REPORT

DNB Electric vehicles portfolio – Impact assessment

CLIENT

DNB Bank ASA

SUBJECT

Impact assessment Nordic EV portfolios

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CLIENT	**DNB Bank ASA (DNB)**	PROJECT MANAGER	Ibrahim Temel
CONTACT	Magnus Midtgård	PREPARED BY	Kjersti Rustad Kvisberg, Ibrahim Temel
		RESPONSIBLE UNIT	10105080 Renewable Energy Advisory Services

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1 Introduction

On assignment from DNB, Multiconsult has assessed the impact of electric vehicles in Norway Denmark, Finland, and Sweden on climate gas emissions. Since the portfolio is dominated by Norwegian and Swedish vehicles, the smaller number of Danish and Finnish vehicles accounting for 11 percent of the portfolio are, for simplicity, considered to have impact in line with Norwegian vehicles. In this document we briefly describe DNB's qualification criteria for Green Financing Instruments, the evidence for the criteria and the result of an analysis of the loan portfolio of DNB. For more information related to the eligibility criteria we refer to DNB's website[1].

The eligibility criteria are formulated in line with Climate Bonds Initiative (CBI) criteria[2]. The eligible EVs/ zero tailpipe emissions vehicles in the portfolio are also automatically eligible according to the climate change mitigation criteria in the EU Taxonomy Delegated Acts[3].

The bank's portfolio is assessed regarding direct emissions (Scope 1) and indirect emissions related to electric power production (Scope 2). A baseline is established as the emission of the average new vehicles introduced to the market, EV's excluded.

2 Electric vehicles - Eligibility criteria

This report investigates the electric vehicle portfolio relevant under the "Zero carbon vehicles" criterion in DNB's Green Finance Framework[1]:

- Fully electric, hydrogen or otherwise zero direct (tailpipe) CO_2-emissions vehicles for the transportation of passengers or freight.

The portfolio examined includes solely electric vehicles financed by the bank, and the calculations include passenger vehicles, light- and heavy-duty vehicles. Making up low volumes in the portfolio, buses and heavy freight trucks are here both considered heavy-duty vehicles.

3 Electric Vehicles – general description

Personal mobility in Norway and Sweden is high, among the highest in Europe, with privately owned passenger vehicles taking the lion's share of the passenger transportation work. Figure 1 shows the nature of passenger transport in Norway and Sweden compared to other selected countries.

Historical figures of how far the average passenger vehicle is driven annually in Norway and Sweden, show a falling slope from 2007 and 2008, when the passenger vehicles peaked and were on average driven about 14,000 km and 13,000 km in Norway and Sweden respectively. The development of distance travelled on average has in general been similar in Norway and Sweden, except for a higher starting point in Norway and a more rapid reduction over the years. In 2022 the average passenger vehicle travelled about 11,100 km in Norway[4] and 11,300 km in Sweden[5]. For light-duty vehicles, travelled distance in 2022 was about 13,500 km in Norway and 13,800 km in Sweden. Heavy-duty vehicles in Norway travelled about 36,800 km in 2022. The expected yearly travelled distance for the

[1] https://www.ir.dnb.no/funding-and-rating/green-bond-framework, 2024
[2] https://www.climatebonds.net/standard/transport, 2024
[3] https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852/amending-and-supplementary-acts/implementing-and-delegated-acts_en, 2022
[4] Statistics Norway Table 12578: Road traffic volumes, by main type of vehicle, type of fuel and age of vehicle 2005-2023
[5] Vehicle mileage for Swedish-Registered Vehicles 1999-2022, Transport Analysis, Official Statistics of Sweden, 2024

vehicles in the portfolio is in this analysis estimated based on an expectation of a continuing trend of reduced yearly travelled distance, and as an average over the vehicles' lifetime.

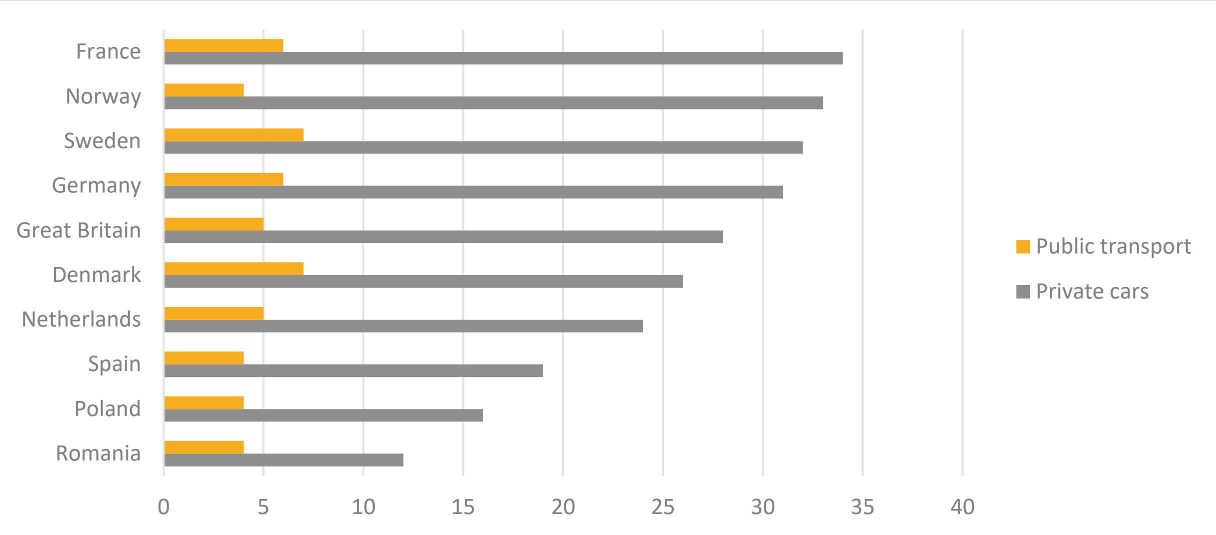

Figure 1 Passenger transport in selected countries [passenger-kilometre per person per day] (Source: Statistics Norway[6]/Eurostat, 2014).

In 2022 the average age of passenger vehicles scrapped for refund in Norway was 18 years old[7], while in Sweden it was 17 years (statistic last updated for 2019)[8]. The average age for vans scrapped in Norway was 16 years in 2022[7]. The history of modern EV's is short and there is yet no evidence for the lifetime of EV's being different from other vehicles. Due to uncertainties related to the expected lifetime of new vehicles sold between 2013 and 2023, the average lifetime for passenger vehicles and light-duty vehicles in this analysis are set to 18 and 16 years respectively, for both Sweden and Norway, independent of fuel type. In this analysis, the average lifetime for heavy-duty vehicles is estimated to be 14 years[9], for both Sweden and Norway, independent of fuel type.

