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°CICERO Shades of Green

Sustainable Edge Sector Brief: Land transport of freight and suburban passengers

Year 2020

Sector definition

NACE codes H49.4, Freight transport by road and removal services, and **H49.391** "Non-urban or suburban passenger land transport. **Geographical scope: Norway.**

This brief provides a climate assessment of freight land transport of goods and suburban passenger land transport, as according to the EU defined NACE codes detailed above. The typical company is a third-party transportation company that transports goods on behalf of customers. The sector includes distribution of smaller items over shorter distances with vehicles under 3.5 tonnes (vehicle + cargo), dry and wet goods over longer distances with trucks between 3.5 – 7 tonnes and transportation with vehicles of over 7 tonnes. Terminologies for vehicles vary between countries and languages. We refer to vehicles under 3.5 tonnes as distribution vehicles. We use the term "truck" to describe vehicles over 3.5 tonnes with fixed transportation space as well as vehicles specifically designed to pull one or more trailers. This brief also includes the non-urban transport of passengers, typical companies in this segment would be bus companies offering transportation outside urban and suburban areas.

Excluded from the scope of this brief are personal passenger cars, inner-city public transportation, rail transport and vehicles involved in construction work.

Summary

As of latest IPCC figures, the transport sector comprised 23% of energy-related CO2 emissions in 2014. In the period between 2021-2030, heavy-duty and light commercial transport are expected to make up 53% of emissions within the transport sector. In Norway, as in many other countries, electric vehicle uptake is expected to grow exponentially for light distribution vehicles, while hydrogen and advanced biofuels could be good solutions for heavy-duty trucks and inter-urban passenger buses. The Norwegian hydrogen and electric truck industries are fast-growing, but still in early phase. Advanced biofuels are a good solution, particularly in the near-term. Concerns of indirect land use change and emissions accounting exist. Expected major drivers in the decarbonisation of this sector include technology focused measures such as improving energy efficiency and fuel switching, as well as structural changes that avoid or shift transport activity.

Main climate and environmental risks[1]

Happening now

1. Increased traffic interruption and road diversions due to more frequent weather and extreme weather events e.g., flooding, heavy precipitation (rain and snow), and freeze-thaw weathering[2]
2. Higher road tolls and restrictions for diesel powered internal combustion engines, especially in cold weather when diesel exhaust is most polluting

Likely in short term

3. Increasingly stringent regulations for emissions not covered under the EU emissions trading system and implementation of zero-emissions urban environments
4. Increasing demand for alternative fuels/engine types in tenders from public institutions and large corporations

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Physical risk exposure

- Climate change impacts over the next 10-20 years are determined by emissions which are already in the atmosphere. Impacts in this period are therefore independent of policy changes.
- Expected increase in extreme weather may lead to: more floods, higher risk of mud- and rockslides, storm-surges in urban areas, more snow and freeze-thaw weathering in Northern regions and at high altitudes. This impacts key supply routes by increasing the risk of more frequent traffic interruptions and necessity for road diversions.
- Physical risks may impact the supply chain for transport companies, e.g., renewable energy installations and lithium and other metal ore mining for battery production

Transition risk exposure

- Transition risks are high in scenarios limiting warming to 20C, given necessary implementation of ambitious policies and tighter regulations.
- Local and regional administrations will establish stricter zero-emission regulations, which would affect transport routes and delivery to final customers. This includes increased road tolls for higher carbon intensity vehicles, or increased taxes and fees on diesel, would give an advantage to non-diesel-powered vehicles.
- Increasing scrutiny from customers seeking to cut supply chain emissions. Tenders from public bodies and large corporations may demand bidders to have alternatives to internal combustion engines

1 The selection of key risks and categorization of those is based on expert judgement. Short-term refers to impacts that are likely in the next decade.
2 Flooding and heavy precipitation will have large local impacts but will likely have limited impact on long-term national transport trends, as the road network is such that road diversions are almost always possible.

Key statistics & background figures

- In 2019, emissions from road transport (8.4m tCO_2eq) constituted 16.7% of total Norwegian emissions (50.3m tCO_2eq) (SSB, 2019a). ¾ of total transport of goods in Norway is done by road transport (SSB, 2019c).

- To achieve climate neutrality, transport emissions will need to decrease by 90% from 1990 levels by 2050 (EU Taxonomy, 2020). The Norwegian government has an ambition to cut emissions by 90-95% by 2050 (Regjeringen, 2020a). The transportation sector is not included in the EU Emissions Trading System (ETS). However, Norway reached an agreement with the EU and Iceland to cut non-ETS emissions by 40 % compared to 1990 levels by 2030 (Regjeringen, 2019).

- According to Klimakur 2030, a third of non-ETS emissions in Norway between 2021-2030 will come from the land transport sector. Of these emissions, 36% are associated with heavy duty transport (trucks and busses) and 17% with light distribution vehicles (Miljødirektoratet, 2020).

- Between 1990 and 2019, Norwegian emissions from road transport have increased by 16.4%, however, the past several years since 2019 have exhibited emissions reductions. Between 2018-2019 emissions decreased by 7.7% (SSB, 2019a).

- Goods transport is still predominantly fossil fuel based. So far in 2020 (as of September 2020), zero-emissions vans have constituted only 6.6% of new van purchases (OFV, 2020). In comparison, zero-emission personal cars have made up 50% of new personal car registrations in Norway.

- Transport of goods and related activities is a large economic sector in Norway, with over 15 000 businesses, over 74 000 employees and a turnover of ca. 87 billion NOK in 2017 (SSB, 2019b).

