

Additional materials online

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1. Synthesis

Table 1: Emission reduction achieved by the main measures of implementation (MtCO2eq)

Note: this table is a synthesis of the calculation detailed in the following tabs.

	Total Netherlands emissions	Territorial mitigation outcomes						Global mitigation outcomes					
		Hemweg coal plant	SED+ top up	Tax on foreign waste	Biofuel mandate	Total	% of Netherlands emissions	Hemweg coal plant	SED+ top up	Tax on foreign waste	Biofuel mandate	Total	% of Netherlands emissions
2020	166	1.23	0.01	0.03	-	1.27	0.8%	0.25	0.01	- 0.14	-	0.12	0.1%
2021	169	0.71	0.23	0.06	-	1.00	0.6%	0.15	0.17	- 0.26	-	0.06	0.0%
2022	165	0.63	0.31	0.09	-	1.02	0.6%	0.14	0.23	- 0.37	-	0.00	0.0%
2023	160	0.53	0.27	0.09	0.17	1.05	0.7%	0.12	0.20	- 0.34	0.09	0.06	0.0%
2024	156	0.44	0.23	0.09	0.15	0.90	0.6%	0.11	0.17	- 0.32	0.09	0.04	0.0%
2025	151	-	0.19	0.09	0.12	0.40	0.3%	-	0.14	- 0.30	0.08	- 0.08	0.0%
2026	147	-	0.15	0.09	0.10	0.34	0.2%	-	0.11	- 0.28	0.07	- 0.09	-0.1%
2027	142	-	0.11	0.09	0.07	0.28	0.2%	-	0.08	- 0.26	0.06	- 0.11	-0.1%
2028	138	-	0.08	0.09	0.05	0.22	0.2%	-	0.06	- 0.24	0.05	- 0.14	-0.1%
2029	133	-	0.04	0.09	0.03	0.15	0.1%	-	0.03	- 0.22	0.02	- 0.17	-0.1%
Total	1,526	3.53	1.62	0.81	0.68	6.65	0.4%	0.76	1.20	- 2.72	0.46	- 0.31	0.0%

2. Article table 1

Article Table 1: Change in emission resulting from the implementation measures (MtCO₂eq)

	2020 outcomes		Long-term outcomes	
	National	Global	National	Global
Closure of the Hemweg coal plant	-1.23	-0.25	-3.53	-0.76
Top-up of the SED+ programme	-0.01	-0.01	-1.62	-1.20
Tax on foreign waste	-0.03	+0.14	-0.81	+2.72
Biofuel mandate for inland navigation	N/A	N/A	-0.68	-0.46
Total	-1.27	-0.12	-6.65	+0.31

Carbon leakage	
2020	Long-term
80%	79%
26%	26%
548%	434%
N/A	33%
91%	105%

reduction from 1990 levels	-0.57%	-0.05%		
reduction in emissions from 2020 to 2029			-0.44%	0.02%

**Annex:
Emission reductions resulting from the implementation measures (MtCO₂eq), under a counterfactual reference scenario**

	2020 outcomes	
	National	Global
Closure of the Hemweg coal plant	2.39	0.48
Top-up of the SED+ programme	-0.01	-0.01
Tax on foreign waste	-0.03	0.14
Biofuel mandate for inland navigation	N/A	N/A
Total	2.35	0.61

reduction from 1990 levels	1.06%	0.27%
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3. Article table 2

Article table 2: Long-term cumulative emission reduction (MtCO₂eq)

Year	Mitigation outcomes of implementation measures		Emissions of the Netherlands
	National	Global	
2020	-1.27	-0.12	165.77
2021	-1.00	-0.06	169.21
2022	-1.02	+0.00	164.70
2023	-1.05	-0.06	160.20
2024	-0.90	-0.04	155.69
2025	-0.40	+0.08	151.19
2026	-0.34	+0.09	146.68
2027	-0.28	+0.11	142.18
2028	-0.22	+0.14	137.67
2029	-0.15	+0.17	133.17
Total	-6.65	+0.31	1,526.46

4. Global Warming Potentials (GWP)

**Table 4(1):
Carbon-dioxide equivalence: global warming potential on 100 years (IPCC Sixth Assessment Report)**

Note: values from IPCC AR6 are used as being the latest, most refined values.

Data from: Chris Smith and others, 'The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity: Supplementary Material' in *Climate Change 2021: The Physical Science Basis, Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (forthcoming), section 7.SM.6

	CO2	CH4	N2O
CO2 eq	1	27.9	273

**Table 4(2):
Carbon-dioxide equivalence: global warming potential on 100 years (IPCC Fourth Assessment Report)**

Note: these data are used for comparison only.

Data from: Gunnar Myhre and others, 'Anthropogenic and Natural Radiative Forcing', in Thomas F. Stocker and others (eds), *Climate Change 2013: The Physical Science Basis. The Working Group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (CUP 2013) 659, at 714

	CO2	CH4	N2O
CO2 eq	1	25	298

5. Hemweg plant

**Table 5(1):
EU ETS emission allowances purchased by power plants (t CO₂)**

Source: EU ETS transaction log, retrieved from European Commission, 'Verified Emissions for 2021' (1 April 2022), <<https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1>>

Year	Vattenfall Centrale Hemweg (NL-200400019)	Amercentrale NL-200400221	Eemshaven (NL-201000010)	Uniper Centrale Maasvlakte (NL-200400153)	Power Plant Rotterdam B.V. (NL-201200005)	Total new plants (excl. Amercentrale and Hemweg)
2019	3,215,867	1,833,587	5,389,580	2,555,625	2,211,747	10,156,952
2020	860,704	942,156	2,528,618	3,391,680	16,978	5,937,276
2021	686,732	546,211	5,306,014	3,927,590	1,849,985	11,083,589

**Table 5(2):
Variation in emissions from gas-fired power plants (t CO₂)**

Source: Netherlands, NIR 2022 (14 April 2022), CRF 2019-20 table 1.A(a)s1, cell G34

Year	CO ₂ emissions	Percentage change
2019	21,104	
2020	21,899	3.8%

Note: Vattenfall Centrale Hemweg includes unit 8 (a coal plant that closed at the end of 2019) and unit 9 (a gas plant that continued operation). As no disaggregated data is publicly available, the coal plant's annual emissions are estimated by comparing emissions from the EU ETS transaction log before and after the closure of unit 8, assuming that emissions from unit 9 followed the national trend in emission from gas plants in 2019-2020.

