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Analysis and opinion by Fredrik Lundberg



This briefing was prepared for Real Zero Europe (RZE).

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The 100 largest emitters

The top industrial emitters in the EU-27 are almost entirely in the steel, cement and refinery industries. The #1 was Voestalpine Stahl Linz in Austria, which emitted 8.7 million tonnes (Mt) of CO_{2eq} in 2021. 11 of the top 14 were in steel and pig iron, as can be seen in the Top 100 table.

Of the top 100, almost all were in the steel, cement and refinery industries, while the rest produce ammonia and other chemicals. This can be seen in the data from the Emission Trading System¹.

1. The 100 largest industrial plants emitters of greenhouse gases in the EU-27

#	Country	Name	code, activity	Allocation Mton	Emissions Mton
1	AT	Voestalpine Stahl Linz	24 steel, pig iron	6,86	8,67
2	DE	Integriertes Hüttenwerk Duisburg	24 steel, pig iron	14,75	7,76
3	PL	Rafineria	21 oil refinery	3,38	6,58
4	FR	Arcelormittal Mediterranee	24 steel, pig iron	5,29	5,32
5	NL	Tata Steel IJmuiden bv BKG 1	24 steel, pig iron	10,22	4,54
6	IT	Stabilimento di Taranto	24 steel, pig iron	6,37	4,35
7	DE	Glocke Duisburg	24 steel, pig iron	6,29	4,34
8	NL	Shell Nederland Raffinaderij B.V.	2 oil refinery	3,00	4,21
9	ES	Arcelormittal España, S.A.	24 steel, pig iron	7,05	4,12
10	DE	Roheisenerzeugung Dillingen	24 steel, pig iron	6,26	3,98
11	FI	Raahen terästedas	5 steel	3,30	3,74
12	BE	ArcelorMittal Gent	24 steel, pig iron	7,35	3,69
13	DE	Glocke Salzgitter	24 steel, pig iron	6,06	3,34
14	BE	TotalEnergies Refinery Antwerp	21 oil refinery	2,41	3,28
15	NL	Dow Benelux B.V. BKG 1	42bulk chemicals	2,43	3,21
16	SE	SSAB Luleå	24 steel, pig iron	2,77	3,15
17	DE	PCK Raffinerie Glocke Schwedt	21 oil refinery	1,74	3,12
18	BE	BASF Antwerpen - 127	42bulk chemicals	3,64	2,87
19	NL	Yara Sluiskil B.V. BKG 1	41 ammonia	2,75	2,75
20	AT	voestalpine Stahl Donawitz GmbH	24 steel, pig iron	2,09	2,74
21	DE	RUHR OEL GmbH - Werk Scholven - CO2-Glocke	21 oil refinery	2,30	2,68
22	AT	OMV Raffinerie Schwechat	21 oil refinery	1,68	2,58
23	DE	Werk 1 und Werk 2	21 oil refinery	1,80	2,57
24	CZ	Třinecké železářny	24 steel, pig iron	3,33	2,54
25	FI	Porvoon jalostamo	2 oil refinery	1,88	2,53
26	PL	Góraźdze Cement Spółka Akcyjna	29 cement	2,37	2,51
27	NL	ESSO Raffinaderij Rotterdam	21 oil refinery	2,04	2,49

¹ <https://www.eea.europa.eu/en/analysis/maps-and-charts/emissions-trading-viewer-1-dashboards>