3.1 EV policy in Norway

The Norwegian government have over time, with different administrations, had high ambitions both regarding electric vehicles and biofuel to reduce CO_2-emissions. There were almost 600,000 electric passenger vehicles on Norwegian roads by the end of 2022, which accounts for 20 percent of the total passenger vehicle stock[10]. The Norwegian Parliament have unanimously agreed that all new light-duty and passenger vehicles sold should be zero-emission from 2025[11].

A broad consensus around gradually expanding the Norwegian EV-politics has been sustained in parliament. The Norwegian EV policy, one of the world's most ambitious EV policies, was made effective by the tax exemption on VAT and the steep registration tax, in addition to a series of initial benefits like free fares on the many toll roads, ferries, free parking and free charging in cities.

In 2023, the Norwegian government adjusted the previous VAT exemption to only be applicable up to 500,000 NOK of the purchase price. Additionally, EV vehicles now need to pay a registration fee, to the same degree as fossil fuel vehicles. Many of the other benefits have been reduced and EVs are

[6] https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/koyrer-nest-mest-i-europa, 2020
[7] Statistics Norway Table 05522: Vehicles scrapped for refund (C) 1999-2023
[8] https://www.bilsweden.se/statistik/bilismen-i-sverige/2019/fordonsbestand-och-mobilitet, 2020
[9] https://www.toi.no/getfile.php?mmfileid=72976#:~:text=Varebilene%20og%20lastebilene%20lever%20i,dr%C3%B8yt%2011%20%C3%A5r%20i%20Norge, 2022
[10] Statistics Norway Table 07849: Registered vehicles, by type of transport and type of fuel (M) 2008-2023
[11] https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/veg_og_vegtrafikk/faktaartikler-vei-og-ts/norge-er-elektrisk/id2677481/, 2021

currently paying up to a maximum, by law, of 70 percent for toll roads, and 50 percent for parking and ferries.

3.2 EV policy in Sweden

Sweden is experiencing a substantial growth in EV sales. Almost 200,000 electric passenger vehicles have been sold in Sweden between 2012 and 2022. Sales from 2022 alone accounts for almost 50 percent (about 96,200) of the domestic electric vehicle fleet, not including hybrids[12]. As a result of high volumes of electric vehicles being sold the latest years, the share of electric vehicles in the entire passenger car portfolio has increased from 2.2 percent at the end of 2021 to 4 percent by the end of 2022[12]. The 2017 policy document "Klimapolitiska ramverket" targets a 70 percent reduction in emissions from domestic travel (except for air travel) between 2010 and 2030[13]. One of the many incentives to achieve the target was a bonus system for environmentally friendly vehicles. The first bonus system was established in 2007 and lasted until January 2012. In July 2018, a new initiative called *Klimatbonus* was introduced, giving buyers of "climate-friendly vehicles" a refund between SEK 10 000 – 70 000, depending on the expected emissions from the vehicle[14]. More than 150,000 vehicles sold fell under the refund scheme between 2019 and august 2021[15]. The *Klimatbonus* initiative has since been modified. From January 1st, 2023, refunds are now capped at SEK 50,000 for EV cars, and SEK 10,000 for hybrid cars with emissions lower than 30 gCO2/km, and only applied for cars bought before November 9th 2022[16].

3.3 Biofuel policy in Norway

Norway has an ambitious biofuel policy, with a 50 percent reduction in greenhouse gas (GHG) emissions from fossil fuel from 2018[17]. In 2018 legislation was put in place to require all petrol retailers to sell fuel containing biofuels. The goal has since been advanced, with a special emphasis on avoiding the usage of biofuels with a high risk of increasing deforestation[18]. In 2023, the overall quota obligation was 17 percent, whereof the advanced biofuel requirement was set at 12.5 percent. To incentivise the use of advanced biofuels, one litre of advanced biofuels is counted as two litres of conventional biofuel, for every litre that exceeds the 12.5 percent advanced biofuel requirement. Subsequently, the overall use of advanced biofuel has increased year after year. In 2022, advanced biofuels accounted for 94 percent of the overall biofuel usage, thus reducing the usage of conventional biofuels[19]. As a result, the overall volume of biofuel has declined the past years, even though the percentage of biofuels has increased. The current government platform ("Hurdalsplattformen") strengthens the obligations to utilize second-generation biofuels in the fuels sold[20].

In 2020, a road tax (no; veibruksavgift) for all biofuel was introduced. The taxation of bioethanol is significantly lower compared to standard gasoline, but the road tax for biodiesel is equal to conventional diesel[21]. Previous estimates from 2018 concluded that biofuel used in Norway resulted in 72 percent lower GHG emissions in a life cycle perspective compared to regular fuels[22]. The same

[12] Vehicles in counties and municipalities 2023 and 2022, Transport analysis, Official Statistics of Sweden
[13] https://www.regeringen.se/artiklar/2017/06/det-klimatpolitiska-ramverket/, 2017
[14] https://www.transportstyrelsen.se/en/road/Vehicles/bonus-malus/bonus/, 2024
[15] https://www.transportstyrelsen.se/sv/vagtrafik/statistik/Miljobilsstatistik/, 2023
[16] https://www.regeringen.se/artiklar/2022/11/fragor-och-svar-om-avskaffad-klimatbonus/, 2023
[17] https://lovdata.no/dokument/LTI/forskrift/2016-10-27-1255, 2018
[18] https://www.regjeringen.no/no/dokumenter/politisk-plattform/id2626036/, 2019
[19] https://www.miljodirektoratet.no/aktuelt/nyheter/2023/mai-2023/mer-frityrolje-og-slakteavfall-pa-tanken-i-2022/, 2023
[20] https://regjeringen.no/no/dokumenter/hurdalsplattformen/id2877252/, 2021
[21] https://www.skatteetaten.no/satser/veibruksavgift/?year=2023#rateShowYear, 2023
[22] https://www.miljodirektoratet.no/aktuelt/nyheter/2019/mai-2019/salget-av-avansert-biodrivstoff-okte-i-fjor/, 2019

year, legislation was passed stipulating that biofuels shall have a minimum of 50 percent lower life cycle GHG emissions than fossil fuels[23].