Estimated 2019 emissions of Hemweg 8	2,386,409
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**Table 5(3):
Emission trends in coal plants other than Hemweg**

	Amercentrale NL-200400221	Total new plants (excl. Amercentrale and Hemweg)
variation from 2019 to 2020	-48.6%	-41.5%
variation from 2020 to 2021	-42.0%	86.7%

**Table 5(4):
National and EU-wide emission trends in the coal energy sector**

Data from Netherlands, NIR 2022 (14 April 2022), CFR 2019–20 table 1.A(a)s1, row 26 ; and EU, NIR 2022 (27 May 2022), CRF 2019–20 table 1.A(a)s1, row 26

Party	Category	CO2	CH4	N2O	GHG	Percentage reduction
EU 2019	Public electricity and heat production - solid fuel	494112.002	4.332569447	8.979541325	496,684.30	
EU 2020	Public electricity and heat production - solid fuel	392058.9188	3.437666195	7.037443726	394,076.05	20.7%
Netherlands 2019	Electricity Generation - solid fuels	18946.76971	0.077589352	0.207529745	19,005.59	
Netherlands 2020	Electricity Generation - solid fuels	11291.6725	0.040299917	0.091389065	11,317.75	40.5%

**Table 5(5):
Implied emission factors of coal power plants in the Netherlands (t/TJ), 2019**

Source: Netherlands, NIR 2022 (14 April 2022), CRF 2019, table 1.A.1(a): solid fuels

	CO2	CH4	N2O
Solid fuels	112.05	0.00046	0.00123

**Table 5(6):
Calculation of the activity data of Hemweg 8 in 2019 (TJ coal consumed)**

Activity data of Hemweg 8 in 2019 (TJ)	21,298
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**Table 5(7):
Calculation of CH4 and N2O emissions of Hemweg, 2019**

	CO2	CH4	N2O	Total
t	2,386,409	10	26	
t CO2 eq	2,386,409	273	7,152	2,393,834

**Table 5(8):
FitchSolutions' Projection of coal generation in the Netherlands (TWh) (raw data and calculation)**

Source: FitchSolutions, Netherlands Power Report Q2 (2022), at 12-13

Year	Estimate / projection	Change from previous year (%)
2020	7.74	
2021	5.64	-27.2%
2022	4.94	-12.3%
2023	4.18	-15.5%
2024	3.46	-17.1%
2025	2.98	-13.8%
2026	2.51	-16.0%
2027	2.06	-17.8%
2028	1.78	-13.4%
2029	1.40	-21.8%

**Table 5(9):
Territorial mitigation outcomes of the closure of the Hemweg coal plant**

Note: it is assumed that the emissions of Hemweg would have followed the trend of Amercentrale in 2020 and 2021, and then the sectorial trend predicted by FitchSolutions from 2022 until 2024.

Year	Baseline scenario: change from previous year (%)	Baseline scenario (closure late 2024) (t CO2 eq)	Territorial emission reduction achieved by the measure (Mt CO2 eq)
2019 (factual)		2,393,834.36	
2020	-49%	1,230,029	1.23
2021	-42%	713,104	0.71
2022	-12%	625,042	0.63
2023	-15%	528,249	0.53
2024	-17%	438,035	0.44
2025	-100%	-	0.00
2026		-	0.00
2027		-	0.00
2028		-	0.00
2029		-	0.00
Total			3.53

**Table 5(10):
Territorial mitigation outcomes of the closure of the Hemweg coal plant (alternative baseline scenario)**

Note: this table assumes an alternative baseline scenario where the Hemweg coal plant would have continued operating in 2020 at its 2019 level of emission, rather than following the sectorial trend.

Year	Counterfactual baseline scenario (t CO2 eq)	Territorial emission reduction achieved by the measure (Mt CO2 eq)
2019 (factual)	2,393,834.36	
2020	2,393,834.36	2.39

**Table 5(11):
Global mitigation outcome of the closure of the Hemweg coal plant**

Carbon leakage rate: 2020	70%
Carbon leakage rate: 2030	55%
Waterbed effect	33%

Notes: The rate of carbon leakage is assumed based on: Letter of the Minister of Economic Affairs and Climate Policy of 19 January 2017, in documents of the House of Representatives 2016–17, file 30196 nr 505 <<https://zoek.officielebekendmakingen.nl/kst-30196-505.html>>, appendix (73 percent in 2020, 54 percent in 2030); Frontier Economics, Research on the Effects of the Minimum CO2 Price: A Report for the Ministry of Economic Affairs and Climate Policy (9 July 2018), at 8 (implying 55 percent carbon leakage in 2025 and 2030); CE Delft, Effecten van sluiting drie extra kolencentrales (May 2019), at 16 (implying around 50 percent throughout the 2020s). The rate of carbon leakage is expected to decrease over time, as neighbouring countries are moving towards cleaner modes of power generation.

Significant uncertainty exists regarding the strength of the waterbed effect occurring in spite of the market stability reserve. See Grischa Perino, Robert A. Ritz and Arthur van Benthem, 'Understanding Overlapping Policies: Internal Carbon Leakage and the Punctured Waterbed' (NBER Working Paper 25643, 2019), at 11.

