1037	Basell Polyolefine GmbH	Münchsmünster power plant	20	< 0.1
DE 202874	Basell Polyolefine GmbH	HDPE polymerization Mümü 42	42	< 0.1
Total				**0.5**

Source: EUTL

Basell operates a steam cracker and further processing facilities for the production of plastics in Münchsmünster on the Danube in Bavaria (Table 3-12).

4 Potential emission reductions in the short term

With a total of forty percent CHP plants account for the largest share of total emissions at the twelve largest chemical parks. Most CHP plants are operated with natural gas, the remaining hard coal CHP plants are currently being replaced by natural gas CHP plants,[8] which are subsidized under the German Combined Heat and Power Act [KWKG]. This will result in emission reductions in the short term.

To date, the promotion of new natural gas power plants under the German Combined Heat and Power Act has been limited up to the year 2026. This support for fossil CHP plants should be terminated and not extended. New plants should be built as part of the power plant strategy and they should have a clear prospect of being converted to hydrogen. With a view to greenhouse gas neutrality, it no longer makes sense to promote natural gas-fired CHP plants via the German Combined Heat and Power Act in order to prevent lock-in to fossil base load generation.

At the same time, it is very important that operators make their (natural gas) CHP plants – which were previously operated at base load – more flexible. This is the only way to ensure that no renewable electricity is displaced whenever there is a high proportion of renewable energy. Alternative steam generation capacities (electric steam generators, heat pumps, natural gas reserve steam generators) make sense in order to decouple heat production from electricity production and to be able to use renewable electricity when there is a high share of renewables. In addition, the electricity market design needs to be revised in order to make industrial CHP plants and the electricity demand of industrial production processes more flexible. Up to now, grid charges have prevented flexibilization because consumer flexibility is penalized by high capacity prices. Section 19 of the German Electricity Grid Fee Ordinance [StromNEV] should therefore be adapted in such a way that it enables plants to become more flexible.

Many chemical parks operate steam crackers that produce a high amount of direct emissions from process heat. These emissions can be avoided by electrifying the steam cracker. Here too, care should be taken to ensure that these new electricity consumers are ideally operated in a flexible manner.

Hydrogen production and further processing into ammonia plays a major role in many chemical parks. Up to now this particular hydrogen has primarily involved grey hydrogen. Due to the high specific emission reductions that are possible if grey hydrogen is replaced, green hydrogen should be used here as a priority (see Liebreich [2023] with regard to the sequence of use of green hydrogen). As ammonia is much easier to transport than hydrogen, the first hydrogen imports will be in the form of ammonia in particular. In order to avoid unnecessary conversion losses, imported ammonia should be prioritized in order to reduce emissions from domestic ammonia production. Green ammonia should not be unnecessarily converted into other energy sources.

Within the scope of carbon capture and utilization, CO_2 and green hydrogen are used to produce hydrocarbons. As long as the amount of green hydrogen available is still limited, it should not be used for CCU. This is because higher emission reductions are often possible if the green hydrogen is used primarily to replace the production of grey hydrogen or to substitute for fossil ammonia production. The temporary incorporation of CO_2 into short-lived products (e.g. disposable plastic) or fuels should be avoided. In this context, “short-lived” means that the CO2 is released again after the products have been used, e.g. when waste is incinerated or fuels are burned. It is better not to produce the CO_2 in the first place or – if residual emissions cannot be avoided – to capture it technically and store it permanently (carbon capture and storage [CCS]).

8 However, with the following exception: the chemical park in Schkopau is supplied with steam by a lignite-fired power plant. The power plant will be shut down by the end of 2034 at the latest due to the German Coal Phase-out Act [KVBG]. However, there are still no plans to replace the steam supply in a climate-friendly manner.

Carbon pricing provides incentives to reduce emissions from plastic incineration. This is achieved by avoiding waste, using long-lasting products and recycling. In Germany, emissions from waste incineration will be covered by national fuel emissions trading as of January 1, 2024 (see Section 7 (2) BEHG/ German Fuel Emission Allowance Trading Act). A new European emissions trading system, ETS-2, will start in 2027, but this will not cover waste incineration. Instead, CO_2 emissions from waste incineration are to be included in the existing ETS-1 (for power plants and industrial facilities) as of 2028. The German government should ensure that there is no regulatory gap for waste incineration during the transition from national fuel emissions trading to ETS-2, particularly in 2027.

5 Literature

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6 Annex

Supplement to Table 3-1: Emissions from the BASF Ludwigshafen chemical park in million tonnes of CO_2

EUTL ID	Operator	Plant	Activity	Emissions
DE 201964	BASF SE	Ethylene oxide factory	42	< 0.1
DE 201998	BASF SE	Acrylic Monomers - North	42	< 0.1
DE 211198	BASF SE	Acetylene Plant - New	42	< 0.1
DE 201969	BASF SE	Acrylic Acid Plant II	42	< 0.1
DE 201938	BASF SE	Sulphuric acid plant	20	< 0.1
DE 202007	BASF SE	Sodium carboxylate/soda plant	44	< 0.1
DE 201968	BASF SE	Phthalic anhydride plant	42	< 0.1
DE 201963	BASF SE	Styrene plant	42	< 0.1
DE 202004	BASF SE	Aromatics Plant	42	< 0.1
DE 201997	BASF SE	Propylene oxide plant	42	< 0.1
DE 202003	BASF SE	Melamine Plant-HP3-Part	42	< 0.1
DE 201967	BASF SE	Formaldehyde plant	42	< 0.1
DE 202005	BASF SE	Neopentyl glycol (NPG) plant	42	< 0.1
DE 209946	BASF SE	Polystyrene plant	42	< 0.1
DE 209949	BASF SE	Ultramid-A-Factory II	42	< 0.1
DE 209950	BASF SE	Ultramid-A-Factory III	42	< 0.1
DE 201952	BASF SE	Cracked sulfuric acid plant	20	< 0.1
DE 210164	BASF SE	PAV plant	42	< 0.1
DE 209948	BASF SE	Styrofoam factory	42	< 0.1

EUTL ID	Operator	Plant	Activity	Emissions
DE 209951	BASF SE	Ultramid B factory I	42	< 0.1
DE 209947	BASF SE	Neopor factory	42	< 0.1
DE 210006	BASF SE	PE wax factory	42	< 0.1
DE 209952	BASF SE	Ultramid B factory II	42	< 0.1
DE 201996	BASF SE	Butyl factory	42	< 0.1
DE 201972	BASF SE	Methanol factory	42	< 0.1
DE 202008	BASF SE	Ammonia factory	44	< 0.1
DE 202001	BASF SE	Lactam factory	42	< 0.1
DE 201995	BASF SE	Nonyl factory	42	< 0.1
DE 201966	BASF SE	Methacrylic acid factory	42	< 0.1
DE 201971	BASF SE	Propionic acid factory	42	< 0.1
Total				**0.6**

Source: EUTL

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