In 2022, 94 percent of the biofuel utilized in the Norwegian transportation sector stems from waste and residue, most of it imported from North America, and China. Biofuels accounted for 13 percent of all fuels consumed by domestic road traffic in 2022- a similar level to 2021. The share of biofuels sold in Norway containing soy or palm oil is also below 0.5 percent, aligning with the target to reduce the usage of raw materials with a high risk for deforestation[24].

3.4 Biofuel Policy in Sweden

Sweden has proactively worked towards a high mix of biofuels in the total fuel sold, as seen in Figure 2. According to the Swedish fuel regulation, all fuel retailers were obliged to reduce the emissions from fuel sold to maximum 88.5 gCO_2-eq/MJ by 2020[25]. In 2022, biofuels accounted for 28 percent of all fuels used[26]. Sweden is currently working towards a 70 percent emission reduction in the transport sector by 2030[27], and has strengthened the requirements for more biofuel in the fuel mix delivered by retailers through linear reduction in emissions from transport fuel[28]. There was a five percent reduction in emissions from road transport from 2021 to 2022, explained by biofuels and more efficient vehicles[29]. The EU Commission has approved Sweden's continuation of tax exemption for highly blended biofuels[30].

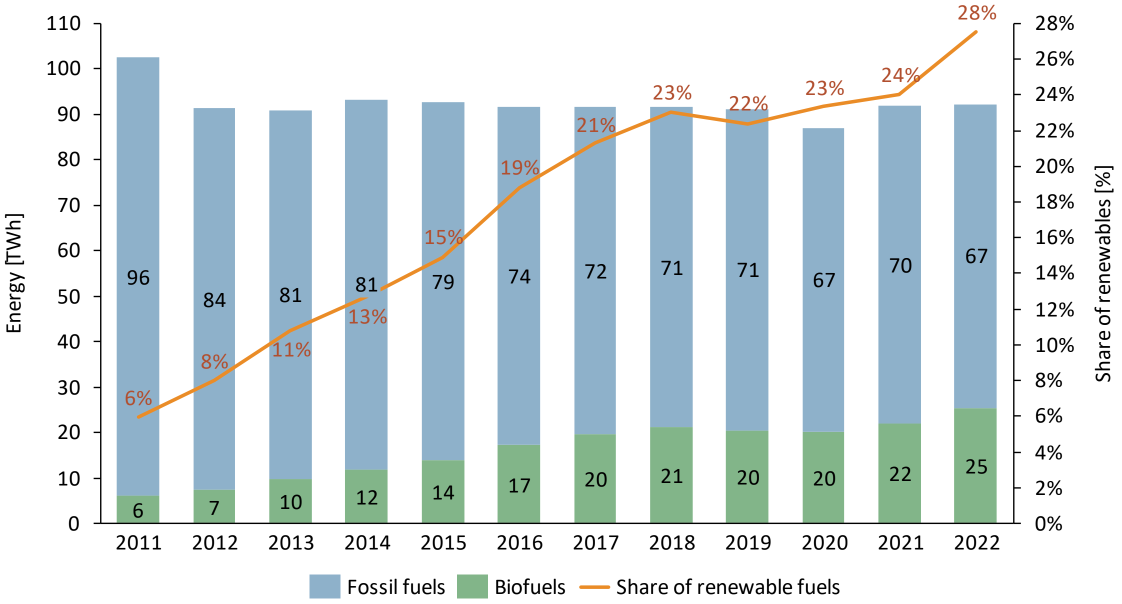

Figure 2 Amount of energy (TWh) from fossil fuel and biofuel in Swedish fuel mix. (Source: Drivmedel 2022, Energimyndigheten[26])

[23] https://lovdata.no/dokument/LTI/forskrift/2022-12-20-2356, 2023
[24] https://www.miljodirektoratet.no/aktuelt/nyheter/2023/mai-2023/mer-frityrolje-og-slakteavfall-pa-tanken-i-2022/, 2023
[25] https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/drivmedelslag-2011319_sfs-2011-319/, 2022
[26] https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=208409, 2023
[27] https://www.svebio.se/om-bioenergi/biodrivmedel/, 2023
[28] https://www.regeringen.se/pressmeddelanden/2020/09/branslebytet-forstarks-med-hogre-inblandning-av-fornybart-i-drivmedel/, 2020
[29] https://bransch.trafikverket.se/contentassets/01e7ada729cf48f2977873379b306d45/pm-vagtrafikens-utslapp-2022.pdf, 2023
[30] https://www.regeringen.se/pressmeddelanden/2022/12/skattebefrielse-for-rena-och-hoginblandade-biodrivmedel-till-och-med-2026/, 2022

4 Climate gas emissions (Scope 1 and 2)

Categorizing the emissions, we have chosen to use the CBI guidelines for the emission calculations. CBI's *Land Transport Background Paper*[31] underlines the focus on tailpipe emissions because of their dominance, the need to send strong signals to vehicle purchasers and the need to promote technologies and infrastructure that have the potential to radically shift emissions trajectories and avoid fossil fuel lock-in. We do however include information on indirect emissions related to power production.

4.1 Indicators

In this analysis we are using two relevant climate gas emission indicators for vehicles:

- Emissions per kilometre [gCO_2/km]
- Emissions per passenger-kilometre [gCO_2/pkm] or tonne-kilometre [gCO_2/tkm]

The vehicle fleet composition and emissions from the different types of vehicles is used to calculate the emissions per kilometre.

A passenger-kilometre, abbreviated as pkm, is the unit of measurement representing the transport of one passenger over one kilometre. Passenger-kilometers are found by multiplying the number of passengers by the corresponding number of kilometers travelled.

Statistics Norway's method for calculating indicators for emissions per passenger-kilometre utilizes a vehicle occupancy of 1.7 persons in passenger vehicles and 1.5 persons in a light-duty vehicle, and these factors have been adopted in this analysis[32]. Also *Transport Analysis* in Sweden uses 1.7 persons vehicle occupancy for passenger vehicles as a basis in their methods for calculating transport work in Sweden, based on results from a national transport survey. The vehicle occupancy in Swedish light-duty vehicles relevant for EV substitution is assumed to be 1.5 as in Norway. Swedish light-duty vehicles statistics include lorries with maximum load weight of up to 3.5 tonnes, in which only the smaller vehicle segment is relevant for EV substitution. Even though *Transport Analysis* have estimated an occupancy of 1 in Swedish light-duty vehicles[33], we assume similar driving patterns and transport work performed by the light-duty EVs in Norway and Sweden.