Year	Estimated rate of carbon leakage (%)	Global mitigation outcome net of carbon leakage (Mt CO2 eq)	Global mitigation outcome net of carbon leakage and waterbed effect (Mt CO2 eq)
2020	70.0%	0.4	0.2
2021	68.5%	0.2	0.1
2022	67.0%	0.2	0.1
2023	65.5%	0.2	0.1
2024	64.0%	0.2	0.1
2025	62.5%	0.0	0.0
2026	61.0%	0.0	0.0
2027	59.5%	0.0	0.0
2028	58.0%	0.0	0.0
2029	56.5%	0.0	0.0
Total		1.1	0.8

**Table 5(12):
Global mitigation outcome of the closure of the Hemweg coal plant (alternative baseline scenario)**

Year	Estimated rate of carbon leakage (%)	Global mitigation outcome net of carbon leakage (Mt CO2 eq)	Global mitigation outcome net of carbon leakage and waterbed effect (Mt CO2 eq)
2020	70%	0.7	0.5

6. SDE+

**Table 6(1):
Calculation of the proportion of the top-up budget compared with the entire budget of the SDE+ programme (bn EUR)**

Note: the top-up consists in a extra EUR 2 billion budget, over the pre-existing EUR 2 billion budget, for the Spring-2020 round of the SDE+. Not all of this budget has been allocated.

Data from: Letter of the Minister of Economic Affairs and Climate Policy of 4 March 2020, in documents of the House of Representatives 2019–20, file 31239 nr 313 <<https://zoek.officielebekendmakingen.nl/kst-31239-313.html>> (announcing a budget of €2 billion in round 2020-I); 'SDE(+)(+) Projecten in beheer April 2022', retrieved from 'Feiten en cijfers SDE(+)(+)', Rijksdienst voor Ondernemend Nederland (6 April 2022) <<https://www.rvo.nl/subsidies-financiering/sde/feiten-en-cijfers#verplichtingenbudget>> (showing that only 61% of the budget was allocated during that round).

	Baseline scenario (as described in BR4)	Policy scenario (with top-up)	Effect of the top- up	Effect of the top- up (% increase)
Budget available for the Spring- 2020 round	2.00	4.00	2.00	100.0%
Budget allocated during the Spring- 2020 round*	1.21	2.42	1.21	100.0%
Total budget allocated during SDE+ 2013- 2020*	47.27	48.48	1.21	2.6%

**Table 6(2):
Rate of implementation of the projects approved under the SDE+ top-up, per year**

Assumptions: approval on 1 September 2020, gradual implementation within 12 months of approval

Year	Estimated rate of implementation
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2020	3%
2021	67%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	100%
2029	100%

**Table 6(3):
Calculation of the territorial mitigation outcome of the measure in 2020 (Mt CO2 eq, 2020)**

Data from Netherlands, Fourth Biennial Report under the UNFCCC (20 December 2019), at 68

	Predicted outcome of SDE+ without top up	Extrapolated outcome of the top-up	Proportion within ETS
Total	14.90	0.38	
ETS	11.60	0.30	78%
Non-ETS	3.30	0.08	

**Table 6(4):
Estimated long-term mitigation benefit of the measure (Mt CO2 eq)**

Rate of waterbed effect in emissions within the EU ETS	33%
Rate of waterbed effect in average SDE+ emission reductions	26%

	Additionality factor	Additional mitigation outcome (NL)	Additional mitigation outcome net of waterbed effect (global)
2020	100%	0.01	0.01
2021	90%	0.23	0.17
2022	80%	0.31	0.23
2023	70%	0.27	0.20
2024	60%	0.23	0.17
2025	50%	0.19	0.14
2026	40%	0.15	0.11
2027	30%	0.11	0.08
2028	20%	0.08	0.06
2029	10%	0.04	0.03
Total		1.62	1.20

7. Foreign waste

**Table 7(1):
Foreign waste incinerated in the Netherlands in 2019**

Metrics	Value, 2019	Source
Quantity of waste incinerated (Mt)	7.39	Netherlands, NIR 2022 (14 April 2022), at 259
Proportion foreign waste in waste incinerated, mass	25%	eg Attero v Netherlands, ECLI:NL:RBDHA:2019:13622 (District Court of the Hague, 18 December 2019), para 2.2; 'Importing and Exporting Waste Materials (EVOA)' Business.gov.nl (nd) < https://business.gov.nl/regulation/importing-and-exporting-waste-materials-evoa/ >, accessed on 10 June 2022
Quantity of foreign waste incinerated	1.8465	

**Table 7(2):
Net reduction in national emissions that would result from ending the incineration of foreign waste - review of estimates**

Source	Emissions from incineration of foreign waste (Mt CO ₂ eq)	Emissions from substitute power and heat generation (Mt CO ₂ eq)	Net emission reduction (Mt CO ₂ eq)
CE Delft, Klimaateffecten importheffing afval (April 2020) < https://ce.nl/publicaties/klimaateffecten-importheffing-afval/ >, 3	0.86	0.71	0.15
PWC, Importheffing Buitenlands Afval en Uitstoot van Broeikasgassen (4 September 2019) < https://www.tweedekamer.nl/kamerstukken/detail?id=2019D37785&did=2019D37785 >, at 5	0.777	0.746	0.03
Tom N Ligthart, De bijdrage van verbranden van geïmporteerd afval aan de Nederlandse en Europese CO ₂ -emissies (TNO 2020), at 3			0.11
average	0.82	0.73	0.09

**Table 7(3):
Reduction in national emissions**

Note: the reduction in the incineration of foreign waste is estimated based on the literature, in particular: CE Delft, Klimaateffecten importheffing afval (n 76), at 2; Netherlands, 'Raming uitbreiding afvalstoffenbelasting tot buitenlands afval dat in Nederland wordt verbrand (i.h.k.v. Urgenda)' (2019) <<https://www.rijksoverheid.nl/documenten/rapporten/2021/05/20/05-54a-afvalstoffenbelasting-raming-reducering-buitenlands-afval>>, at 2; Mike Brown, Bethany Ledingham and Emma Stewart, 'Impacts of the Netherlands' Waste Import Tax' (Eunomia, 24 March 2020), at 17.