- The first electric truck in Norway was operative in September 2016. At the end of 2018, there were 13 electric trucks in use in Norway, most of which were used as waste collection trucks (Hovi et al., 2019). Hydrogen-based truck industry is fast growing, but still very early-phase.

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About this brief

This sector brief was developed by CICERO as a part of the Sustainable Edge research project. The purpose of the brief is to outline the key material climate-related issues for the sector. The audience for the brief is the financial sector, either as potential investors or lenders to the sector. The reader is expected to have background knowledge of the sector and of climate risk assessment. The analysis methodology is rooted in CICERO's climate science and build on CICERO Shades of Green's methodology for green bond frameworks. This brief is to be considered a science-based opinion.

CICERO Shades of Green AS is a subsidiary of CICERO established in November 2018. CICERO Shades of Green AS has commercialized a corporate climate risk assessment based partially on the Sustainable Edge research, in addition to their own methodological development.

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Please note this assessment focuses on climate-related issues and risks. Other environmental and social aspects may be noted, but assessing material social, ethical and governance issues are outside the scope of the assessment. We discuss governance specifically in the context of climate governance, this should not be viewed as a substitute for a full evaluation of the governance of the sector and does not cover, e.g., corruption.

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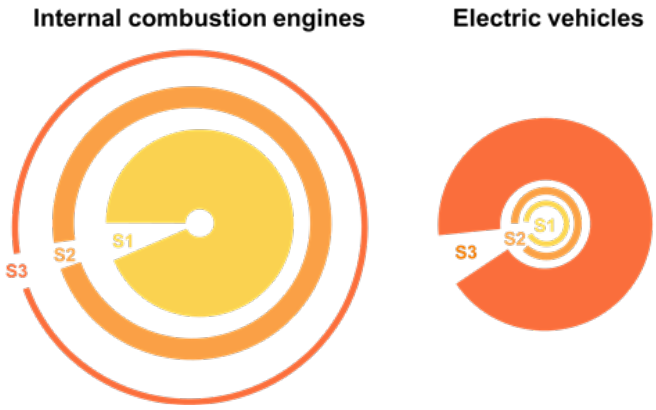
Emissions



This diagram illustrates the distribution of emissions by scope for internal combustion engines and electric vehicles. The relative width of the circles conveys the relative share of Scope 1, 2, and 3 emissions. The total size of the whole circle indicates the total absolute emissions of ICE and EVs (total emissions are lower for EVs than for ICEs). The share of Scope 2 emissions depends on grid emissions factors. Scope 3 emissions are similar for both ICE and EVs but will depend on the size and type of vehicle (heavy-duty truck vs commercial distribution van). Note: available research on life cycle emissions of EV vs ICE cars varies greatly.

Scope 1 (S1)

Scope 1 emissions are direct emissions arising from sources owned or controlled by the company, e.g., emissions of CO2 and H2 from trucks.

Status:

- Fuel use is the largest contributor to life-cycle emissions of a globally averaged vehicle (IEA, 2020).
- Fuel switching away from diesel and petroleum is gaining momentum but is not yet demonstrating benefits on a scale consistent with 1.5-degree pathways (IPCC, 2018).
- Hydrogen produced in Norway is mostly ‘grey hydrogen’, meaning it is produced with fossil fuels and without CCS. (Regjeringen, 2020b).
- EVs are cleaner than diesel (22%) and gasoline (28%) counterparts, even in the most carbon intensive scenario: battery produced in China and vehicle used in Poland (most carbon intensive EU grid) (T&E, 2020).

Potential and challenges: to reduce scope 1 emissions

- Electrification can cut 1.9m tonnes CO2 by 2030, assuming 90% electric delivery trucks, electric city busses and some electrification of heavy trucks (Veikart, 2016). Norwegian battery EVs offer a three- to fourfold energy efficiency improvement compared to internal combustion engines (Fridstrøm et al, n.d.).
- The hydrogen economy for land transport faces challenges in cost reduction through upscaling and mass production. (Philibert, 2020). Hydrogen can also be sourced from existing industrial processes that produce hydrogen as a biproduct. (Regjeringen, 2020b)
- Leakage of hydrogen from synthesis, storage and use could have significant climate effects. Hydrogen is an indirect GHG as it affects the tropospheric distribution of methane and ozone, which are the second and third largest contributors to global warming respectively. The climate impact of a global hydrogen economy is 0.6% of global fossil fuel economy (assuming a leakage rate of 1%) (Derwent et al, 2006). Further research in this field is required to fully understand all climate impacts.
- Advanced liquid biofuel has high potential for short-term Scope 1 emission reductions in the sector (Miljødirektoratet, 2020). The resulting scope 3 emissions depend heavily on type of biofuel: biodiesel from waste wood leads to around 90% emissions reductions, while biodiesel from palm oil leads to a 150% increase in emissions (ICCT, 2011). Concerns of indirect land use change, limited supply and emissions from biofuels necessitates further decarbonisation beyond biofuels toward electric and hydrogen technology.
- Increasing regulations to reduce NOx and PM concentrations from combustion engines; opportunity to incorporate Euro VI or higher engines, and HVO/2 generation or higher biofuels (Hagman, 2019).
- The potential for improving the efficiency of the internal combustion engine (ICE) is limited. But there is significant potential in improving structural efficiency (logistics, supply chains, routing) (IPCC, 2018).