For heavy-duty vehicles, a more relevant factor is the tonne-kilometre, abbreviated as tkm. This unit represents the transportation of one tonne over one kilometre. Freight in heavy-duty vehicles in both Norway and Sweden are assumed to be 10.09 tonnes per vehicle, in line with Norwegian statistics[34].

4.2 Direct emissions (tailpipe)- Scope 1

Under scope 1 of the "Low Carbon Land Transport and the Climate Bonds Standard (Version 1.0)", we calculate the "Direct tailpipe CO_2 emissions from fossil fuels combustion" avoided.

The estimation of the baseline is performed through three steps:

1. Estimating the gross CO_2-emission per km (c) from the average vehicle that is being substituted by the zero-emission vehicle.
2. Multiplied by the number of km (d) the vehicle is estimated to travel.

[31] https://www.climatebonds.net/files/files/CBI_Background%20Doc_Transport_Jan2020%20.pdf, page 25
[32] https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/mindre-utslipp-per-kjorte-kilometer, 2022
[33] Transportarbete i Sverige – om metoderna för att beräkna transportarbete, PM 2019:5, Transport Analysis
[34] https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/elbiler-reduserer-utslipp-per-personkilometer?tabell=405070, 2022

3. Multiplied by the number (n) of vehicles substituting fossil vehicles in the portfolio.

This can be described in the following equation:

$$E_{baseline} = c_{weighted\ average} \cdot d_y \cdot n_{total} = E_{avoided} \qquad (1)$$

All EVs and fuel cell vehicles are considered eligible with zero tailpipe emissions. Therefore, for scope 1 calculations, the emissions from these vehicles are set to zero, and the baseline will amount to the total avoided emissions.

To estimate the annual emissions avoided by the eligible assets, projections are made for direct tailpipe CO_2-emissions from fossil fuels combustion in the national vehicle fleets.

For the substituted fossil-fuelled vehicles, emission data are retrieved from recognized test methods and not actual registrations of emissions in a Nordic climate[35]. Test methods have lately been improved to better reflect actual emissions but are still likely to underestimate the emissions[36].

Biofuels are already to some degree mixed with fossil fuels in both Norway and Sweden, and the reduced emissions due to these contributions are considered in the emissions from the vehicle that would have been bought as an alternative for the electric vehicle in this portfolio, in effect reducing the impact. As both Norway and Sweden aim to substantially reducing emissions from fossil fuelled vehicles by using biofuel in the fuel sold before 2030, the marginal emission reduction possibly obtained through these political goals between 2020-2030 have been accounted for in the analysis. It is assumed that the biofuel share in the fuel mix will remain constant between 2030 and the end of the vehicles' lifetime, assumed to be in 2040, 2038 and 2036 for passenger vehicles, light-duty vehicles and heavy-duty vehicles registered in 2023, respectively.

To estimate the weighted average of emissions per fossil vehicle ($c_{weighted\ average}$) we use the average annual emission from new vehicle models from 2011-2023[37] [38]. For heavy-duty vehicles, emission factors per fossil vehicles are from the Norwegian Environment Agency[39].

To estimate the distance travelled by the average vehicle we assume that EVs drive the average of the total vehicle portfolio for each vehicle type in each country each of the years it is used in its lifetime. Statistics of annual driven distance by electric, diesel and gasoline cars younger than 10 years builds up under this assumption[40]. Figure 3 shows the average yearly distance travelled by passenger cars and light-duty vehicles in Norway and Sweden.

[35] Nordic: Norway, Sweden, Finland, Denmark
[36] https://www.vegvesen.no/fag/fokusomrader/miljo+og+omgivelser/klima, 2021
[37] https://ofv.no/CO2-utslippet/co2-utslippet, 2024
[38] SE: 2022 numbers most recent available: https://www.transportstyrelsen.se/sv/vagtrafik/statistik/Statistik-over-koldioxidutslapp/statistik-over-koldioxidutslapp-2022/, 2023
[39] https://www.miljodirektoratet.no/tjenester/klimagassutslipp-kommuner/beregne-effekt-av-ulike-klimatiltak/, 2023
[40] Statistics Norway Table 12578: Road traffic volumes, by main type of vehicle, type of fuel and age of vehicle 2005-2023

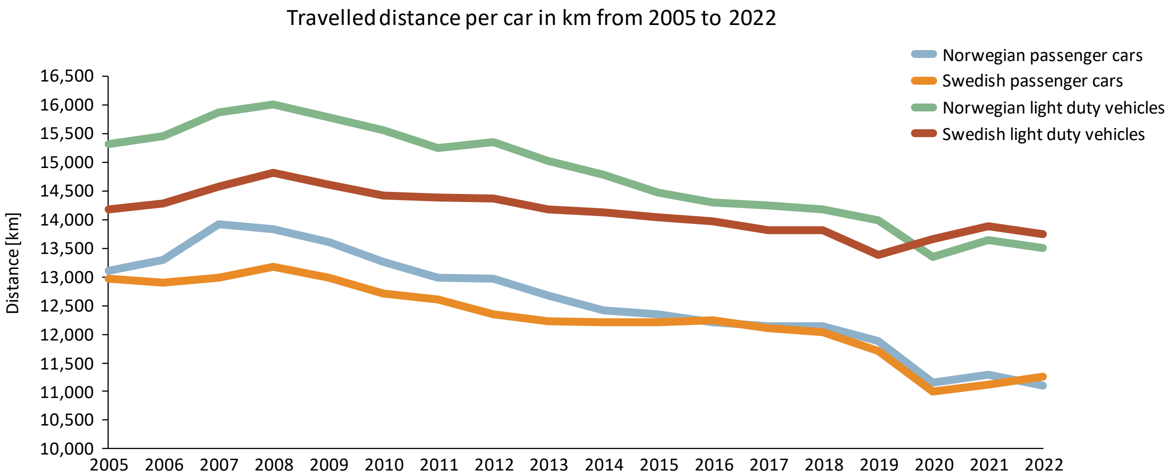

Figure 3 Average travelled distance per passenger vehicles 2005-2022 [km] (Source: Statistics Norway40 [41], Statistics Sweden[42]).