	Reduction in incineration of foreign waste	Rate of additionality	Reduction in waste incineration in the NL, additional (Mt)	Reduction in national emissions (Mt CO2)
2020	33%	100%	0.58	0.03
2021	67%	100%	1.11	0.06
2022	100%	100%	1.58	0.09
2023	100%	100%	1.50	0.09
2024	100%	100%	1.43	0.09
2025	100%	100%	1.36	0.09
2026	100%	100%	1.29	0.09
2027	100%	100%	1.23	0.09
2028	100%	100%	1.16	0.09
2029	100%	100%	1.11	0.09
total				0.81

**Table 7(4):
Emissions from landfilling in the UK**

Metrics	Value	Source
Proportion of foreign waste incinerated in the NL originating from the UK (2017)	81%	PWC, Importheffing Buitenlands Afval en Uitstoot van Broeikasgassen (4 September 2019) < https://www.tweedekamer.nl/kamerstukken/detail?id=2019D37785&did=2019D37785 >, 13 (2017)

Proportion of waste disposed of domestically through landfilling (average)	60%	UK, NIR 2022 (14 April 2022), at 440
Proportion of waste disposed of domestically through landfilling (marginal rate applicable to waste formerly exported for incineration)	95%	This assumption reflects the fact that the waste previously exported for incineration has already been sorted out, hence composting is unlikely, and that waste incineration plants in the UK and other countries of the region are already working full capacity. As such, it is estimated that a higher proportion of this waste will be landfilled. Similar assumptions are reflected in the literature, for instance PWC, 'Importheffing Buitenlands Afval en Uitstoot van Broeikasgassen' (4 September 2019) < https://www.tweedekamer.nl/kamerstukken/detail?id=2019D37785&did=2019D37785 >, at 25; CE Delft, Klimaateffecten importheffing afval (April 2020) < https://ce.nl/publicaties/klimaateffecten-importheffing-afval/ >, at 7-8.
Year-to-year decrease in landfilling	5%	Assumption. By comparison, see UK, NIR 2022 (14 April 2022), Annex, at 958, implying 2.5 percent reduction in waste landfilled from 2010 to 2019.
waste landfilled (Mt) (2019)	51.25	UK, NIR 2022 (14 April 2022), at 958
Methane emitted (kt CH4) (2019)	560	UK, NIR 2022 (14 April 2022), at 958
Implied emission factor (kt CH4 / Mt waste landfilled)	10.93	calculated
Implied emission factor (Mt CO2eq/ Mt waste landfilled)	0.30	calculated

Note: no decrease in methane emissions per tonne of waste landfilled is assumed. UK landfills have reduced methane emissions in the 1990s and 2000s by implementing methane recovery programmes, but they seem to have reached a technological ceiling, at around 40 percent methane emitted, in the 2010s. See UK, NIR 2022 (14 April 2022), Annex, at 957-58

**Table 7(5):
Emissions from landfilling in third countries other than the UK**

2020	95%	0.45	0.14	75%	0.08	0.03	0.05	0.00	-0.14
2021	90%	0.90	0.27	71%	0.15	0.05	0.06	0.00	-0.26
2022	86%	1.28	0.39	68%	0.20	0.06	0.10	0.01	-0.37
2023	81%	1.22	0.37	64%	0.18	0.06	0.10	0.01	-0.34
2024	77%	1.16	0.35	61%	0.17	0.05	0.11	0.01	-0.32
2025	74%	1.10	0.34	58%	0.15	0.05	0.11	0.01	-0.30
2026	70%	1.04	0.32	55%	0.14	0.04	0.11	0.01	-0.28
2027	66%	0.99	0.30	52%	0.12	0.04	0.11	0.01	-0.26
2028	63%	0.94	0.29	50%	0.11	0.03	0.11	0.01	-0.24
2029	60%	0.90	0.27	47%	0.10	0.03	0.11	0.01	-0.22
total		9.98	3.04		1.40			0.07	-2.72

8. Biofuel mandate

Table 8(1):
Mandatory share of biofuel in fuel for inland navigation (raw data)

Source: Decision of 20 December 2021 (Besluit tot wijziging van het Besluit energie vervoer), Stb. 2021, 619, <<https://zoek.officielebekendmakingen.nl/stb-2021-619.html>>, art I(D), amending Decree of 3 May 2018 (Besluit energie vervoer), <<https://wetten.overheid.nl/BWBR0040922/2022-01-01>>, art 3(1)

	Requisite share of biofuel
2020	0
2021	0
2022	0
2023	18.9%
2024	19.9%
2025	21.0%
2026	22.3%
2027	23.6%
2028	25.0%
2029	26.5%
2030	28.0%

Table 8(2):
Calculation of the percentage of international and transit transportation in inland navigation in the Netherlands (2017-2021)

Data from Eurostat, 'Inland waterways transport measurement': 'Transport by type of good', IWW_GO_ATYGO, <<https://ec.europa.eu/eurostat/databrowser/bookmark/fd64c2d6-4048-462e-984e-6d664c806321?lang=en>>

	2017	2018	2019	2020	2021	average
Total transport (million TKM)	49,015	46,892	46,993	45,166	47,394	47,092
National transport (million TKM)	13,097	13,445	13,324	13,154	13,376	13,279
International transport (million TKM)	27,122	25,681	25,815	24,651	26,407	25,935

Transit (million TKM)	8,796	7,766	7,854	7,360	7,610	7,877
Percentage international + transit (to, from, and through the Netherlands)	73%	71%	72%	71%	72%	72%