#	Country	Name	code, activity	Allocation Mton	Emissions Mton
28	ES	Repsol Petróleo S.A.	21 oil refinery	1,82	2,45
29	PT	Refinaria de Sines	21 oil refinery	1,51	2,36
30	DE	Einheitliche Anlage Bremen	24 steel, pig iron	4,34	2,27
31	BE	Esso Raffinaderij	21 oil refinery	1,45	2,18
32	PL	RAFINERIA	21 oil refinery	1,53	2,16
33	ES	Petróleos del Norte S.A.	21 oil refinery	1,52	2,15
34	NL	BP Raffinaderij Rotterdam B.V.	21 oil refinery	1,46	2,14
35	GR	ΜΟΤΟΡ ΟΙΛ (ΕΛΛΑΣ) - ΔΙΥΛΙΣΤΗΡΙΑ ΚΟΡΙΝΘΟΥ Α.Ε.	21 oil refinery	1,46	2,05
36	IT	Raffineria di Augusta	21 oil refinery	1,12	2,03
37	ES	Repsol Petróleo S.A. - Instalación de Tarragona	21 oil refinery	1,61	2,03
38	GR	Ελληνικά Πετρέλαια Α.Ε. Διυλιστήριο Ελευσινας	21 oil refinery	1,26	1,99
39	DE	Raffinerie Wesseling	21 oil refinery	1,20	1,91
40	DE	Kokerei Duisburg Schwelgern	22 coke	0,55	1,88
41	FR	RAFFINERIE DE GRAVENCHON	21 oil refinery	1,15	1,85
42	IT	Raffineria di Milazzo	2 oil refinery	1,10	1,75
43	FR	Raffinerie de Normandie (RN)	21 oil refinery	0,69	1,72
44	DK	Aalborg Portland A/S	29 cement	1,68	1,70
45	DE	Mineralölraffinerie Leuna	21 oil refinery	1,85	1,69
46	LT	Naftos perdirbimo produktų gamykla	21 oil refinery	1,23	1,65
47	IT	Raffineria Di Sannazzaro	21 oil refinery	1,08	1,63
48	PL	Cement Ożarów S.A. -Zakład Cementownia Ożarów	29 cement	1,55	1,60
49	DE	Werk Flandersbach-Anlage zum Brennen v. Kalkstein	30 lime, dolomite	1,17	1,59
50	SE	SSAB Oxelösund	24 steel, pig iron	1,44	1,59
51	SE	Preemraff Lysekil	21 oil refinery	1,39	1,57
52	GR	Ελληνικά Πετρέλαια Α.Ε. Διυλιστήριο Ασπροπυργου	21 oil refinery	0,91	1,52
53	DE	Roheisen-und Stahlherzeugung	24 steel, pig iron	2,68	1,48
54	PL	Zakłady Azotowe Puławy S.A.	42bulk chemicals	2,28	1,47
55	NL	Zeeland Refinery N.V.	21 oil refinery	1,28	1,46
56	ES	Repsol Petróleo S.A. - Instalación de Puertollano	21 oil refinery	0,95	1,45
57	ES	Compañía Española de Petróleos S.A. - San Roque	21 oil refinery	1,32	1,45
58	RO	Liberty Galati SA	24 steel, pig iron	3,10	1,42
59	LT	Katilinė, amoniako paleidimo katilinės Nr.1 ir Nr.2	41	1,28	1,36
60	PL	CEMENTOWNIA WARTA S.A.	29 cement	1,22	1,34
61	SE	Slitefabriken	29 cement	1,46	1,34
62	DE	Raffinerie Godorf	21 oil refinery	0,88	1,26
63	CY	Vasiliko Cement Works Public Company Ltd	6 cement	1,17	1,25
64	DE	Ammoniakanlage	43 hydrogen syngas	1,06	1,24