As Figure 3 shows, traffic volumes per passenger vehicle and light-duty vehicle have shown a historic decline and we use linear regression on publicly available datasets (d_{2005}-d_{2022}) and extrapolate until 2041. This is a conservative approach as it is likely, at some point, to see a flattening. Traffic volumes for heavy-duty vehicles have shown a similar trend, but on a higher level, with Norwegian heavy-duty vehicles driving on average 36,800 km in 2022.

Based on calculated gross tailpipe CO_2-emissions for the average vehicle produced in each of the years between 2011-2023, biofuel- and fossil fuel content in petrol/diesel pumped in each year between 2023-2041, as well as the travelled annual distance for the average vehicle, Table 1 through Table 3 present the calculated emission factors and CO_2-emissions in a year for the relevant vehicle categories.

Table 1 Passenger vehicles: Greenhouse gas emission factors (CO_2- equivalents), average direct emissions.

	Direct emissions substituted fossil passenger vehicles – Average Norway	Direct emissions substituted fossil passenger vehicles - Average Sweden	Direct emissions EV
Emissions per passenger-km	45 gCO_2/pkm	46 gCO_2/pkm	0 gCO_2/pkm
Emissions per km	77 gCO_2/km	79 gCO_2/km	0 gCO_2/km
Emissions per vehicle per year	677 $kgCO_2$/vehicle/year	746 $kgCO_2$/vehicle/year	0 $kgCO_2$/vehicle/year

[41] Statistics Norway Table 12575: Road traffic volumes, by type of vehicle and age of vehicle 2005-2023
[42] Vehicle mileage for Swedish-Registered Vehicles 1999-2022, Trafikanalys, Official Statistics of Sweden, 2023

Table 2 Light-duty vehicles: Greenhouse gas emission factors (CO_2- equivalents), average direct emissions[43].

	Direct emissions substituted fossil light-duty vehicles – Average Norway[44]	Direct emissions substituted fossil light-duty vehicles - Average Sweden[45]	Direct emissions EV
Emissions per passenger-km	133 gCO_2/pkm	72 gCO_2/pkm	0 gCO_2/pkm
Emissions per km	200 gCO_2/km	109 gCO_2/km	0 gCO_2/km
Emissions per vehicle per year	2,208 $kgCO_2$/vehicle/year	1,274 $kgCO_2$/vehicle/year	0 $kgCO_2$ /vehicle/year

Table 3 Heavy-duty vehicles: Greenhouse gas emission factors (CO_2- equivalents), average direct emissions for Norway.

	Direct emissions substituted fossil heavy-duty vehicles – Average Norway[46]	Direct emissions EV
Emissions per tonne-km	101 gCO_2/tkm	0 gCO_2/tkm
Emissions per km	1,019 gCO_2/km	0 gCO_2/km
Emissions per vehicle per year	33,332 $kgCO_2$/vehicle/year	0 $kgCO_2$/vehicle/year

The difference in emissions per km for vehicles in Sweden and Norway is mainly due to different share of biofuels in the fuel mix in the two countries today, and different goals for biofuels in 2030. In Sweden, a substantial increase of biofuel in diesel by 2030 is influencing the average emissions considerably.

4.3 Indirect emissions (Power consumption only)- Scope 2

4.3.1 Electricity production mix

In 2022, renewables accounted for 98 percent of the total (145.9 TWh) Norwegian electricity production [47]. As shown in Figure 4, the Norwegian production mix in 2022 (88 percent hydropower and 10 percent wind power) resulted in emissions of 7 gCO_2/kWh. In Sweden, the electricity production mix (41 percent hydropower, 19 percent wind and 29 percent nuclear[48]) gave specific emissions of 6.6 gCO_2/kWh. In the figure, the production mix is included for other selected European states for illustration.

[43] The portfolio includes 19 heavy-duty vehicles for Sweden, which is included in the statistic for light-duty vehicles because the data collected from Sweden does not differentiate between heavy and light-duty vehicles in the same way as Norway.
[44] Increase from previous year due to changes in biofuel regulations (targets and double counting of advanced fuels) and calculating biofuel projections on most recent statistics.
[45] Increase from previous year due to updated emission factors based on WLTP from 2021 and later, and due to using 2021-numbers where 2022- and 2023-numbers are missing.
[46] Factors have been updated to better avoid double counting the emission reductions caused by biofuels, causing increase from previous years.
[47] Statistics Norway Table 08307: Production, imports, exports and consumption of electric energy (GWh) 1950-2022
[48] Statistics Sweden: Electricity supply and use 2001–2022 (GWh), 2023