**Table 8(3):
Evolution of emissions from domestic inland navigation in the 2010s**

Data from Netherlands, NIR 2022 (14 April 2022), CFR 2010-20 table 1.A(a)s3, rows 68, 69 and 72

year	Fuel	CO2 (Kt)	CH4 (Kt)	N2O (Kt)	Total (Mt CO2eq)	Total fossil fuels (Mt CO2eq)	Year-to-year variation
2010	Diesel	1101.43	0.11	0.03	1.11		
2010	Gasoline	67.49	0.04	0.00	0.07		
2010	Total	1,168.91	0.15	0.03	1.18	1.18	
2011	Diesel	1107.25	0.11	0.03	1.12		
2011	Gasoline	66.67	0.04	0.00	0.07		
2011	Total	1,173.92	0.15	0.03	1.19	1.19	0.4%
2012	Diesel	1015.59	0.10	0.03	1.03		
2012	Gasoline	66.72	0.04	0.00	0.07		
2012	Total	1,082.32	0.14	0.03	1.09	1.09	-7.8%
2013	Diesel	1076.63	0.10	0.03	1.09		
2013	Gasoline	66.29	0.04	0.00	0.07		
2013	Total	1,142.92	0.15	0.03	1.16	1.16	5.6%
2014	Diesel	918.45	0.09	0.03	0.93		
2014	Gasoline	65.87	0.04	0.00	0.07		
2014	Total	984.32	0.13	0.03	1.00	1.00	-13.9%
2015	Diesel	1026.01	0.10	0.03	1.04		
2015	Gasoline	65.06	0.04	0.00	0.07		
2015	Total	1,091.07	0.14	0.03	1.10	1.10	10.8%
2016	Diesel	951.34	0.09	0.03	0.96		
2016	Gasoline	65.65	0.04	0.00	0.07		
2016	Total	1,016.98	0.13	0.03	1.03	1.03	-6.8%
2017	Diesel	919.11	0.09	0.03	0.93		
2017	Gasoline	65.58	0.04	0.00	0.07		
2017	Total	984.68	0.13	0.03	1.00	1.00	-3.2%
2018	Diesel	916.93	0.09	0.03	0.93		
2018	Gasoline	64.92	0.04	0.00	0.07		

2018	Total	981.85	0.13	0.03	0.99	0.99	-0.3%	
2019	Diesel	843.66	0.08	0.02	0.85			
2019	Gasoline	64.92	0.04	0.00	0.07			
2019	Total	908.58	0.12	0.02	0.92	0.92	-7.5%	
2020	Diesel	627.54	0.06	0.02	0.63			
2020	Gasoline	63.84	0.04	0.00	0.07			
2020	Total	691.37	0.10	0.02	0.70	0.70	-23.9%	
							Average year-to-year increase in fossil emissions (excluding 2020)*	-2.5%

* the 2019-20 variation is not taken into account in the average because it is expected to be a temporary consequence of the Covid-19 pandemic.

**Table 8(4):
Emissions from inland navigation without the policy (Mt CO2 eq)**

	Domestic navigation	Cross-border navigation	Total
2020	0.70	1.70	2.40
2021	0.69	1.76	2.46
2022	0.68	1.72	2.39
2023	0.66	1.68	2.33
2024	0.64	1.63	2.28
2025	0.63	1.59	2.22
2026	0.61	1.55	2.16
2027	0.60	1.51	2.11
2028	0.58	1.48	2.06
2029	0.57	1.44	2.01

Note: it is assumed that the average change in fossil emissions observed in domestic inland navigation in the 2010s (related mainly to efficiency gains) will continue to be observed in domestic navigation in the 2020s, and will also be observed in international and transit navigation in the 2020s.

**Table 8(5):
Reduction in national emissions (Mt CO2 eq)**

Metrics	Value	Source
Rate of emission reduction from the use of biofuel	75%	Assumption informed by Directive 2009/30/EC of 23 April 2009 amending Directive 98/70/EC and Directive 1999/32/EC, [2009] OJ L140/88, Annex IV.A; E4tech, 'Master Plan for CO2 Reduction in the Dutch Shipping Sector: Biofuels for Shipping' (May 2018) < http://artfuelsforum.eu/wp-content/uploads/2018/06/180601_E4tech_PDB-Masterplan_FinalReport_v5.0_FV.pdf >, at 60.
Rate of carbon leakage from (purchase of fuel abroad) in domestic traffic	25%	The biofuel blending mandate will increase the price of inland navigation fuel in the Netherlands, leading some ships to refuel elsewhere. This rate is discounted by the additionality factor: the carbon leakage effect is expected to reduce as neighbouring states start taking similar measures.

Note: as estimates of territorial emissions do not include LULUCF, emissions from indirect land use change are not included in this table.

	Additionality factor	Carbon leakage from purchase of fuel abroad	Emissions avoided by the policy, additional	Reduction in national emissions
2020	100%	-	-	-
2021	90%	-	-	-
2022	80%	-	-	-
2023	70%	0.12	0.05	0.17
2024	60%	0.10	0.05	0.15
2025	50%	0.08	0.04	0.12
2026	40%	0.06	0.04	0.10
2027	30%	0.04	0.03	0.07
2028	20%	0.03	0.02	0.05
2029	10%	0.01	0.01	0.03
total		0.44	0.24	0.68

**Table 8(6):
Reduction in global emissions (Mt CO2 eq)**

Metrics	Value	Source
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Rate of emission reduction from the use of biofuel	75%	Assumption informed by Directive 2009/30/EC of 23 April 2009 amending Directive 98/70/EC and Directive 1999/32/EC, [2009] OJ L140/88, Annex IV.A; E4tech, 'Master Plan for CO2 Reduction in the Dutch Shipping Sector: Biofuels for Shipping' (May 2018) < http://artfuelsforum.eu/wp-content/uploads/2018/06/180601_E4tech_PDB-Masterplan_FinalReport_v5.0_FV.pdf >, at 60.
Rate of carbon leakage (purchase of fuel outside the NL) in cross-border traffic	75%	Expected to be considerably higher than for domestic traffic, as cross-border traffic is more likely to refuel abroad to minimize costs. This rate is discounted by the additionality factor: the carbon leakage effect is expected to reduce as neighbouring states start taking similar measures.
Indirect emissions from land-use change (proportion of emission reduction from the use of biofuel)	33%	Assumption informed by the literature, e.g.: Hugo Valin and others, The land use change impact of biofuels consumed in the EU: Quantification of area and greenhouse gas impacts (Ecofys and others, 25 August 2015), https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf , x-xi; Vassilis Daioglou and others, 'Progress and barriers in understanding and preventing indirect land-use change' (2020) 14 Biofuels, Bioproducts and Biorefining 924; Koen P. Overmars and others, "Indirect land use change emissions related to EU biofuel consumption: an analysis based on historical data" (2011) 14 Environmental Science & Policy 248, at 254; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017DC0284 at 3.

	Leaked emissions from domestic navigation (purchase of fuel abroad)	Additionality factor	Carbon leakage (purchase of fuel outside the NL) in cross-border traffic	Emissions avoided by the policy, additional	Indirect land use change emissions	Reduction in global emissions
2020	-	100%	-	-	-	-
2021	-	90%	-	-	-	-
2022	-	80%	-	-	-	-
2023	0.12	70%	0.88	0.08	0.04	0.09
2024	0.10	60%	0.74	0.08	0.04	0.09
2025	0.08	50%	0.60	0.08	0.04	0.08
2026	0.06	40%	0.47	0.07	0.04	0.07
2027	0.04	30%	0.34	0.06	0.03	0.06
2028	0.03	20%	0.22	0.05	0.02	0.05
2029	0.01	10%	0.11	0.03	0.01	0.02
total	0.44		3.35	0.45	0.23	0.46

9. Contextual analysis

**Table 9(1):
Compilation of estimates and projections of national GHG emissions (excl. LULUCF) in successive reports (Mt CO₂ eq)**

1990	2020	Type of data*	Emission reduction 1990-2020	Source
212	183	Projection WEM	13.7%	Michiel Hekkenberg and Martijn Verdonk, Nationale Energieverkenning (Energieonderzoek Centrum Nederland 2014), at 53
212	176	Projection WAM	17.0%	Michiel Hekkenberg and Martijn Verdonk, Nationale Energieverkenning (Energieonderzoek Centrum Nederland 2014), at 53
220	181	Projection WEM	17.7%	Netherlands, Second Biennial Report under the UNFCCC (29 December 2015), at 69
221.4	171.3	Projection WEM	22.6%	Netherlands, Third Biennial Report under the UNFCCC (29 December 2017), at 67
221.7	171.3	Projection WEM	22.7%	Netherlands, Fourth Biennial Report under the UNFCCC (20 December 2019), at 80
220.5	164.3	Estimation	25.5%	Netherlands, NIR 2022 (14 April 2022), at 18
222.7	165.8	Estimation	25.6%	Recalculation of Netherlands, NIR 2022 (14 April 2022), CRF 1990/2020, summary 2, using GWP100 data from IPCC AR6 (instead of AR4 in the NIR)
222.7	169.2	Estimation	24.0%	Recalculation of StatLine, 'Emissions of greenhouse gases according to IPCC Guide-lines, quarter', < https://opendata.cbs.nl/statline/#/CBS/en/dataset/84979ENG/table?dl=68C4D >, accessed on 9 June 2022, corrected to account for difference between AR4 and AR6 GWP100

Note: WEM stands for "with existing measures"; WAM, for "with additional measures"

**Table 9(2):
Estimates and projections of national emissions, 2020-2029**

Year	Emissions	Type of data	Source
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2020	165.8	Estimation	Recalculation of Netherlands, NIR 2022 (14 April 2022), CRF 1990/2020, summary 2, using GWP100 data from IPCC AR6 (instead of AR4 in the NIR)	
2021	169.2	Preliminary estimation	StatLine, 'Emissions of greenhouse gases according to IPCC Guide-lines, quarter', < https://opendata.cbs.nl/statline/#/CBS/en/dataset/84979ENG/table?dl=68C4D >, accessed on 9 June 2022, corrected to account for difference between AR4 and AR6 GWP100	
2022	164.7	Projection WEM	Linear extrapolations from 2021 estimate and 2030 projection	
2023	160.2	Projection WEM		
2024	155.7	Projection WEM		
2025	151.2	Projection WEM		
2026	146.7	Projection WEM		
2027	142.2	Projection WEM		
2028	137.7	Projection WEM		
2029	133.2	Projection WEM		
2030	128.7	Projection WEM		Planbureau voor de Leefomgeving (PBL) and others, Klimaat- en Energieverkenning 2021 (2021), at 210, recalculated and corrected to account for difference between AR4 and AR6 GWP100

**Table 9(3):
Reduction in national emissions in certain sectors, 2019-2020**

Source: Netherlands, NIR 2022 (14 April 2022), CRF 2020 table 1s1

	Energy industries (1.A.1)				Transport (1.A.3)			
	CO ₂	CH ₄	N ₂ O	Total	CO ₂	CH ₄	N ₂ O	Total
2019	56,734.64	4.93	0.90	57,117.04	30,547.95	2.69	0.89	30,866.96
2020	47,438.14	5.49	0.86	47,827.20	26,040.23	2.39	0.77	26,316.46
difference				9,289.84				4,550.50
percentage of reduction				16.3%				14.7%

Table 9(4): Analysis of the factors leading to a decrease in transport emissions in 2020

	2019	2020	Variation	Source
Car travel (person-km per year)	14,656.0	9,726.0	-33.6%	StatLine, 'Mobility; per person, modes of travel, purposes of travel and regions', < https://opendata.cbs.nl/statline/#/CBS/en/dataset/84710ENG/table?dl=697A3 >
Population	17,282,163.0	17,407,585.0	0.7%	StatLine, 'Population; key figures', < https://opendata.cbs.nl/statline/#/CBS/en/dataset/37296eng/table?dl=697B0 >
Total car travel (bn person-km per year)	253.3	169.3	-33.2%	Calculated
Car emissions, CO2 (Kt)	16,666.3	13,367.0	-19.8%	NL NIR 2022, CRF 2019-20 Table 1.A(a)s3 row 27
Car emissions, CH4 (Kt)	1.7	1.4	-15.2%	
Car emissions, N2O (Kt)	0.3	0.2	-21.9%	
Car emissions (Kt CO2eq)	16,786.8	13,464.2	-19.8%	Calculated
Emission intensity (gCO2eq/person-km)	66.3	79.5	20.0%	Calculated

10. Eurobarometer surveys

Table 10: Opinion polls

Data compiled from Eurobarometer, 'Climate Change' (series of surveys conducted every two years between 2009 and 2021)

Question	Response	Party	2021	2019	2017	2015	2013	2011	2009	2008	average 2017-2021	average 2011-2015	difference between averages (percentage points)
QB2R. And how serious a problem do you think climate change is at this moment? Please use a scale from 1 to 10, with '1' meaning it is "not at all a serious problem" and '10' meaning it is "an extremely serious problem".	A very serious problem (7-10)	EU	78%	79%	74%	69%	69%	68%	63%	75%	77.0%	68.7%	8.3%
		NL	80%	74%	78%	58%	58%	58%	48%	66%	77.3%	58.0%	19.3%
QB3. In your opinion, who within the EU is responsible for tackling climate change? (MULTIPLE ANSWERS POSSIBLE)	National governments	EU	63%	55%	43%	42%	48%	41%	N/A	N/A	53.7%	43.7%	10.0%
		NL	73%	71%	68%	51%	61%	25%	N/A	N/A	70.7%	45.7%	25.0%
	You personally	EU	41%	36%	22%	19%	25%	21%	N/A	N/A	33.0%	21.7%	11.3%
		NL	57%	60%	55%	43%	41%	20%	N/A	N/A	57.3%	34.7%	22.7%
QB5. Have you personally taken any action to fight climate change over the past six months?	Yes	EU	64%	60%	49%	49%	50%	53%	N/A	N/A	57.7%	50.7%	7.0%
		NL	61%	64%	59%	47%	54%	59%	N/A	N/A	61.3%	53.3%	8.0%
QC7 How important do you think it is that the (NATIONALITY) government sets targets to increase the amount of renewable energy used, such as wind or solar power, by 2030?	Total 'Important'	EU	88%	92%	89%	91%	90%	N/A	N/A	N/A	89.7%	90.5%	-0.8%
		NL	92%	91%	97%	97%	96%	N/A	N/A	N/A	93%	97%	-3.2%

11. AR6 GWP recalculation

**Table 11(1):
Recalculation of NIR 2022 estimates**

**CRF Table 2(II)
1990**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134
Total actual emissions of halocarbons (by chemical) and SF ₆	378.81					
Total emissions ⁽³⁾	5606.33					
AR4 GWP	14800	675	92	1,640	3,500	1100
AR4 CO ₂ eq	5606.3288	0	0	0	0	0
check	0.00	0.00	0.00	0.00	0.00	0.00
AR6 GWP	14600	771	135		3740	
AR6 CO ₂ eq	5530.5676	0	0	0	0	0

**NIR 2022 CRF Summary2
1990**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
	CO ₂ equivalent (kt)					
Total (net emissions) ⁽¹⁾	167465.28	31835.19	17589.13	5606.33	2662.85	206.70
1. Energy	155366.74	2845.60	348.51			
2. Industrial processes and product use	6255.51	321.19	7294.12	5606.33	2662.85	206.70
3. Agriculture	184.67	14671.92	9655.37			
4. Land use, land-use change and forestry ⁽¹⁾	5658.37	0.36	110.22			
5. Waste	NO,IE,NA	13996.13	180.89			
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO

Indirect CO ₂ ⁽³⁾	917.19					
Total CO ₂ equivalent emissions without land use, land-u						
Total CO ₂ equivalent emissions with land use, land-u						
Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-u						
Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-u						
Total AR4 CO ₂ eq excluding LULUCF	162,724.11	31,834.84	17,478.90	5,606.33	2,662.85	206.70
AR4 GWP100	1.00	25.00	298.00			
Total mass units	162,724.11	1,273.39	58.65			
AR6 GWP100	1.00	27.90	273.00			
AR6 CO ₂ eq excluding LULUCF	162,724.11	35,527.68	16,012.55	5,530.57	2,669.72	228.46

**NIR 2022 CRF Table 2(II)
2020**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134
Total actual emissions of halocarbons (by chemical) and SF ₆	6.66	27.27			61.96	
Total emissions ⁽³⁾	98.56	18.41			216.85	
AR4 GWP	14800	675	92	1640	3500	1100
AR4 CO ₂ eq	98.56426851	18.40787999	0	0	216.8490875	0
check	0.00	0.00	0.00	0.00	0.00	0.00
AR6 GWP	14600	771	135	0	3740	0
AR6 CO ₂ eq	97.23231893	21.02588959	0	0	231.7187392	0

**NIR 2022 CRF Summary2
2020**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
	CO ₂ equivalent (kt)					

Total (net emissions) ⁽¹⁾	141288.88	16968.10	7845.70	1151.94	67.24	124.58
1. Energy	132037.21	2142.41	583.79			
2. Industrial processes and product use	5734.10	374.73	1312.81	1151.94	67.24	124.58
3. Agriculture	78.21	11885.34	5690.66			
4. Land use, land-use change and forestry ⁽¹⁾	3439.36	0.50	91.41			
5. Waste	NO,IE,NA	2565.12	167.05			
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO
Indirect CO ₂ ⁽³⁾	419.32					
Total CO ₂ equivalent emissions without land use, land-u						
Total CO ₂ equivalent emissions with land use, land-u						
Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-u						
Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-u						
Total AR4 CO ₂ eq excluding LULUCF	138,268.84	16,967.60	7,754.30	1,151.94	67.24	124.58
AR4 GWP100	1.00	25.00	298.00			
Total mass units	138,268.84	678.70	26.02			
AR6 GWP100	1.00	27.90	273.00			
AR6 CO ₂ eq excluding LULUCF	138,268.84	18,935.84	7,103.77	1,251.87	67.28	137.69
Comparison 1990-2020						
AR4						
AR6						

**Table 11(2):
Recalculation of CBS provisional estimates (Mt CO₂eq)**

Source: StatLine, 'Emissions of greenhouse gases according to IPCC Guide-lines, quarter', <<https://opendata.cbs.nl/statline/#/CBS/en/dataset/84979E>

	CO ₂	Non-CO ₂ AR4 eq	Total AR4 eq	Non-CO ₂ AR6 eq	Total AR6 eq
2020	138.3	26.1	164.4	27.5	165.8
2021	141.5	26.3	167.8	27.7	169.2
Variation		0.8%			

**Table 11(3):
Recalculation of PBL's 2030 projection**

Source: Planbureau voor de Leefomgeving (PBL) and others, Klimaat- en Energieverkenning 2021 (2021), at 210, corrected to account for difference be

	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
2020 estimate (AR4 eq)	138.1	19.0	6.9	1.5	0.1	0.1
2030 projection (AR4 eq)	102.0	17.2	6.5	1.2	0.1	0.1

AR4	1.0	25.0	298.0			22800.0
AR6	1.0	27.9	273.0			25200.0
2020 estimate (AR6 eq)	138.1	21.2	6.3	1.6	0.1	0.1
2030 projection (AR6 eq)	102.0	19.2	6.0	1.3	0.1	0.1

HFC-134a	HFC-143	HFC-143a	HFC-152	HFC-152a	HFC-161	HFC-227ea	HFC-236cb	HFC-236ea	HFC-236fa	HFC-245ca	HFC-245fa	HFC-365mfc	Unspecified mix of HFCs ⁽¹⁾	Total HFCs
(t)												CO ₂ equivalent (kt)		
1,430	353	4,470	53	124	12	3,220	1340	1370	9,810	693	1,030	794	1000	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	5606.3288
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1530		5810		164									1000	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	5530.5676

Unspecified mix of HFCs and PFCs	NF ₃	Total
NO	NO,IE	225365.49
		158560.85
NO	NO,IE	22346.70
		24511.96
		5768.95
		14177.03
NO	NO	NO

use change and forestry		219596.54
use change and forestry		225365.49
use change and forestry		220513.73
use change and forestry		226282.68
IE	IE	220,513.73
IE	IE	222,693.09

HFC-134a	HFC-143	HFC-143a	HFC-152	HFC-152a	HFC-161	HFC-227ea	HFC-236cb	HFC-236ea	HFC-236fa	HFC-245ca	HFC-245fa	HFC-365mfc	Unspecified mix of HFCs ⁽¹⁾	Total HFCs
(t)												CO ₂ equivalent (kt)		
369.51		34.92		0.68									133.54	
528.40		156.09		0.08									133.54	
1430	353	4470	53	124	12	3220	1340	1370	9810	693	1030	794	1000	
528.4018856	0	156.0923728	0	0.084816	0	0	0	0	0	0	0	0	133.5441	1151.94441
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1530	0	5810	0	164	0	0	0	0	0	0	0	0	1000	
565.3530664	0	202.8851647	0	0.112176	0	0	0	0	0	0	0	0	133.5441	1251.871455

Unspecified mix of HFCs and PFCs	NF ₃	Total

NO	NO,IE	167446.45
		134763.41
NO	NO,IE	8765.41
		17654.20
		3531.27
		2732.16
NO	NO	NO
Use change and forestry		163915.18
Use change and forestry		167446.45
Use change and forestry		164334.50
Use change and forestry		167865.77
IE	IE	164,334.50
IE	IE	165,765.30
		25.48%
		25.56%

NG/table?dl=68C4D>, accessed on 9 June 2022

etween AR4 and AR6 GWP100

Total
165.7
127.1

167.5
128.7

CF ₄	C ₂ F ₆	C ₃ F ₈	C ₄ F ₁₀	c-C ₄ F ₈	C ₅ F ₁₂	C ₆ F ₁₄	C ₁₀ F ₁₈	c-C ₃ F ₆	Unspecified mix of PFCs ⁽¹⁾	Total PFCs	Unspecified mix of HFCs and PFCs ⁽¹⁾	SF ₆	NF ₃
(t)									CO ₂ equivalent (kt)		CO ₂ equivalent (kt)	(t)	(t)
277.33	48.21								25.17			9.07	,IE
2049.47	588.21								25.17			206.70	,IE
7,390	12,200								1000		1000	22,800	17200
2049.4687	588.2108	0	0	0	0	0	0	0	25.17082187	2662.850322	0	206.7048	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
7380	12400								1000			25200	
2046.6954	597.8536	0	0	0	0	0	0	0	25.17082187	2669.719822	0	228.4632	

CF ₄	C ₂ F ₆	C ₃ F ₈	C ₄ F ₁₀	c-C ₄ F ₈	C ₅ F ₁₂	C ₆ F ₁₄	C ₁₀ F ₁₈	c-C ₃ F ₆	Unspecified mix of PFCs ⁽¹⁾	Total PFCs	Unspecified mix of HFCs and PFCs ⁽¹⁾	SF ₆	NF ₃
(t)									CO ₂ equivalent (kt)	CO ₂ equivalent (kt)	(t)	(t)	
2.96	0.36								40.97			5.46	,IE
21.87	4.39								40.97			124.58	,IE
7390	12200	0	0	0	0	0	0	0	1000		1000	22800	17200
21.8744	4.392	0	0	0	0	0	0	0	40.974802	67.241202	0	124.5792	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	
7380	12400	0	0	0	0	0	0	0	1000		0	25200	0
21.8448	4.464	0	0	0	0	0	0	0	40.974802	67.283602	0	137.6928	