#	Country	Name	code, activity	Allocation Mton	Emissions Mton
65	IT	Raffineria Isab Impianti Sud	21 oil refinery	1,07	1,23
66	GR	ΕΡΓΟΣΤΑΣΙΟ ΚΑΜΑΡΙΟΥ ΒΟΙΩΤΙΑΣ	29 cement	1,36	1,22
67	FR	Raffinerie de Lavera	21 oil refinery	0,96	1,22
68	DE	Ammoniakanlage 1	41 ammonia	0,97	1,18
69	ES	Compañía Española de Petróleos S.A. - La Rábida	21 oil refinery	1,19	1,14
70	ES	Bp Energía España, S.A.	21 oil refinery	0,74	1,08
71	DE	Mineralölverarbeitung Burghausen	21 oil refinery	0,88	1,07
72	DE	Raffinerie Heide GmbH	21 oil refinery	0,54	1,02
73	FR	Raffinerie de Feyzin (FZN)	21 oil refinery	0,59	1,02
74	SK	Rafinéria	21 oil refinery	0,98	1,02
75	IE	Irish Cement Limited (Platin Works)	29 cement	0,90	0,99
76	DE	Werk Lägerdorf	29 cement	0,90	0,98
77	EE	Enefit Õlitööstus	21 oil refinery	0,84	0,98
78	IT	S.A.R.P.O.M S.R.L.	21 oil refinery	0,61	0,95
79	DE	Ethylenanlage (Cracker) Boehlen	42bulk chemicals	0,69	0,95
80	ES	Dow Chemical Ibérica, SL - La Pobra de Mafumet	42bulk chemicals	0,88	0,94
81	DE	Raffinerie als Glocke	21 oil refinery	0,68	0,94
82	RO	SC Holcim (Romania) SA - Ciment Campulung	29 cement	0,92	0,93
83	ES	Repsol Petróleo S.A. - Instalación de A Coruña	21 oil refinery	0,60	0,92
84	DE	RUHR OEL GmbH - Werk Horst - CO2-Glocke	21 oil refinery	0,59	0,90
85	PT	Cimpor - Centro de Produção de Alhandra	29 cement	1,01	0,90
86	RO	SC Holcim (Romania) SA - Ciment Alesd	29 cement	0,94	0,89
87	NL	Air Liquide Industrie B.V., vest. Botlek-Rotterdam	21 oil refinery	0,63	0,89
88	HU	TVK	42 bulk chemicals	0,82	0,88
89	SK	Danucem Slovensko a.s., cementáreň Rohožník	29 cement	0,79	0,86
90	ES	Solvay I	44 soda ash	0,72	0,86
91	PL	CEMENTOWNIA CHEŁM CEMEX	29 cement	1,08	0,85
92	RO	ROMCIM SA-Punct de lucru Medgidia	29 cement	0,77	0,85
93	DE	Drehöfen Deuna	29 cement	0,86	0,85
94	DE	Zementwerk Rüdersdorf	29 cement	1,16	0,84
95	PT	Centro de Produção de Souselas	29 cement	0,83	0,84
96	RO	Rompetro Rafinare SA	21 oil refinery	0,74	0,84
97	ES	Repsol Química, S.A. - El Morell - Cogeneración	42 bulk chemicals	0,45	0,83
98	FR	Raffinerie de Donges (DGS)	21 oil refinery	0,22	0,83
99	PT	Fábrica SECIL - Outão	29 cement	0,87	0,83
100	PL	Dyckerhoff Polska Sp. z o.o.	29 cement	0,81	0,82

https://climate.ec.europa.eu/document/download/ebb2c20e-8737-4a73-b6ba-a4b7e78ecc01_en?filename=verified_emissions_2023_en_1.xlsx

Table 2. Some major emitters, grouped

code	activity	Emissions Mtons	Free allocation Mtons
24	Steel and pig iron	133,2	94,2
21	Oil refineries	103,8	73,2
29	Cement	94,8	97,4
30	Lime	21,1	18,3
42	Bulk chemicals	25,5	32
41	Ammonia	12,2	13,7
21-99	All industry	433,1	450,5
	For comparison		
20	Power stations etc	637,5	73,3
	All stationary installations in the ETS	1070,5	523,9

Power vs industrial emissions

Emissions from the power producers (called “combustion of fuel” in EU jargon) have plummeted² almost by half, from 1341,7 Mtonnes in 2007 to 637,4 Mt in 2023. This trend was strongly reinforced during the first half of 2024 and can easily be explained: fossil fuels are giving way to wind and solar³.