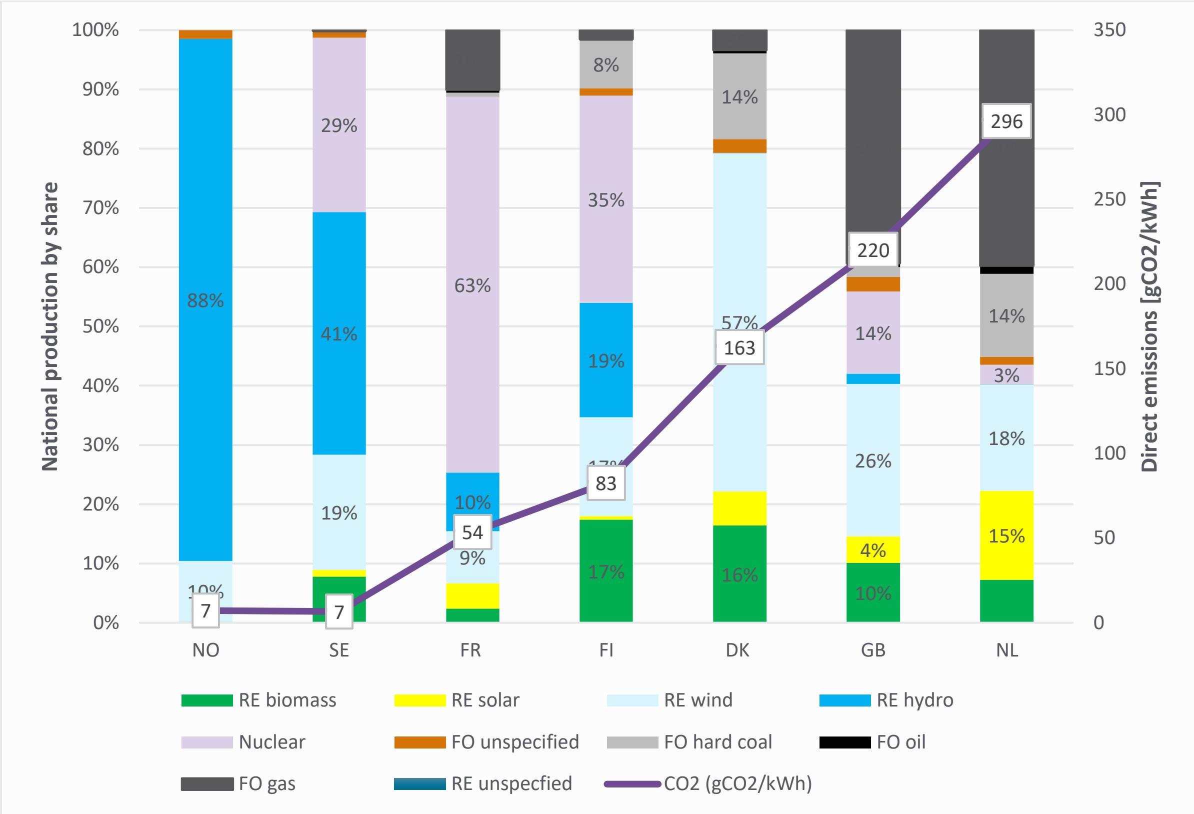

Figure 4 National electricity production mix in some selected countries. (European Residual Mixes 2022, Association of Issuing Bodies[49])

4.3.2 CO_2- emissions related to electricity demand

Power is traded internationally in an interconnected European electricity grid. For impact calculations of all power consumption, and even electrification of transportation, the regional or European production mix is more relevant than the national power production mix and is the basis for the main analysis. We have, however, also included calculations of indirect emissions from power production setting the system boundary at national borders.

The direct emissions in power production in Europe (EU27+UK+Norway) is expected to be dramatically reduced the coming decades. Figure 5 illustrates the emission trajectory used as basis for scope 2 emission calculations for EV's. Due to urgency the trajectory takes into consideration the 1.5 °C scenario and a substantial reduction of emissions in the power sector that will have close to zero emissions in 2050. This is in line with the EU's ambitious decarbonisation of the power sector[50].

[49] https://www.aib-net.org/facts/european-residual-mix, 2023
[50] https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/631047/IPOL_BRI(2019)631047_EN.pdf, 2019

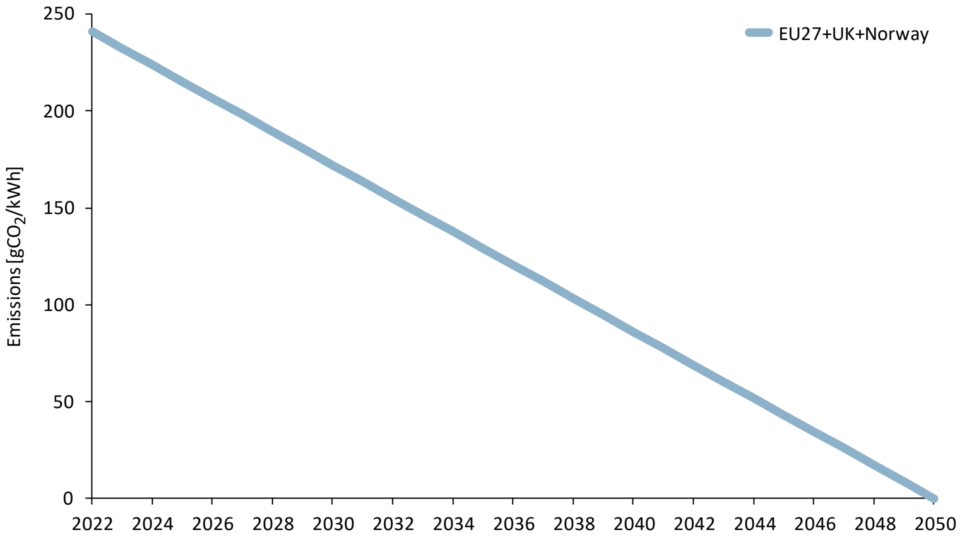

Figure 5 Direct CO_2 emissions in European electricity production mix, trajectory from 2022 to a zero target in 2050. (Source: EU, Multiconsult, Association of Issuing Bodies)

The national power production mixes are also likely to change somewhat in the period. For context, Figure 6 similarly illustrates an assumed linear projection from 2022 of Norwegian and Swedish electricity production mixes towards 2050.

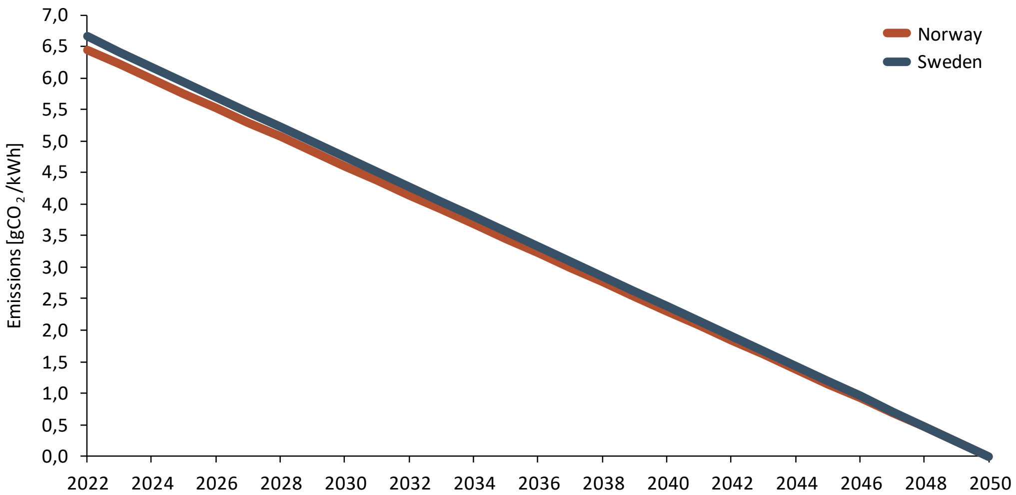

Figure 6 Direct CO_2 emissions in Norwegian and Swedish electricity production mix, trajectory from 2022 to a zero target in 2050. (Source: Multiconsult, Association of Issuing Bodies)

The GHG emission intensity baseline for power consumption depends on system boundaries. The table below illustrates the CO_2-factor for the European production mix as an average of the three last years with available data. This value will vary from year to year.