Targets

- Industry target to reduce emissions by 50% to 2030, aiming for zero emissions 2050 compared to 2005 (Veikart, 2016). 50% of new trucks in 2030 should be zero-emission (Regjeringen, 2019). The EU targets a 40% cut in non-ETS sectors, which includes transportation.
- The Norwegian National Transport Plan assumes 1.7 bn liters available biofuel in 2030 (Veikart, 2016)
- The Norwegian government has outlined an escalation plan for both biofuel and hydrogen (Regjeringen, 2020b).

Scope 2 (S2)

Scope 2 GHG emissions are indirect emissions from sources owned or controlled by the company, this includes generation of electricity, heat or steam purchased by the company.

Status:

- As of June 2020, 94.6% of electricity is produced from hydropower in Norway (SSB, 2020).
- The grid electricity emission factors are low in Norway compared to other European countries. For example, one estimate is 0.01 kgCO2e/kWh (Carbon footprint, 2019).

Potential and challenges:

- Trend towards electrification and digitalization (e.g., in logistics planning) in the goods transport sector, which increases the use of electricity and prompts the need for greater renewable electricity generation (TØI, 2018).
- Opportunity to install renewable energy e.g., small, run-of-river hydro power plants, wind or solar for own use for charging vehicles.
- Electric vehicles face a challenge in that they have lower engine power. Electric trucks have higher requirements for range and power and are not yet commercially available; as of the end of 2018, only 13 were in use.
- Battery costs are expected to decline, providing the potential for growth in the EV industry and increased electrification.
- The production of hydrogen has varying Scope 2 emissions, depending on how it is produced. Green hydrogen is produced with renewable electricity, while blue hydrogen is produced with natural gas and CCS. Blue hydrogen can produce a significantly greater volume of hydrogen per day (120-240 tonnes) than green hydrogen (8 tonnes) (Regjeringen, 2020b).
- The cost of electricity for electrolysis in Norway is low due to the exemption of production of hydrogen from electricity fees (Regjeringen, 2020b).
- Opportunity to cleanly produce own zero-carbon hydrogen fuel (e.g., ASKO produces its own hydrogen fuel) (ASKO, 2017).

Targets

- The Norwegian government supports R&D within hydrogen sector, including in ensuring energy efficiency and cost effectiveness through Enova, Innovasjon Norge and Forskningsrådet (Regjeringen, 2020b).
- Hydrogen is a key area of prioritisation for the EU, specifically developing renewable hydrogen in a gradual trajectory towards 2050. In the short and medium term, the EU will also invest in low-carbon hydrogen (European Commission, 2020).

Scope 3 (S3)

Scope 3 emissions comprise of indirect emissions incurred by a transport company through their upstream and downstream value chain. For example, embedded emissions in purchased goods and services, distribution of manufactured vehicles, and end-of-life treatment of vehicles.

Status:

- EV batteries are carbon intensive to manufacture due to high electricity demand and mining activities. Carbon intensity is therefore dependent on production location and grid emissions factor, as well as on type and concentration of materials (e.g., cobalt content) in the battery. However, a recent study has shown that battery footprints are two to three times lower than commonly used estimates (T&E, 2020).
- Hybrid and EV technologies increase the demand for certain minerals, such as lithium, gallium, and phosphates (IPCC, 2014). There are concerns of local (incl. water) pollution from lithium mining.
- Lithium-ion battery production requires extracting and refining rare earth metals, which is energy intensive due to the need for high heat and sterile conditions. In 2016, most batteries from European EVs were manufactured in Japan and South Korea, where approx. 25-40% of electricity generation is from coal (ICCT, 2020).
- Vehicles at end-of-life have value as a source of spare parts and materials such as aluminum. The EU requires 95% recyclability for vehicles. In 2017, Norway had a recovery rate of 98%, and a recycling rate of 85% (Eurostat, 2020).
- Cargo can generate Scope 3 emissions. Transport of fossil fuels or blended fossil fuels is not eligible under the EU Taxonomy (EU Taxonomy).

Potential and challenges:

- Potential to use aluminium to reduce the weight of vehicles and therefore reduce fuel required. However, the increase in GHG emissions from increased aluminium production could under specific circumstances be larger than the GHG savings from vehicle weight reduction. Studies have, however, indicated that in about two decades, closed-loop recycling can significantly reduce the impacts of aluminium-intensive vehicles (IPCC, 2014).
- Circular economy and life-cycle considerations must be accounted for. Note that there is large variation in life cycle analysis methodology. Recycling of batteries is rarely included in LCAs due to significant uncertainty about how recycling affects carbon footprints (ICCT, 2020).
- Vehicle end-of-life, potential for recycling and recovery of materials and parts.
- Optimization of cargo and transport routes.
- Many suppliers of trucks are located outside Norway, where climate targets may less ambitious.

Targets

Klimakur 2030 includes considerations for suppliers, and logistics. EU Taxonomy Do-No-Significant-Harm criteria have multiple regulations to limit the environmental impact of batteries etc. and promote circular economy thinking. Better planning of order frequency and volume can reduce transport requirements. As could, developing a tool to allow smaller, local companies to make collective orders and share logistics solutions.

! Current risk management

- Norges Lastebileier-forbund (NLF) publishes a yearly report focused on climate and environmental factors, emphasising the role of the whole value chain in reducing environmental impacts. NLF is engaged with reducing emissions to air of CO_2, CO, NOx and PM and has a strategic goal to ensure that member companies use most advanced technologies and maintain a high replacement rate for fleets to switch to lower carbon alternatives.
- According to the EY Climate Risk Barometer report, the transport sector is amongst the top performers globally for TCFD reporting. However, the report specifically highlights that Norwegian transport companies are underperforming in terms of risk management (EY, 2019). This likely means they are lacking in reporting on how climate risks are integrated in overall risk management of the company and/or how they conduct materiality assessments.

Key opportunities

- Decarbonization and digitalization are considered the most transformative forces in road transport (Hovi et al, 2019).
- Production of own renewable fuel (e.g., solar power, hydrogen, biofuel) and concurrent development of infrastructure for charging/fueling. Green hydrogen will be cheaper than blue hydrogen in many global locations within the next 5-15 years (IRENA, 2020).
- Research on dynamic charging concepts, as well as demonstrations of catenary line solutions, may enable expansion of the range of operations for heavy-duty and long-distance operations for regional buses and long-haul trucking. (IEA, 2020) Hydrogen-based trucks have a faster refueling time than electric trucks (Regjeringen, 2020b).
- Optimisation of transport routes for freight and suburban passenger transport, including implementation of hybrid transport routes that combine road and rail to reduce emissions.
- Heavy-duty vehicles are produced in smaller series than passenger cars, which increases the opportunity to influence the market with a smaller number of orders.
- Electrification results in lower fuel use and resulting cost reductions.

Key pitfalls

- For “zero-carbon” fuels, scope 1, 2 and 3 emissions can be large. Hydrogen may be either ‘green’ (produced with renewable electricity) or ‘blue’ (based on fossil fuels with CCS). Note that blue hydrogen has a higher yield than green hydrogen but is more carbon intensive. Certain biofuels may be linked to deforestation and irresponsible land use change and battery production has a high carbon intensity.
- Circular economy principles should apply; materials used for vehicle production and waste handling should be considered. E.g., biofuel, hydrogen and batteries must be responsibly and sustainably sourced and must minimise climate impact.
- Energy efficiency improvements to fossil fuel-based fleets generally reduce transportation costs and could therefore lead to higher trade volumes (rebound effects) and increased long-term prevalence of fossil fuel assets (lock-in).
- The long vehicle lifespan of a diesel-fueled truck may lead to lock-in of fossil fuels. Electrification of fleets needs to happen urgently to have the desired decarbonisation effect.
- In the long run, insurance coverage might be insufficient to cover climate impacts on supply chain and communication infrastructure.
- Smaller transport operators, mainly SMEs or micro enterprises, are currently missing out on fuel savings and reduced fuel bills, as policies are mostly directed at heavy-duty vehicles (European Commission, 2018).

Disclosure and integration of climate risk

Disclosure of climate risk and environmental impact

According to the EY Climate risk disclosure barometer, which reviewed 65 transportation companies, there is good coverage of TCFD implementation across the entire transportation sector, but quality of implementation varies significantly. Norway was listed as a high performer in the targets and metrics category, meaning they report well on Scope 1, 2, and 3 emissions, the methodology used and targets for reductions of emissions. Note, however, that this report also includes other transportation modes out of the scope of this brief, like heavy industry shipping.

There is precedent for public reporting on progress in the sector. ASKO, a food delivery service, reports on the share of biofuel in its fuel-mix as well as the number of zero-emissions vehicles. ASKO is also certified by ISO 14001, which requires regular reviews of environmental impact. Kolonial, also a food delivery service, discloses its carbon emissions (as well as statistics on their food waste). Other logistics companies like DB Schenker are lacking on publicly disclosed climate risk analyses, however most report on carbon emissions.

Integration of climate risk in operations / decisions

Companies are making investments in electric and hydrogen vehicles. Norwegian companies have pre-ordered around 70 new hydrogen trucks from Nikola Motor. These are not yet in production but are planned for release in 2023 (Regjeringen, 2020b).

Multiple Norwegian distribution companies have integrated clear environmental strategies in their operations. ASKO has already reached its ambition to reach carbon neutrality by only using renewable fuels (biofuel, hydrogen and electric) and undertakes other initiatives such as reducing impact of food packaging and supply chain considerations. Bring and Posten plan to reach zero emissions by 2025 for both their distribution fleet and storage buildings. DHL has undertaken a pilot project to replace light distribution vans with distribution bicycles and in connection with this initiative has established a centrally located micro-terminal for intermediate storage. DB Schenker has invested in electric trucks in order to reach their target of 100% electric goods distribution within Ring 3 of Oslo by 2020. They also have a climate goal to reduce specific CO2 emissions by 30% by 2020 compared to 2006 levels, and by 50% until 2030. The company is reducing transport miles by consolidating goods, shifting to lower-carbon modes of transport and increasing the efficiency of fleets through continuous fleet renewals. They also allow customers to reduce or compensate for CO2 emissions along the entire supply chain (DB Schenker, 2020).

Regulations and scenario information

Policies in Norway

Currently electric and hydrogen vehicles are exempt from multiple fees and taxes, including engangsavgift, merverdiavgift, trafikkforsikring as well as exemptions from tolls and free ferry passage. While these decisions are now made by local authorities, the national government has set the limitation that zero-emissions vehicles should not pay more than half price for toll roads and ferry passage (Regjeringen, 2020b).

The Norwegian government has committed to including the following targets in the National Transport Plan 2018-2029: all new light distribution vehicles will be zero-emission vehicles in 2025. By 2030, all new heavier vans, 75 % of new long-distance buses and 50 % of new trucks will be zero-emission vehicles to facilitate low emission distribution of goods in the largest urban centres (Regjeringen, 2019).

The Norwegian government will follow the national action plan to reach carbon neutrality in the road transport sector by increasing the share of zero-emissions vehicles, as well as the share of hydrogen and advanced biofuel for heavy duty transport, which is harder to decarbonise. Hydrogen is an area of prioritisation for heavy duty transport and is seeing massive growth. Norsk Hydrogen Forum has a goal to reach 1000 hydrogen heavy duty trucks on Norwegian roads by 2023. The current target is to increase the share of biofuels blended into fossil fuels to 40 % by 2030, depending on the rate of technology development and the development of alternative fuels (Regjeringen, 2019).

The EU has approved a new fuel economy standard for cars and vans for the time period 2021-30, and a new CO_2 emissions standard for heavy-duty vehicles. Aggressive targets for 2030 will contribute to increasing adoption of EVs. A revision of the Clean Vehicles Directive also aims to accelerate the adoption of electric buses and other public vehicles.

EU Taxonomy

There are multiple categories in the EU Taxonomy relevant to the scope of this brief.[3] For all categories, vehicles with zero direct tailpipe emissions (or less than 1g CO2/kWh for heavy-duty vehicles) are automatically eligible. Additional criteria, including within biofuels and alternative fuels, for each category are summarized below:

Light commercial vehicles

- Vehicles with tailpipe emission intensity of max 50g CO2/km (WLTP) are eligible until 2025. From 2026 onwards only vehicles with emission intensity of 0g CO2/km (WLTP) are eligible.

Freight transport services by road:

- Zero-emission heavy-duty vehicles (vehicles without an internal combustion engine, or vehicles that emit less than 1g CO2/km)
- Low-emission heavy-duty vehicles with specific direct CO2 emissions of less than 50% of the reference CO2 emissions of all vehicles in the same sub-group are eligible.
- Fleets of vehicles dedicated to transport fossil fuels or fossil fuels blended with alternative fuels are not eligible.

Suburban and interurban passenger land transport:

- Vehicles that have zero direct tailpipe emissions are eligible.

Infrastructure for low carbon land transport may also be eligible, as long as it is fundamental to the operation of the transport service. Please see the taxonomy eligibility criteria for further details.

The current EU taxonomy draft sets additional requirements in the area of "Do no significant harm" in terms of circular economy considerations in maintenance and end-of-life management, as well as local and global pollution (air and noise) and ecosystem concerns. In Norway, this may include considerations for environmental impact of winter spikes on tires and the recycling/upcycling of used tires.

The current draft also requires minimum social safeguards, currently defined as meeting the International Labour Organisation (ILO) Core Labour Practices.

3 The thresholds and categories in this sector brief are based on the draft Delegated regulation report for climate change mitigation published in November 2020. The full EU Taxonomy is not yet finalized, so thresholds are subject to change.

Global scenarios

Electric vehicles (including personal passenger cars) are one of the few technologies currently on track to reach the IEA Sustainable Development Scenario, which predicts an exponential increase from 0.8% of global stock in 2018 to 13.4% in 2030. The SDS incorporates the targets of the EV30@30 campaign to collectively reach a 30% market share for electric vehicles in all modes except two-wheelers by 2030. Historical growth has mostly occurred due to supply-side regulations and standards, but more comprehensive regulation is required to maintain the trajectory. To date, 17 countries have announced 100% zero-emission vehicle targets or the phase-out of internal combustion engine vehicles through 2050 (IEA, 2020).

The International Renewable Energy Agency (IRENA) reports that freight transport currently comprises more than 40% of transport sector's total energy demand, and projects in their Planned Energy Scenario (PES) that energy demand will further rise by 20% from 25 EJ in 2016 to 30 EJ in 2050 (IRENA, 2020). In their Transforming Energy Scenario (TES), CO2 emissions decline by almost 75% compared to the PES.

According to the IEA, most medium- and heavy-duty electric trucks on the road are in China, where the sales rose over 6 000 units in 2019. In Europe, a group of original equipment manufacturers (OEMs) have delivered electric medium-freight trucks to selected fleet operators for commercial testing. (IEA, 2020). However, trucks that operate on regional and long-haul basis show the lowest sales and stock shares among all vehicle categories in the IEA scenarios.

With battery production required to increase about eighteen-fold by 2030 in the IEA SDS, significant battery cost reductions can be expected through the conjunction of increasing battery pack size, battery chemistry changes and economies of scale thanks to larger manufacturing plants.

CICERO Shades of Green & analyst perspective[6]

CICERO Dark Green for the sector

Considerations for main activities

- Zero-emission vehicles, such as electric or hydrogen vehicles.
- Use of alternative fuels (i.e. hydrogen or biofuels) for heavy duty vehicles e.g., passenger buses (regional bus services) and trucks. Life cycle emissions assessments (incorporating production method) should be used to determine relative emissions from green/blue hydrogen and advanced biofuels/biogas.
- Infrastructure for low-emission vehicles (e.g. electric chargers). Account for grid emissions factors to determine environmental impact.
- Emphasis on optimisation of logistics to reduce number of trips taken by trucks, while ensuring no lock-in of fossil fuel truck infrastructure (e.g., logistics improvements for 100% zero-emissions fleet).
- Emphasis on a circular economy approach, including recycling of materials, and longevity and reparability of vehicles.
- Investments in clean road transportation should primarily replace existing conventional fuel fleets.
- Storage facilities run on renewable energy.

Considerations for upstream and downstream factors

- Upstream: electricity generated from renewable energy and advanced biofuels with sound environmental management (avoiding indirect land-use changes). Use of hydrogen fuel-cell systems for heavy duty transport.
- Digital solutions: enabling avoidance of transport and/or enabling utilization of low carbon transport (EU Taxonomy).
- Construction of enabling infrastructure: accessible chargers for electric vehicles, access to hydrogen filling stations and advanced biofuel for heavy duty vehicles (EU Taxonomy).
- Accounting for full life-cycle emissions throughout the vehicle manufacturing supply chain, including ensuring sustainable sourcing of batteries, biofuels, hydrogen.
- Factories powered by renewable energy.
- Freight transported is limited to Dark Green goods.

Current best practice – activities

- ★ Early electrification of fleet and heavy prioritisation of zero-emission vehicles and related zero-emission infrastructure.
- ★ Production of own renewable fuels e.g., ASKO producing its own hydrogen (ASKO, 2017)
- ★ Investments in infrastructure that supports decarbonization of road transport sector (e.g. chargers for electric vehicles)
- ★ Streamlined and optimized solutions for logistics. Includes increasing the load factor of cargo, suburban off-loading sites where heavy-duty vehicles can be replaced for electric distribution vehicles into the city. Additionally, combining road freight with rail transport, which has a lower carbon intensity due to higher loading capacities.
- ★ Energy efficiency improvements to fossil fuel-based fleets generally reduce transportation costs and could therefore lead to higher trade volumes (rebound effects) and increased long-term prevalence of fossil fuel assets (lock-in). Investments in energy efficiency screen for and mitigate these effects.
- ★ Circular economy approach to batteries and manufacturing materials. Ensure vehicles are built to be easily reparable and recyclable.
- ★ Conducting full life-cycle analyses to determine environmental impact (with consistent methodologies)[4]. Projects should also consider emissions and environmental impacts associated with the production and end-of-life phase of vehicles.
- ★ For heavy-duty vehicles, concurrent investments in hydrogen and electric trucks to drive further industry maturity, while also implementing using sustainably sourced advanced liquid biofuels with a low carbon intensity.

Current best practices – governance

- ★ The Poseidon Principles are a voluntary Includes setting intermediate and long-term science-based targets for reducing GHG emissions, undertake scenario stress-testing, align with TCFD recommendations to incorporate climate risks and opportunities in the company strategy.
- ★ Reporting on life-cycle emissions and impact, broken down by vehicle-type, as well as consideration of types of goods being transported and distance travelled.
- ★ Environmental considerations integrated in supply chain decision making. This includes ensuring materials used for batteries are responsibly sourced, and end-of-life re-use or recycling.
- ★ Consider both current weather variability and future climate change, including uncertainty.
- ★ Governance measures and policies should be consistent with the expected lifetime of the activity and vehicle, e.g., by appropriately considering fossil fuel lock-in effects of investing in fossil fuel-based vehicles.

4 Due to uncertainty in LCA methodologies, there is value in promoting the consistency of LCAs across the sector.

Data and indicators for climate risk disclosure

Historic data

According to the Veikart report from 2016, emissions from commercial mobile sources has increased from 8 million tonnes in 1990 to more than 10.5 million tonnes in 2014 in Norway. Note: personal passenger cars and mopeds have been omitted. Heavy-duty diesel road transport has experienced significant growth and currently makes up the largest share, while rail transport and heavy machinery also take significant portions. Other light diesel-driven vehicles have also experienced significant growth. This indicates the importance of focusing on land and rail transport for emissions reductions.

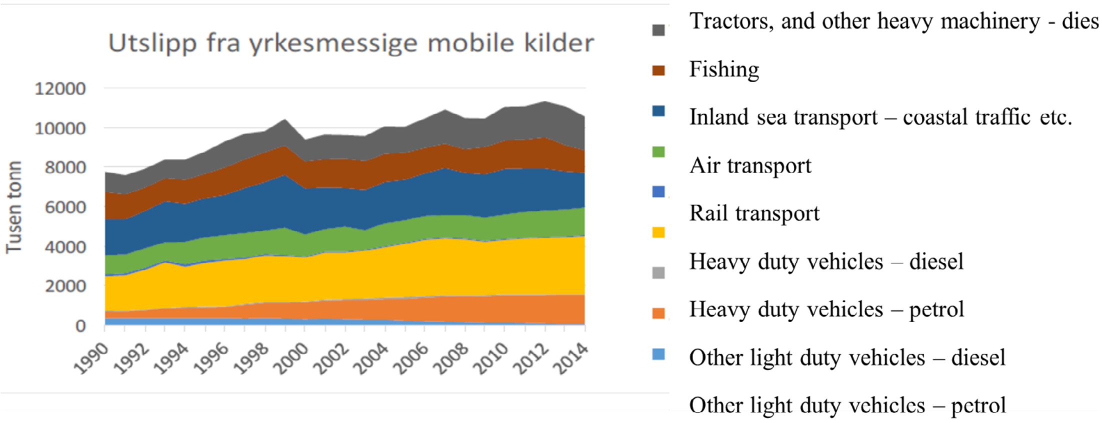


Figure 1 Emissions from commercial mobile sources in Norway. Source: Veikart, 2016

Figure 2 below illustrates the emissions reductions contributions from various measures planned for adoption in the road transport sector under Klimakur 2030. The two largest contributions are 'improving the use of advanced biofuels in road transport' and '100% of new personal passenger cars are electric in 2025', both contributing to reductions of around 2.5 million tonnes of CO2e. Note that beyond 2030, it will be important to switch away from advanced biofuels towards electric and hydrogen.

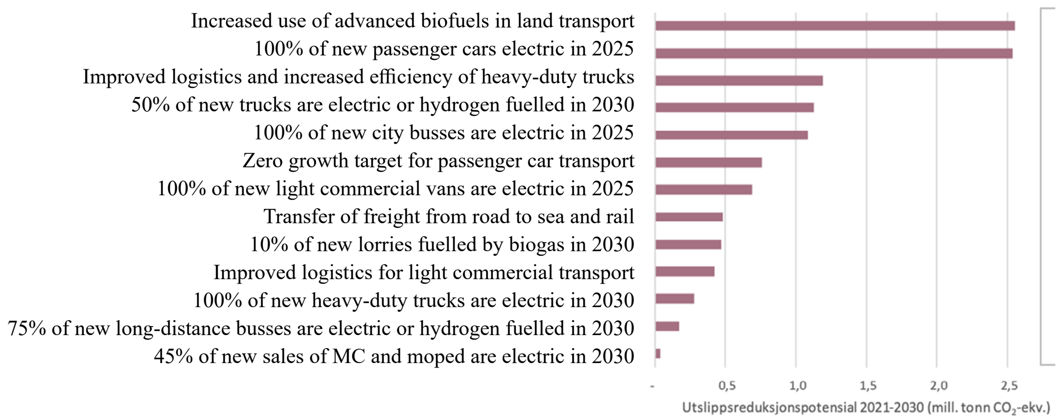


Figure 2 Emissions reductions contributions from various Klimakur 2030 measures in Norway. Source: Klimakur 2030 (Miljødirektoratet, 2020)

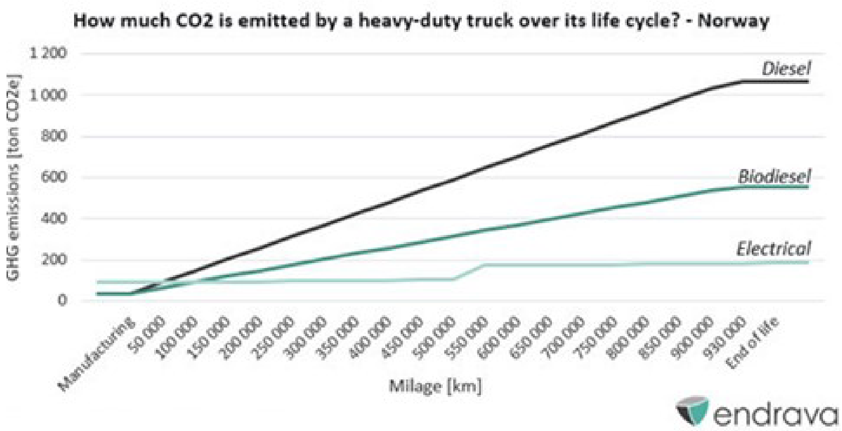


Figure 3 CO2 emissions over life cycle for electric, biodiesel and diesel-powered heavy-duty trucks. Source Endrava, 2020

Figure 3 indicates that life cycle emissions for heavy duty trucks depend significantly on type of fuel used. For electrical heavy-duty trucks, scope 1 emissions and scope 2 emissions are negligible in Norway, and emissions remain fairly constant throughout the truck's lifetime. After 500,000km, emissions increase, presumably as the battery has to be changed. Both biodiesel and diesel emissions increase linearly with greater distance as scope 1 emissions increase with usage. Emissions for all three truck types flatten out as the cars reach end-of-life. Biodiesel emissions increase slower than diesel emissions because part of the scope 1 emissions are offset as biofuels also include an inherent carbon sink.

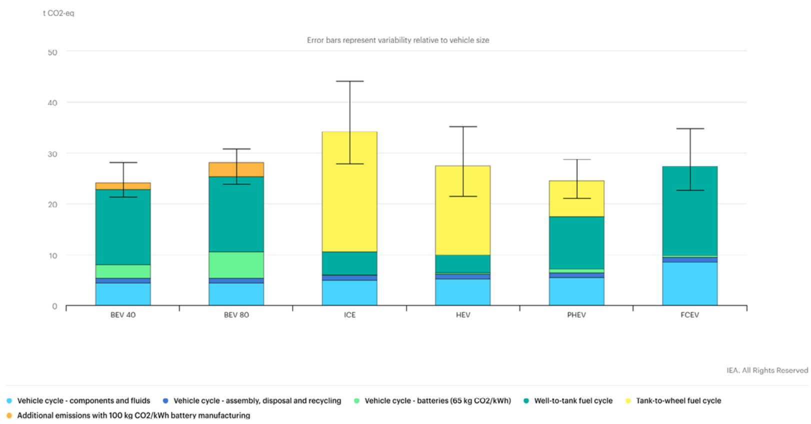


Figure 4 Comparative life-cycle greenhouse gas emissions over ten-year lifetime of an average mid-size car by powertrain, 2018. (IEA, 2018, Last updated June 2020).

Figure 4 illustrates life cycle emissions for globally averaged vehicles. Life cycle emissions are currently comparable on for all types of vehicles (BEV – battery electric vehicles where BEV 40 refers to a 40kWh battery while BEV 80 refers to a 80 kWh battery, ICE – internal combustion engines, HEV-hybrid electric vehicles, PHEV – plug-in hybrid electric vehicles and FCEV- fuel cell electric vehicles). BEVs and FCEVs have the highest share of emissions in the well-to-tank fuel cycle due to the high carbon intensity of manufacturing. The BEVs have an additional emission of 100 kg CO2/kWh for battery manufacturing. This trend is decreasing however, as manufacturing processes are increasingly decarbonising. Note: this graph is constructed for global trends and scope 2 emissions will vary based on the energy mix of electricity in different countries. For example, in Norway, scope 2 emissions are considered negligible.

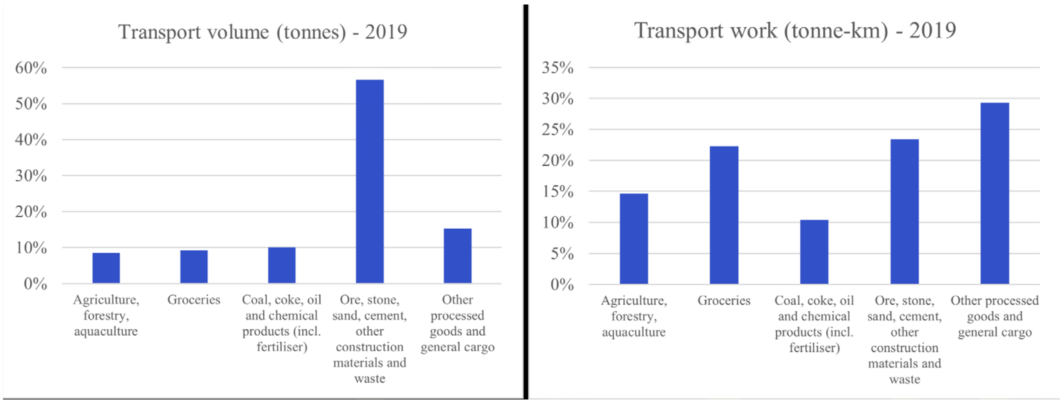


Figure 5 Transport volume (tonnes) and transport work (tonne-km) by freight transport in Norway in 2019. Source: SSB, 2020b

In 2019, total "transport work", which accounts for both total volume of goods transported as well as distance travelled by Norwegian trucks, was 19389 million ton-km. 10% was in coal, oil and chemical products, 15% in agriculture, forestry and fish products, 22% in groceries, 23% was in ore, rock, cement and other construction materials, and 29% was in "other processed goods and general cargo". However, without accounting for distance travelled, ore, rock, cement and other construction materials makes up 57% of total transported goods, while consumables make up 9% (SSB, 2020b). This indicates that these construction materials are mostly locally sourced, and that groceries (food and drink) are transported longer distances.

Considerations for main activities

- Miljøstatus Klimagassutslipp Veitransport
- SSB.no – GHG emissions by sector, public transportation usage
- IEA.org – outlook and trends for transport sector

Considerations for upstream and downstream factors

- Inconsistency and uncertainty on LCA methodology and reporting
- Large variation within transport sector in emission sources. The carbon footprint of BEVs (Battery Electric Vehicles) is majority Scope 3, while ICEs (Internal Combustion Engines) are majority Scope 1. Similarly, electric trucks have much larger Scope 3 emissions than electric cars and vans.

Indicators which would improve climate risk disclosure[5]

Transition risk

Preliminary indicators and metrics
Carbon intensity (CO2eq / km)
Life cycle emissions for both production and use-phase of vehicles.
Zero-emissions vehicles in fleet: absolute number and share
Number of charging and hydrogen filling stations installed (/km2)
Load factor – average load to total vehicle freight capacity (tonnes/vehicle-km)
Type of freight
Increased mobility (area covered per unit time)
Cost of electric vehicles (NOK or USD)

Physical risk

Preliminary indicators and metrics
Number of disruptions due to e.g., floods, extreme precipitation, urban overflow, avalanche, landslides (total events and working hours lost)
Relevant indicators for heat: past and projected mean and max temperatures for different emission scenarios (e.g. RCP 8.5 and RCP 4.5), Heat Wave Magnitude Index daily (HWMId), Wet Bulb Globe Temperature (WBGT)
Relevant indicators for precipitation: Frequency and consecutive number of extremely wet days, maximum daily rainfall daily and over 5 consecutive days or total wet day precipitation
Lost income due to extreme weather/natural disasters (NOK or USD lost)

5 Please note that these are preliminary indicators and metrics that will be further developed. As the methodology and data availability evolves, we expect adjustments to the list. Also note that within the sector there are many different business models and different indicators and metrics may be more relevant depending on the company under assessment.

Key analyst questions for all companies in this sector

1. What is the share of zero-carbon vehicles in the company’s fleet?
2. What are the company’s targets and strategies for decarbonisation? Does the company have a strategy for full electrification of its fleet by 2050, in line with global goals?
3. How does the company account for life cycle emissions?
4. If financing electric vehicles, will this also include the expansion of vehicle charging infrastructure?
5. For alternative energy vehicles (biofuel, hydrogen), how is the fuel sourced?
6. How are climate resilience factors determined and integrated into company activities?
7. What regions does the company operate in? Long vs short distance transportation?
8. What are the environmental policies for suppliers and sourcing of materials related to production of vehicles and associated infrastructure?
9. What goods are being transported? And how exposed are these goods to physical and transition risks? (e.g., transport of oil and gas)

7 Please note that these are preliminary indicators and metrics that will be further developed. As the methodology and data availability evolves, we expect adjustments to the list. Also note that within the sector there are many different busines models and different indicators and metrics may be more relevant depending on the company under assessment.

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