Power emissions is largely a solved problem, though it happens too late and too slowly. Everybody knows that coal, oil, shale and peat have to go. All electricity could be supplied by renewables and storage.

That is also what is happening. Wind and solar supplied much more electricity (727 TWh) to the EU than coal (343 TWh) in 2023.

Efficiency is doing its bit, too: In 2023, EU electricity demand fell by 3.4% to its lowest level since 2001 (2,696 TWh)⁴.

The electrification of cars, heating (electric heat pumps instead of fossil heat) and some industries has, so far, been more than offset by more efficient use of electricity such as better lighting, fans, pumps and refrigerators.

The emissions from fossil power plants are still very large, but we know they can be cut, and we know how. It is getting simpler and cheaper to balance the variable renewables, because batteries are getting cheaper.

² ibid

³ file:///C:/Users/bfred/Downloads/Report_Wind-and-solar-overtake-EU-fossil-fuels-in-the-first-half-of-2024-1.pdf

⁴ <https://ember-climate.org/insights/research/european-electricity-review-2024/>

Free ride for industry

For the *industrial emissions*, i.e. emissions excluding power plants and aviation, the trend is less encouraging. Emissions did hardly drop at all from when the system started in 2005 to a few years ago. There is a drop from 518,1 Mt 2019 to 433 Mt 2023, but it is not easy to tell why that is, and how much is trend and how much is due to business cycle and even to data inaccuracy⁵.

The long-term *difference* between power plants on the one hand and industry on the other is however striking and easy to explain. The industry has free allocation that cover most of their emissions. The power (and some heat) industry usually has not. For them CO₂ is a real cost, and strongly influences the competition between lignite power (very high emissions), hard coal power (high emissions), gas power (lower emissions) and renewables (no emissions).

The steel, cement and refinery industries have not had the same need to change. In 2023 they got *more* free allowances 450 Mt than their *actual emissions* of 433 Mt.

With the EU Carbon Border Adjustment Mechanism, this is going to change. As changes in the heavy industry takes time, a positive interpretation of the recent emission drop might be that they are starting to adapt for the future.

The steel industry has a plan, which is to tear down the blast furnaces, and replace coal and coke with green hydrogen. This can happen in the next few years but can't explain the emission drop that has happened.

No future for oil refineries

Refineries should see a reduced activity in the future with the advance of electric vehicles or more efficient vehicles. This may indeed be the case, as refinery throughput decreased more than 6 percent (from 10542 barrels per day 2019 to 9870 by 2023)⁶. They may also use less petroleum and more biofuels but have not done so on a significant scale.

The cement industry has some obvious low-hanging fruits. One is using less cement per tonne of concrete in construction, which the construction companies or their customers may do by just more careful calculation. Another is to reduce the high emission cement and add more alternative binders such as slag, ash clay and some recycling. This seems to be happening, to judge from the environmental reports from the cement giants HolcimLafargue and Heidelberg Materials. The cement industry also talks about CCS and electric heating in the ovens, but that has not happened, so it can't explain the emissions drop.

Everybody knows that coal, oil, shale and peat must go. All electricity could be supplied by renewables and storage.

That is also what is happening. Wind and solar supplied much more electricity (727 TWh) to the EU than coal (343 TWh) in 2023.

5 The EU Commission has been contacted for an explanation why some seemingly steel, cement and refinery plants have been placed in single digit codes and if they nevertheless are included in the collective figures at emission trading dashboard, and also why some installations have cryptic names. No answer was received as of October 16.

6 2024 Energy Institute Statistical Review of World Energy, Oil Refinery Throughput

Efficiency is doing its bit, too: In 2023, EU electricity demand fell by 3.4% to its lowest level since 2001 (2,696 TWh)⁷.

The electrification of cars, heating (electric heat pumps instead of fossil heat) and some industries has, so far, been more than offset by more efficient use of electricity such as better lighting, fans, pumps and refrigerators.