Finans Norge recently released a guidance document for calculation of financed greenhouse gas emissions, including recommendations for grid factors to be used[51]. To demonstrate how emissions vary depending on grid factor and for clarity if comparing avoided emissions from the green portfolio with total portfolio calculations, the two recommended grid factors are included: Norwegian physically delivered electricity 2022 from The Norwegian Water Resources and Energy Directorate

[51] https://www.finansnorge.no/dokumenter/maler-og-veiledere/veileder-for-beregning-av-finansierte-klimagassutslipp/, 2024

(NVE) and the Norwegian residual mix for 2022 as calculated by Association of Issuing Bodies (AIB). The corresponding Swedish residual mix for 2022 from AIB is used for Swedish emissions. To represent current emissions from Swedish electricity production, including export/import, a factor from the Swedish Energy Agency (Energimyndigheten) recommended when calculating emissions from biofuel emissions has been used. The mentioned grid factors are included in Table 4.

Table 4 Electricity greenhouse gas factors (CO_2- equivalents). (Source: Association of Issuing Bodies[52], NVE[53], Swedish Energy Agency[54], Multiconsult).

Scenario	Description	Emission factor
European (EU27+UK+Norway) production mix average 2020-2022	Location-based production mix with wide system boundary of EU countries, UK, and Norway	241 gCO_2/kWh
Norwegian NVE physically delivered electricity 2022	Location-based production mix with narrow system boundary including net export/ import only to neighbouring countries and average annual emission factors	19 gCO_2/kWh
Swedish Energy Agency electricity mix	Location-based production mix with narrow system boundary, adjusted to include export/import	26 gCO_2/kWh
Norwegian residual mix 2022	Market-based residual mix with a European marketplace, represents electricity not covered by Guarantees of Origin	502 gCO_2/kWh
Swedish residual mix 2022	Market-based residual mix with a European marketplace, represents electricity not covered by Guarantees of Origin	39 gCO_2/kWh[55]

For the average production mix, the following calculations use the CO_2- factor as an average from a baseline in 2022 (Table 4) and the expected lifetime for each type of vehicle, following the trajectory of the European production mix in Figure 5. For instance, for passenger vehicles with an expected lifetime of 18 years, the CO_2- factor will then be an average of the CO_2- factor presented in Figure 5 in the period from 2023-2041. The projected trajectories for declining CO_2 emissions related to power production for European (EU27 incl. UK and Norway), from 2023 and forward, will impact the indirect emissions and avoided emissions from the vehicle portfolio. The same method is not used to estimate the CO_2- factor based on the other mixes.

The energy consumption of EV's is very much dependent on size and outdoor temperature. There is not sufficient available data to ensure an accurate estimation of energy consumption for the average EV. In these calculations we are using the average for all currently available EV models in the Electrical Vehicle Database[56], 0.195 kWh/km, which is close to the factor presented in the Swedish "Handbok för vägtrafikens luftföroreningar"[57]. The same handbook presents an energy consumption for light-duty vehicles of 0.25 kWh/km. These factors (0.195 kWh/km and 0.25 kWh/km) have been used in the

[52] https://www.aib-net.org/facts/european-residual-mix, 2023
[53] https://www.nve.no/energi/energisystem/kraftproduksjon/hvor-kommer-stroemmen-fra/, 2024
[54] https://www.energimyndigheten.se/fornybart/hallbarhetskriterier/hallbarhetslagen/fragor-och-svar/vaxthusgasberakning/, 2024
[55] As calculated by AIB. Lower than Norwegian residual mix due to larger share of electricity usage covered by Guarantees of Origin.
[56] https://ev-database.org/cheatsheet/energy-consumption-electric-car, 2024
[57] "Handbok för vägtrafikens luftföroreningar", ch. 6, Trafikverket, 2021

analysis. For heavy-duty vehicles, the factor 1.25 kWh/km, an average for recent EV trucks has been used[58].

In Table 5, indirect emission factors are presented in both emissions per kilometre and per passenger-kilometre/tonne-kilometre, used to calculate indirect emissions for the portfolio based on European (incl. UK and Norway) production mix. Similar factors have been computed based on the Norwegian and Swedish factors and used in corresponding calculations of impact.

Table 5 Annual average GHG emission factors (CO_2- equivalents) per distance for all electric vehicles - based on ***EU + UK + NO*** *average power production mix 2020-2022.*

	Indirect emissions electric passenger vehicle	Indirect emissions electric light-duty vehicle	Indirect emissions electric heavy-duty vehicle[59]
Emissions per passenger-km or tonne-km, indirect emissions from power production	19.3 gCO_2/pkm	29.5 gCO_2/pkm	22.9 gCO_2/tkm
Emissions per km, indirect emissions from power production	32.8 gCO_2/km	44.3 gCO_2/km	231.3 gCO_2/km

Table 6 Electricity annual average consumption emission factors per distance (CO_2- equivalents) ***fossil fuelled alternatives****.*

	Indirect emissions fossil passenger vehicle*	Indirect emissions fossil light-duty vehicle*	Indirect emissions fossil heavy-duty vehicle*
Emissions per passenger-km or tonne-km, indirect emissions from power production	0 gCO_2/pkm	0 gCO_2/pkm	0 gCO_2/tkm
Emissions per km, indirect emissions from power production	0 gCO_2/km	0 gCO_2/km	0 gCO_2/km

*Note that there are indirect emissions related to fossil fuel as well, but scope 3 emissions are not included in this analysis. Scope 3 emissions differ between fossil and electric vehicles mostly due to the batteries where there is rapid technology development.

[58] https://www.toi.no/publikasjoner/gronn-lastebiltransport-teknologistatus-kostnader-og-brukererfaringer, 2021
[59] Increase from previous year due to updated emission factor assumptions from 0.25 kWh/km to 1.25 kWh/km for heavy-duty vehicles.

5 Portfolio analysis and impact assessment - avoided emissions EVs

The 130,199 eligible vehicles in DNB's YE-2023 portfolio are estimated to drive 1.09 billion km per year. The available data from the bank includes the current number of contracts and related portfolio volume. Table 7 through Table 9 show the number of eligible vehicles and corresponding calculated mileage for vehicles in Sweden, in Norway, Danmark and Finland, and in total.

*Table 7 Number of eligible vehicles and expected yearly mileage **Swedish vehicles**.*

	No. of vehicles	Sum km/yr	Sum passenger-km/yr
Passenger vehicles	40,318	382 mill.	650 mill.
Light-duty vehicles	1,583	18 mill.	28 mill.
Sum Swedish portfolio	**41,901**	**400 mill.**	**678 mill.**

*Table 8 Number of eligible vehicles and expected yearly mileage **Norwegian** (83%)**, Danish and Finnish vehicles**.*

	No. of vehicles	Sum km/yr	Sum passenger-km/yr or tonne-km/yr
Passenger vehicles	84,164	738 mill.	1,254 mill.
Light-duty vehicles	4,071	45 mill.	67 mill.
Heavy-duty vehicles	63	2 mill.	21 mill.
Sum Norwegian, Danish and Finnish portfolio	**88,298**	**785 mill.**	**1,342 mill.**

*Table 9 Total number of eligible vehicles and expected yearly mileage in **all Nordic countries**.*

	No. of vehicles	Sum km/yr	Sum passenger-km/yr or tonne-km/yr
Passenger vehicles	124,482	1,220 mill.	1,904 mill.
Light-duty vehicles	5,654	63 mill.	95 mill.
Heavy-duty vehicles	63	2 mill	21 mill.
Sum entire Nordic portfolio	**130,199**	**1,085 mill.**	**2,020 mill.**

Table 10 to Table 12 summarises the lower CO_2-emissions compared to baseline for the eligible assets in the portfolio in an average year in the lifetime of the vehicles in the portfolio, presented as reductions in direct emissions and indirect emissions in rounded numbers. Table 10 present results based on European power production mix. Table 11 is based on Norwegian and Swedish electricity mixes considering export/import and Table 12 on Norwegian and Swedish residual mixes for 2022. Finally, Table 13 shows the sum of direct and indirect avoided emissions for all grid factors mentioned in Table 4.

Note that the indirect emissions are only calculated for EV's and not fossil fuelled vehicles.

Direct emissions in the following tables are calculated by multiplying distance travelled [km] by the vehicles in the portfolio in a year from Table 7 through Table 9, by the specific emission factors [gCO_2/km] in Table 1 to Table 3. Indirect emissions are calculated by multiplying distance travelled [km] by the vehicles in the portfolio in a year by the specific emission factors [gCO_2/km] in Table 5 through Table 6.

Table 10 The portfolio's estimated impact on GHG-emissions, indirect emissions based on ***European power production*** *mix 2020-2022.*

	Avoided emissions compared to baseline – NO (incl. DK+FI)	Avoided emissions compared to baseline – Sweden	Avoided emissions sum entire Nordic portfolio
Direct emissions only (Scope 1)	68,070 tonnes CO_2/year	32,100 tonnes CO_2/year	**100,170 tonnes CO_2/year**
Indirect emissions only (Scope 2, EU prod. mix)	-26,630 tonnes CO_2/year	-13,340 tonnes CO_2/year	**-39,970 tonnes CO_2/year**
Sum direct and indirect	**41,440 tonnes CO_2/year**	**18,760 tonnes CO_2/year**	**60,200 tonnes CO_2/year**

Table 11 The portfolio's estimated impact on GHG-emissions, indirect emissions based on ***Norwegian and Swedish electricity mixes*** *considering export/import.*

	Avoided emissions compared to baseline – Norway (incl. DK+FI)	Avoided emissions compared to baseline – Sweden	Avoided emissions sum entire Nordic portfolio
Direct emissions only (Scope 1)	68,070 tonnes CO_2/year	32,100 tonnes CO_2/year	**100,170 tonnes CO_2/year**
Indirect emissions only (Scope 2, NO phys. del. el. 2022 and SE el. mix)	-3,000 tonnes CO_2/year	-2,060 tonnes CO_2/year	**-5,060 tonnes CO_2/year**
Sum direct and indirect	**65,070 tonnes CO_2/year**	**30,040 tonnes CO_2/year**	**95,110 tonnes CO_2/year**

Table 12 The portfolio's estimated impact on GHG-emissions, indirect emissions based on ***Norwegian and Swedish residual mixes*** *for 2022.*

	Avoided emissions compared to baseline – Norway (incl. DK+FI)	Avoided emissions compared to baseline – Sweden	Avoided emissions sum entire Nordic portfolio
Direct emissions only (Scope 1)	68,070 tonnes CO_2/year	32,100 tonnes CO_2/year	**100,170 tonnes CO_2/year**
Indirect emissions only (Scope 2, NO/SE residual mix)	-79,130 tonnes CO_2/year	-3,080 tonnes CO_2/year	**-82,210 tonnes CO_2/year**
Sum direct and indirect	**-11,060 tonnes CO_2/year**	**29,020 tonnes CO_2/year**	**17,960 tonnes CO_2/year**

Note that the high residual mix for Norway lead to net negative NO+DK+FI avoided emissions. The same is not found for Sweden, which has a large share of nuclear energy in the electricity usage not covered by Guarantees of Origin. A residual mix calculated for the Nordic countries is 468 gCO_2/kWh for 2022[60], which in sum would give avoided emissions of -11,040 tonnes CO_2/year for the entire Nordic portfolio.

The reduction in direct emissions correspond to 38 million litres gasoline saved per year.

In Table 13 below, the sum of direct and indirect avoided emissions for the whole Nordic portfolio are shown based on all indirect emission grid factors mentioned in Table 4. Direct emissions are the same for all mixes, only indirect emissions are dependent on choice of electricity factor. The table enables comparison with the bank's impact reporting on other green bond asset classes and financed emissions across all assets – green and others.

Table 13 Sum of direct emissions and indirect GHG emissions (CO_2-equivalents) for entire Nordic portfolio. Based on European average power production mix, NO/SE electricity mixes considering export/import and NO/SE residual mixes.

	Indirect emission factor electricity[61]	Avoided emissions sum entire Nordic portfolio
Sum direct and indirect European mix 2020-2022	241 gCO_2/kWh[62]	60,200 tonnes CO_2/year
Sum direct and indirect NO physically delivered el. 2022 and SE electricity mix	NO: 19 gCO_2/kWh, SE: 26 gCO_2/kWh	95,110 tonnes CO_2/year
Sum direct and indirect NO/SE residual mixes 2022	NO: 502 gCO_2/kWh, SE: 39 gCO_2/kWh	17,960 tonnes CO_2/year

[60] https://ei.se/bransch/ursprungsmarkning-av-el/residualmix, 2023
[61] Used to calculate emissions per driven distance as shown in Table 5, which is then used in emission calculation.
[62] Projected towards net zero and averaged over vehicle lifetime.