Some people think that nuclear can or should be part of the solution, but this does not look likely. In the EU-27, nuclear production peaked 2006 at 929 TWh. In 2023 it was a third less. More reactors are being phased out in Belgium and Spain over the next few years, while just two reactors are under construction in the EU.

Emission trading works, at last...

Emissions trading, which began in 2005, did not contribute much to emission cuts until 2018, when prices were raised through political intervention. They were raised again in 2021 because of the rising prices of imported natural gas and are kept from falling too low by an annual reduction of the number of allowances⁸. But right now, or for the near future, ETS is a rather effective instrument.

Industrial emissions, on the other hand, are supposedly addressed by the ETS, which is more or less the only instrument for reducing them. But this has not worked. There is only a weak downward trend.

There are essentially two kinds of industry. One is manufacturing industry, which produces cars or furniture, for example. The direct emissions are relatively small, even for very big factories. They use electricity for their machinery, lighting and ventilation. They use gas, oil or district heat for heating. The electricity does not emit any greenhouse gases at the point of use, and it is not used in very large quantities anyway. Siemens, an engineering giant with 320,000 employees globally, emitted 387 kilotons of CO₂ (scope 1) in 2023, also globally.

...but for the process industry, not so much

The other kind is process industry or energy-intensive industry, such as oil refineries, cement factories, iron and steel, other metals, ammonia plants and some other chemicals production. They are large point sources of CO₂ and some are also producers of other greenhouse gases that can opt into the ETS. They are also often huge consumers of electricity.

The technical difference between the two kinds of industry is far from easy to tell. Iron and steel are produced from ore (iron oxide) with coal and coke as reductants. It looks (and smells) like coal combustion, very much like a coal power station. An oil refinery uses oil to provide heat for distillation. It looks and smells very much like an oil power plant.

A cement factory uses fossil fuels to heat up the limestone to a very high temperature. Those fossil fuels are combusted just as they are in a power or heat plant, and they emit

⁷ <https://ember-climate.org/insights/research/european-electricity-review-2024/>

⁸ See for example <https://www.cleanenergywire.org/factsheets/understanding-european-unions-emissions-trading-system>

CO₂ in exactly the same way. When the mineral calcium carbonate (CaCO₃) is heated, it emits CO₂, leaving behind calcium oxide (CaO), which is used as cement to make concrete. The latter emission is not literally “from fossil fuels”, but the limestone itself is a fossil, usually from ancient corals. The CO₂ is very much like the CO₂ from fossil fuels. Its fossil origin can be corroborated by C₁₄ dating, just like oil, coal and gas, but unlike biomass.

The official EU text⁹ says in its definitions:

(11) “combustion emission” means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen.

That would cover all emissions from refineries, the steel industry (including coking), other metals production, the chemicals industry and fuel emissions from cement factories.

The real difference between “combustion” CO₂ and “process emissions” is mainly legal and economic, not physical or technical. But using such a concept, the industries got a “get-out-of-jail free” card.

Don't want to pay, don't pay

Process emissions are exempt the Polluter Pays Principle. They get free allocations, about 100 percent, and sometimes even more, as can be seen in the tables.

One reason for this is that the industries have claimed that they are hard-to-abate. This claim is increasingly untenable.

The steel industry now has a strategy for (real) zero, with green hydrogen.

Much of the cement emissions can be cut by alternative binders, or other construction materials or methods, as argued in another RZE Briefing.

In a zero Europe there is no place for mineral oil, so oil refineries will have to cease. The oil and refinery industry is uses a lot of chemicals, so when oil is gone, some of the chemicals will not be needed.

This is not the place for a detailed analysis of every industry, but the present consumption of aluminium, glass and, especially, plastics for packaging is not decreed by Destiny. We could reduce, reuse and recycle much more and produce much less goods, emissions and waste.

⁹ Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions