

Sep 15th 2023

Accelerating just energy transitions in transport systems

This proposal is presenting Nordic opportunities, best practices, actionable solutions, challenges and barriers of relevance to the topic "Accelerating just energy transitions in transport systems", for the UNFCCC Mitigation Work Programme 2nd dialogues (in Abu Dhabi, 15-17 October 2023). We are hereby submitting a Nordic narrative and identified key areas of expertise for Nordic contributions within each of the four sub-topics specified.

- 1. Deploying and shifting to collective and non-motorized modes of transport (rail, urban public transit, cycling, etc.)
- 2. Energy and resource efficiency in the transport sector (design improvements, circular economy and material changes, vehicle vintage, carpooling, etc.)
- 3. Electrification of vehicles (infrastructure, batteries and minerals)
- 4. Shifting to low- or zero-carbon fuels (hydrogen, biofuels, biogas, compressed natural gas)

IVL and partners welcomes the topic and subtopics chosen for this second dialogue. To accelerate the transition, it is imperative to share learnings of successes as well as set-backs, and inspire across sectors on how to go from words to action. Building on this work will ensure uniformity, conformity, and compliance with decisions across activities implemented.

In Summary

The Nordic countries are at the forefront of development towards reducing transport emissions thanks to an inclusive and holistic mobility planning, along with technology advancements. Recurring input from stakeholders regards the need for a clear policy landscape to enable long-term planning and investments. The need of knowledge elevation within authorities and capacity to modernize policies and regulations to match the transition ambitions and goals, is also mentioned. Standardizations, sector integration, public procurement demands and collaborative clusters with representatives from authorities, the private sector, research entities and civil society are other success factors in accelerating this development in the Nordics.

An overall observation further, is that many parts of a transition are in reality blocked by social resistance – when people need to change habits and what is perceived as valuable freedom of choice. Besides technological progress and economic incentives, there is a need for a more human centered approach to accelerate change. Real impact will come when people and companies utilize the solutions offered. Hence, showcasing role models, enhancing communication within value chains, as well as to create public awareness, acceptance and demand, should be given more attention.

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Sep 15th 2023

Table of Contents

1 De public t	ploying and shifting to collective and non-motorized modes of transport (rail, urban ransit, cycling, etc.)
1.1	Challenges
1.2	Opportunities
1.3	Examples4
1.4	Key areas of Nordic expertise (shift to collective and non-motorized transport)4
2 En econom	ergy and resource efficiency in the transport sector (design improvements, circular y, material changes, vehicle vintage, carpools, etc.)6
2.1	Challenges6
2.2	Opportunities7
2.3	Examples7
2.4	Key areas of Nordic expertise (energy and resource efficiency)8
3 Ele	ctrification of vehicles (infrastructure, batteries and minerals)9
3.1	Challenges9
3.2	Opportunities
3.3	Examples12
3.4	Key areas of Nordic expertise (electrification)14
4 Shi	fting to low- or zero-carbon fuels (hydrogen, biofuels, biogas, compressed natural gas).15
4.1	Challenges15
4.2	Opportunities
4.3	Examples16
4.4	Key areas of Nordic expertise (fuel shift)17



Sep 15th 2023

1 Deploying and shifting to collective and non-motorized modes of transport (rail, urban public transit, cycling, etc.)

It is possible to drastically reduce transport GHG emissions and reach carbon neutrality in the Nordic region by 2040-2050, but strong and immediate actions are required.

1.1 Challenges

• Terminology should show aim

An aim for "A <u>transport efficient</u> society", shows a clearer target of <u>mitigating</u> <u>unnecessary</u> transport. This can be reached through a different planning - towards more dense neighbourhoods, more locally accessible services etc.

- Mapping the systematic benefits of proposed mobility solutions to highlight the gains in energy use and emissions reduction, also to improve design and implementation, of urban and transport plans around concepts like Mobility-as-a-service (Maas), car/bike sharing, transit-oriented development, integrated urban logistics hubs etc.
- **Behaviour change** is a challenge. Positive role-models, incentives and good marketing is important to motivate change.
- Weather issues cold/rain. Despite this you will find cities in the northern Nordics with many people cycling to work all year round. When accessible and safe bicycling lanes (and removing snow quickly during winter) are prioritized by authorities, people are motivated to use them. You can get from door-to-door easily and save money while getting your daily exercise.
- A green transition also needs to involve **fair conditions in the new services that arise**. For instance, often not the case for bicycle delivery staff. Companies should sign collective agreements and employees should be given influence over new technology and routines introduced.
- External shopping malls in city planning, also with everyday merchandise resulting in extensive vehicle usage is needed. Many are talking about the negatives of this, but alternatives are in most cases still not being planned and implemented.

1.2 Opportunities

- **Making transport more equitable** for people in all parts of society. Inclusive dialogues to find what works and how motivation for behaviour change can be triggered.
- Increased integration in the transport sector and of the actors, will make utilization easier for individuals as well as companies. Even to choose more sustainable alternatives (walk, bike, public commute). Such, so called "transit-oriented", development should be the urban paradigm for fast-growing cities, facilitating seamless access to public transport and solutions for shorter trips.



Sep 15th 2023

- Transport policies and programmes should be designed to create socially inclusive solutions address both technical and social dimensions. Policies should target building cities supporting priority to walking, bicycling, public transport and sharing solutions. Infrastructure design and provision should be guided by needs-based assessments and target a low-carbon transport society.
- Emission-free Public Transport on water where possible. Today, high-speed emission-free passenger ferries are economically on a par with bus traffic. Needs to be incorporated in procurement process. Speedy public catamarans are available in, for instance, Oslo, Seattle, New York, Brisbane, Sydney, Hongkong.

1.3 Examples

Still there is often **plans for increased traffic from authorities** with base case prognosis, based on increased population etc. Which results in building more capacity for more vehicles. Should rather be a Target driven planning instead of Prognosis driven (good examples: Ireland, Switzerland).

Balance needed when incentivising - for example electrical vehicles – it increases electrification but also encourages an increasing vehicle usage. Strong packages needed in urban areas to keeping car-usage down to a minimum – for resource efficiency and to enable use of roads for alternative transport, like bicycles.

The tendency of increasing size of batteries "to be safe on long distances" will hopefully be less with development of fast charging batteries and battery-change services.

Parkingspots reserved for carsharing in city center, and new building blocks incentivized to decrease parking and provide carsharing.

Congestion/traffic charges for city centers (2 cities in Sweden, 6 cities in Norway). To lower the increase of vehicle usage and using the money for financing of bike routes, public transport etc.

Bike-transport - urban delivery, "full last mile solutions to the door". <u>Velove</u>, <u>By Expressen</u>, <u>Move by Bike</u>

Electric waste management and cargo vehicles in urban areas. Emission and noise reduction. <u>Ragn-Sells</u>, <u>Älskade Stad</u> with various actors collaborating ("Beloved City")

Creation of general engagement in climate change mitigation – <u>Ii Municipality, Finland</u>.

1.4 Key areas of Nordic expertise (shift to collective and non-motorized transport)

Green Transport Planning – Nordic negotiation model – authorities cooperating with other stakeholders for sustainable planning and procurement. City, employers, property owners etc come together to decrease vehicle usage, reduce parking space and increase public transport. Example: Green Transport Plan <u>Gothenburg</u> (in Swedish).

Example: <u>Norwegian Transport Plan</u>: From car-based mobility to sustainable modes – new focus with dense neighbourhoods and creating a focus on liveability - Infrastructure for people.



Sep 15th 2023

Bike Priority – safe bike routes, removing car parking along streets etc with good results. Example: <u>Bicycle Track Priority Plan Copenhagen</u>.

<u>Urban Growth Agreement</u> Norway, declaration of intent between Government and regions – containing a Zero-growth target for car traffic and policy directions for city planning and land usage. For instance: walking should be defined as one way of traffic and be given highest priority for space and movement (next comes bicycles, followed by commuter vehicles and lastly car traffic). Also in Swedish investigation 2022: <u>"Right for the Climate"</u>, from page 447 (in Swedish).

Gender perspective on choice of transport mode. Women tend to choose more sustainable modes of traffic, which shows in city planning around typically male or female dominated workplaces. <u>Travel habits</u> in Umeå municipality, where also a <u>pilot</u> is done with actors in Industrial area (male dominant) to create rolemodels, travel policies and incentives via the companies to increase bicycling etc.

As part of the Nordic Smart Mobility and Connectivity program, Nordic Innovation developed the <u>Nordic Urban Mobility 2050 Futures Game</u> together with the Finnish service design company Hellon. The Futures Game can be used as a strategic tool allowing participants to create future mobility scenarios that are either plausible, desirable or worst-case examples. For stakeholders like topic experts, business leaders, product developers, municipal leaders and members of the public.

Climate budgeting – public organizations following up political ambitions by linking fiscal budgets to yearly climate budgets, with specific actions where the reduction in emissions is being measures. This started in Oslo and has spread to municipalities in the entire country. (Norway)





Sep 15th 2023

2 Energy and resource efficiency in the transport sector (design improvements, circular economy, material changes, vehicle vintage, carpools, etc.)

2.1 Challenges

- Barriers to address when behaviour and routines need changing, such as: lack of trust, improving information sharing, loss of income, knowledge gaps and attitudes. Between companies, departments, individuals etc.
- Freight companies must collect data to be able to track progress towards targets, but the sector is lacking demand from authorities, especially on Scope 3-emissions only voluntary activities. They need to start. Authorities should decide a standardized baseline year, then companies can evaluate alternatives (HVO, electrification etc), use a model for calculations, set targets and follow the progress.
- Standardized measurements and proper templates/models for calculations needed. It is necessary to be able to easily calculate emissions. Especially problematic when, for instance, changing distributor – suddenly calculations might be done in a different way and comparisons become hard or impossible.
- General challenge of cars designed to be larger in size. We need a system to compress the size, which will also demand smaller batteries on EVs. Instead, we might risk seeing broader road-lanes and parking-spaces.
- **Price competition of transport** due to Heavy Cargo Transport (HCT) development, with 32-33 metres trailers. Makes transport of goods on road more efficient (which is good), but also cheaper per tonnage. This can add to negative effects if compared with rail transport which might be more expensive per ton. Another risk leading to road transport being cheap is if **workers terms are compromised**. The pressure of sustainable value chains needs to increase, and clients will have to pay more for transport services.
- Different travelling systems across regions payment, booking etc problematic.
- Maximising turnover of public research funds to reach National/Global targets for instance on development of digital solutions aimed to benefit public transport, but with risk of ending up in usage for development of cars after research project is ended.
- There should be a **better measurement in how to view success of transport and mobility** – to promote fair and equal access (as well as tax money for research reaching targets of a just transition). For instance, have targets of how many people made it to the doctor's office, were on time for their job/school, etc.
- Pilot-tests often have a more tech- than human-centered focus, risking failure due to
 missing out on providing safety, information, comfort etc.
 Example: Testing autonomous vehicles or "on-demand" public transport with pickupspots without weather protection, vague info on when the vehicle is coming, if there will
 be someone keeping order in the vehicle, who are allowed to use it and how.



Sep 15th 2023

2.2 **Opportunities**

- More Global Directives to follow reduces competition from actors who refuse to take own initiatives. Example: IMO (International Maritime Organization) demanding better fuel efficiency for sea freight, has shown results one solution being to drive slower.
- **Coordination of National policy instruments to prevent effects from overlapping**, which may reduce their effectiveness. Learn effects from each policy instrument isolated as well as in the evaluation of existing ones.
- **Battery driven catamarans** for public transport using 80 % less energy than conventional catamarans.
- **Better logistics solutions** to increase degree of cargo filling and reduce emissions especially "last mile-transport" where even subcontractors to same company can go to same area instead of being coordinated.

2.3 Examples

Car pooling – municipalities and organizations supporting by not allowing employees to use their own vehicles when working (teaching a pool-behaviour and providing vehicles with low/zero emissions). Plus offering the vehicles to general public on evenings/weekends.

Digital coordination of sea vessels to port – <u>CDM</u> (Collaborative Decision Making)

Less parking space near building – property owners getting points/rewards for less parking (or being able to expand the building), if they host a car pool and/or create a connection to public transport nearby. Many municipalities working on this with stakeholders.

"From road to railport" – A commute with a combined port. Reach with your truck to the railroad in Location A in the evening (do declarations etc there) - then let the goods travel on rail at night, all the way on to the ship.

https://www.goteborgshamn.se/erbjudande/trafik-och-linjer/jarnvag-railport-scandinavia/

Addition of sails to sea vessels of different size, to reduce fuel consumption. Can be either integrated in new construction, or retro-fitted. Tankers and vehicle transportation ships with sails – for partly or fully be driven by wind. <u>Tärntank</u>, <u>Oceanbird</u>

Increase size of vehicles transporting sand, gravel, concrete, steel etc. In cities like Stockholm these deliveries represent 55 %, calculated by tonnage-kilometre, and the CO2-emissions can be cut significantly (fully if introducing electric vehicles).

Just-in-time principles at the harbour – a win-win-win concept. Saving time, money and emissions by better coordination.

Mobility-as-a-Service (Maas) bringing different, preferably more sustainable, kinds of transport together into a single intuitive mobile app, combining options from different providers, handling everything from travel planning to payments. <u>EC2B</u> ("Easy to be"), offers businesses and residents a convenient access to mobility services – public transport, rental bicycles, car pool,



Sep 15th 2023

rental car, taxi, carpooling, home delivery, etc. in the property or via common mobility hubs in the area.

2.4 Key areas of Nordic expertise (energy and resource efficiency)

<u>Clean Shipping Index</u> – A practical tool with certificate for actors in maritime supply chain with third party verification. Will give advantage through incentives like reduced fees in harbour and sea passages as well as in procurement of services.

Gothenburg Port "<u>The Green Connection</u>" – aiming to be the World's most sustainable port and reducing Co2-emissions by 70% until 2030. <u>Tranzero Initiative</u> with interlinked measures to accelerate the switch to fossil-free fuels. Infrastructure and access by the Port authority, commercial offerings to customers by Volvo and Scania and fossil-free vessels by Stena Line (Elekra concept).

Drones and delivery robots based zero emission urban logistics, actively piloted in Finland.

<u>Voi</u> is one of the fastest-growing mobility companies in the world, born in Sweden, Electric micromobility, e-scooters.

<u>HITS</u> project is studying **off-peak deliveries** and **pooling** as two ways to increase transport efficiency. City of Stockholm wants to implement the above for reduced congestion, reduced emissions and more attractive streets (if freight transport can be reduced in number). Challenges:

- A. Noise regulations for off-peak timings (silent e-vehicles but noisy loading/unloading).
- B. **Regulations about liability** (insurance, etc.) when applying "unmanned reception" who is responsible if there is no one who receives?
- C. Commercial business model regarding pooling. The municipality can contribute/control against pooling by regulating the street that provides incentives for pooling. At the turn of the year, there will be new legislation regarding household waste that may affect the ability to collect different waste fractions.

Autonomous vehicles, for instance for mining by <u>Scania</u> (video), bus commute in <u>Norway</u> and Sweden, <u>RISE</u>. <u>Einride Volvo Group</u> solution for Bönnöy Kalk.

Recycling of batteries for electrical vehicles – As a frontrunner on electrification of vehicles the Nordic countries are also leading the way on the recycling of heavy batteries. Some of the companies that stand out are <u>Northvolt</u> (Sweden) and <u>Batteriretur</u> (Norway).





Sep 15th 2023

3 Electrification of vehicles (infrastructure, batteries and minerals)

Transforming transport systems will have substantial impacts on the larger energy system. It is important to increase the understanding of the synergies – and potential conflicts – between the two systems.

3.1 Challenges

- In transition when new infrastructure and new value chains are developing, it demands a lot from all stakeholders, i.e. property owners, authorities, electric companies, vehicle owners and users. Good communication is very important.
 - o Changes in routines, permits and policies etc
 - o Communication across sectors/departments
 - New work schedules and routes to manage charging etc
 - Expansion of connectivity solutions (like 5G) along main transport routes.
 - Coordination
- **Taking the drivers' working environment into account.** Guidelines regarding new safety risks linked to electrified vehicles. Network of fast charging points, where drivers can take a break, have access to food and hygiene facilities. Working time rules should include charging, to avoid unfair and unpaid workload.
- Expansion of electric capacity to meet needs.
 - Legislation around grids needs to be modernized.
 - Efficiency in authority decision processes is essential.
 - Energy companies need to plan their production/distribution of electricity so as not to create bottlenecks but instead increase flexibility in the system.

• Infrastructure for charging

- Lack of investments
- Electricity demand increase, also demand for high power charging capacity.
- Need to speed up the transition and dare to test different type of technical solutions.
- Low population density (common challenge in the Nordic countries)
- Policy makers need more/better knowledge to understand the <u>role of business model</u> <u>innovation for transport innovations</u>. It is critical for them to understand this is a mechanism that can: commercialize novel technologies that reduces transport emissions; harness synergies between different types of transport innovations and bring about significant changes in the ways in which transportation is produced and used. It is also critical for them to know of <u>best practices to solve some of the challenges related</u> <u>to having sufficient energy and power supply</u>, e.g. by complementing new power production with energy flexibility solutions.
- Sub-optimization and lack of collaboration between logistics operators leads to uncoordinated deliveries of goods, low filling and an unnecessary high number of vans and trucks.



Sep 15th 2023

- Government need to take ambitions and targets of green transition into action. The maritime sector would benefit by improvements, since it has lagged behind in terms of innovation and technological developments.
- Sharing of data between sectors (like energy and transport often seen as proprietary).
 - Incentives (legislation?) needed to increase harmonizing of data and datainterfaces.
 - Standardized systems and platforms between transport and energy to enable data-transfer.
- **Bridging complexity of scaling new systems/solutions** of electric freight, like charging, range limitations, high battery cost and work environmental issues.
- **Support mechanisms** for new technologies, emerging solutions and business models
 - To lower cost they are often based on one-to-one replacement of vehicles, instead of considering possible efficiencies to address it on a fleet level.
 - Could be more **flexible** in terms of deadlines, and other conditions.
 - Should be s**tandardized** across Europe and other continents, to enable a much more stable operating space for development.
- Climate policies for transport must be reformed to consider target conflicts and to meet and incentivize electrification. Overall, the current climate policy instruments for vehicles without CO2-emissions when driven, tend to undermine fuel taxation as a regulatory instrument for traffic volume. Electrification of transport generates a target conflict between greenhouse gas reduction, regulating traffic volume and tax revenue to fund public infrastructure and social costs of traffic. The target conflict calls for reassessing the taxation for road transports in Nordic countries.

3.2 **Opportunities**

- **Possibility to have bi-directional charging**, means the EV's can be part of stabilizing the grid. Especially in case of a lot of intermittent production, like solar and wind.
- **Energy flexibility solutions** that can contribute to solving restraints in energy and power supply, like batteries and data-based grid optimization services.
- **Emerging business opportunities**, for instance connected to battery technology.
- Electrification of smaller ferries and airplanes, which can be fast-charged, show beneficial economic calculations than conventional ferries despite fossil fuels being subsidized with zero tax.
- **Implementation of ERS** (Electric Road Systems), where found suitable as best option. Example: A thorough 360° analysis in France, 2021, showed ERS being the best for society regarding CO2-emissions, the total cost of ownership, optimized material usage, and national sovereignty. By 2030, nearly 5,000 km of road are expected to be ERS, with projections increasing to almost 9,000 km by 2035. Ultimately, unlocking the full benefits



Sep 15th 2023

it can extend to approximately 16,000 km.

- More promotion could be done, since there is money to save for many stakeholders in the value chains!
- **Charging with plates** instead of sockets, V2G (vehicle to grid) would help scale solutions.
- Shared infrastructure for logistics operations, such as urban consolidation centres and parcel lockers, may optimize the transport of goods, increase efficiency and enable financial gains for stakeholders.
- Development of regulations and policies in the maritime sector. Example:
 - mandating emissions-free maritime transportation and limiting the sale of new fossil fuel-powered boats and ships.
 - Modernise legislation and certification processes to accommodate hydrofoiling vessels, placing them on equal footing with conventional vessels.
 - Consider revising speed limit restrictions for vessels that do not create wakes, i.e. do not cause erosion to shorelines or damage to other boats. Solutions for fast yet safe transport on water are available.
- **Revise public procurement criteria** to enable development of emerging technologies and innovators to enter markets that often are dominated by established companies providing conventional solutions.

Examples: Incorporate energy efficiency standards as a requirement, not merely an optional one. The same concerning emissions, which should be set to zero. A holistic systems-thinking perspective should guide procurement decisions. For instance, rather than prescribing the size of a vessel to be procured, the focus should be on the number of passengers to be transported within a given timeframe.

- **Urban planning** should consider how to seamlessly include waterborne transportation into public transportation systems.
- The Nordic general public's receptivity to innovations and green technology is evident through the region's emergence as a thriving hub for start-ups. Some countries, Norway in particular, have established a robust framework, including various financial incentives and support mechanisms, to facilitate the introduction of new technologies to their market. At the same time, others are lagging behind, and green technology that is accepted in Norway runs the risk of not getting approval in other countries due to a general unease to work with electrification in the maritime sector.
- **The availability of real-time data and computational power** enable different business models and setups, to handle increased complexities and accelerating electrification.



Sep 15th 2023

3.3 Examples

<u>REEL</u> is a national initiative where 45 leading Swedish actors have joined forces to accelerate the transition to electrified, emission-free heavy freight road transport. Within the project, around 70 different regional logistics flows in varying types of driving assignments are operated. REEL gathers transport buyers, forwarders and distributors, haulage companies, terminal operators, charging point operators, electricity grid companies and suppliers of trucks, charging equipment and management systems. In addition, regions, national authorities and universities participate in this initiative.

<u>E-Charge</u> gathers 14 Swedish actors that in collaboration as first in the world develop, test and demonstrate battery electric long-haul trucks and Megawatt Charging System (MCS). The tests will be carried out on real logistic flows in Sweden and will be adapted to the drivers' driving and resting times. Scalable system solutions are developed in cooperation, with the power to accelerate the development towards more sustainable transports.

<u>Klimatklivet (the Climate Step)</u> – investment support administrated by the Swedish Environment Protection Agency since 2015 (part financed via EU) for development of fossil free fuels, electrification of transport sector, like charging infrastructure for public use, at Property associations and companies.

<u>ForSea Ferries</u> operate the service between Helsingborg in Sweden and Helsingør in Denmark with two fully electric driven ferries since 2018. The service runs with departures for both passengers and cargo every 15 minutes, 24 hours a day, in all weather conditions. An automatic robot arm is plugged into the ferries, recharging them each time they are in port. The 5-9 minutes charging at each stop is sufficient for the 20-minute crossing.

Fornebu HUB, Bærum municipality, Norway, Fornebu Hub - Fremtidsrettet varelogistikk

Ferries in Norway (80 operating today) since many years thanks to Norway's complete maritime ecosystem, relatively mature markets, technology, and synergistic public-private partnerships. The world's first <u>all-electric ferry</u>, MS Ampere, and the first high-speed electric ferry, <u>MS</u> <u>Medstraum</u>. In addition, the ferry company <u>Bastø Fosen</u> operates the world's largest e-ferry across the Oslofjord's busiest commuter route.

<u>Candela</u>, electric boats and small ferries boasting an 80-90% increase in energy efficiency compared to traditional counterparts. Rethinking and reshaping the waterborne public transportation landscape.

<u>Polestar</u>, electric cars. Within the focus area of Climate neutrality, they have two goals: to be climate neutral by 2040 (Scope 1, 2 and 3), and to create a climate neutral car (cradle-to-gate) by 2030 with five strategic initiatives: climate-neutral platform, climate-neutral materials, energy optimisation, climate-neutral manufacturing and renewable energy in the supply chain.

<u>Einride Saga</u>, electric vehicle logistics technology deployed in Sweden, Norway, Germany, the UK, the US and the Netherlands. Operating one of the largest fleets of electric trucks in Europe. Saga, an intelligent freight operating platform – helping businesses map their



Sep 15th 2023

electrification journey, unlock operational efficiencies with algorithmic precision and receive info of reduced emissions by going electric.

<u>ElectriCITY</u> – Citizen driven Innovation-platform to make an area of Stockholm climate neutral by 2030. Profitable business models are in focus. Collaborating with 50 housing associations, 60 companies, research organizations, Stockholm City Environmental Management and Invest Stockholm. Of opinion that profitable change initiatives (like below) are preferable to mandatory measures such as enforcing Environmental Zones.

Initiative BoatPlan Stockholm: How to convert the Stockholm archipelago public transport on water to 100% emission-free with electricity or hydrogen as fuel. Based on guidelines from Region Stockholm in terms of climate, environment and attractive public transport. *Local Reload-central* with dedicated E-vehicles for package delivery (mainly to Delivery-boxes) and collection of recyclable waste materials.

Joint procurement of waste collection/recycling services – reduced from eleven to two service providers and, through framework agreements, discounted prices and transition to fossil-free transport. More clients in a small geographical area also resulted in shorter collection-distances for the service providers. Also joint procurements of property maintenance, cleaning services and gardening with zero fossil fuels as a counterclaim. Additional benefit is that the suppliers really like to work more locally.

<u>Green City Ferries</u> are dedicated to efficient, sustainable waterborne mobility, delivering innovative, energy-efficient, and emission-free (electric or hydrogen driven) high-speed ferries for inland waterways and island traffic. First globally, six years ago, with supercharging of the passenger ferry Movitz and three years ago a prototype of world's fastest electric ferry with super charging. Now launched in combination with pontoons and charging stations.

Enironmental Zones, prohibiting certain types of vehicles within an area is investigated by the City of Stockholm to increase air quality and transition towards emission-free vehicles. Regulatory authority, like a city, can contribute to such change. Lindholmen Science studies how to ensure a transport-efficient supply, despite the introduction of an environmental zone 3.

ASKO (the biggest grocery logistics company in Norway) has invested in many electric trucks, and H2 trucks. Witing the end of 2026, the whole fleet will be zero-emission and renewable.

The Norwegian Post has electrified the entire fleet of small cars and vans. In the greater Oslo they have electrified the whole fleet.

ENOVA Norway, is supporting charging infrastructure for heavy duty vehicles at hubs, depot and fast charging along the road.

All cars and vans bought by the Norwegian Government or local/regional municipalities has to be zero-emission, from 2024 this will also count for busses or bus-sevices in contracts for the city.

Electric road systems, the EVolution Road project with an electric road test and demonstration site in Lund (<u>Elonroad</u>, Sweden)

Nordic actors offering e-motorbikes, also pushing emission free transition abroad, like <u>Cake</u>, <u>Roam Electric</u>, <u>RGNT</u> and <u>Stilride</u>.



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Sep 15th 2023

Key areas of Nordic expertise (electrification) 3.4

Electric vehicle incentives and introduction (Iceland, Norway, Sweden). The introduction of EVs in Norway has been so successful that in 2022, 79 % of new car sales were EVs. The public transport in Oslo wil be fully electrified (including busses and ferries) at the end of 2023.

System knowledge of electric charging infrastructure for cars and boats in Norway.

Maritime Cleantech – a world-leading cluster for clean maritime solutions with nearly 150 partners to cover the whole valuechain.

HDVs and non-road mobile machines electrification, SIX Cluster in Finland for mobile machinery. Establishment of charging infrastructure for Heavy Duty Vehicles (HDVs)

Heavy Volvo trucks ordered by Swedish logistics companies.

Electric aviation, Heart Aerospace.

Project with DNV Norway on electrification. Energy flexibility, with several ongoing pilot projects and newly established companies in Norway.

Electric roads implementation, pilot in Lund with Evolution Road.

Norway with a twist... Environmental Zones in cities (compare Netherlands) – all but electric vehicles are forbidden. Nordic context - in report "Zero emission vehicles".

Public procurement by traffic companies also demanding social sustainability in valuechains.

The E18 Western corridor in Norway, with a holistic approach to logistics infrastructure through intermunicipal cooperation.



Shift from vehicle centricity to integrability of cross-sector assets and systems, onization of interfaces and data sharing in transport and e highlighting the need for hom

Image: Ericsson, pre-study Arthur D Little.

Sep 15th 2023

4 Shifting to low- or zero-carbon fuels (hydrogen, biofuels, biogas, compressed natural gas)

Transition of the Nordic transport sector towards carbon neutrality means that gasoline, diesel, kerosene and heavy fuel oil must be replaced by sustainable biofuels, hydrogen, electrofuels (produced from CO2 and water using electricity) or green electricity. This concerns both passenger transport dominated by cars and freight transport that is almost equally divided between trucks and ships.

4.1 Challenges

- **Bridging the knowledge gap** amongst decision makers to enable redesign of vision and targets concerning the energy system and make fossil free alternatives more practically feasible.
- Unclear set of rules and incentives over time. Political landscape changing and then the acceleration of transition is slowed down since investments are large in this sector and depends on longterm planning.

Example: the Swedish government have proposed to reduce the reduction quota for diesel and gasoline to 6 %, from January 1, 2024 from 30.5 % for diesel and 7,8 % for gasoline in 2023, to reduce the fuel prices. This risk to hinder investments in biofuel production and slow down the transition. Pure and high blended biofuels in diesel and gasoline are in Sweden exempted for tax until January 1, 2027.

- **Cost of biofuels are higher than conventional fuels**. Biogas had ten-year Governmental Aid approval for tax exemption in Sweden, until January 1 2031. It has now been stopped due to a decision in the Administrative Tribunal of the Council of Europe. It is still unclear when, or if, the tax exemption can be renewed. (Landwärme ruling) This makes investment in biofuels uncertain for vehicle owners.
- **Administrative structures** to apply for support mechanisms are often hard to understand and time consuming.
- The transition from a few potential fuels with well-developed technologies to many new potential fuels with a large need for technology development requires good coordination and also capacity building of many stakeholders.
- Need of investments for more scaling and industrialization of many fuel solutions for which there are no longer need for more tests and pilots. However, the latter needed for some fuels (e.g. hydrogen and ammonia used for ships).
- **Limitation of certain raw materials,** for biofuels such as HVO etc, an uncertain supply of other fuels for the transport sector.

4.2 **Opportunities**

• Establishing an exempt for maximum weight (now 4.25 ton in Sweden) for electric and biogas lorries would help to maximize the cargo-optimization. Now they might go half loaded due to heavier construction with gas-motor or batteries.



Sep 15th 2023

- The potential to produce and use sustainable biofuels is vastly unutilized in the Nordics where we have possibility to use biomasses. Example Sweden: approximately 2 TWh bio-methane is produced, but <u>potential is estimated</u> to be 30 TWh in 2045 only using waste materials.
- **Replace fossil natural gas use with biogas**. Suits particularly well for heavy transport on road and on sea. Many countries already have gas-networks, which makes it a bit easier. The digester-technology can be more or less complex hence be suited for different development stages and budgets.

Increasing biogas production also creates:

- Resilient systems not depending as much on imports.
- Reduced methane/CO2-emissions from waste piles/lagoons.
- o Fertilizer
- New business models, infrastructure, investment and stakeholders.

Bio-fuels, e-fuels – creating markets for this. Working with transport buyers – and it spills over to all of industry. Companies are wanting to be fossil free, but it is also important to divert from Business as Usual – making room for other ways of solving need of transportation in society.

- Exchange of financing schemes charging vehicles on a "Per kilometre basis". The lost tax revenue from fuel taxes will need to be covered by a new tax base. The charge on a per kilometre basis will also restore the socially efficient balance between road capacity and traffic volume.
- **Calculation models development needed** to accompany new technology advancements and setting of new targets with relevant predictions and scenarios.
- A potential for fuel production based on abundant local resources, e.g. hydrogen production from wind energy at coastal locations with little local energy use.
- **Development of multimodal energy hubs** where more transport modes can localise their energy infrastructures in hubs (for example; ferries, heavy duty truck sharing refuelling logistics).

4.3 Examples

Fossil free Construction Sites through public procurement – in <u>Oslo</u> (Norway) and Gothenburg (Sweden)

National Plan for future fuelling and storage for water transport, an InterReg-project started in Sweden.

Transition in marine transport, going straight for electro fuels, for instance e-methanol – Örnsköldsvik, Sweden.



Sep 15th 2023

Biogas, ethanol, RME and HVO has been successful in Sweden and Finland over time. <u>Fossil free</u> <u>transport chain across Sweden</u> for Volvo Trucks with Sandahls Goods & Parcel, Gasum and Real Rail Sweden.

Varanger Kraft's green hydrogen production plant in Berlevåg in Northern Norway.

<u>PowerCell</u> develops and manufactures hydrogen fuel cell stacks and systems with a uniquely high power density, used in a wide range of industries, including aviation, marine, on- and offroad.

<u>Widriksson</u> – freight company in Sweden which already 2012 set goal of being fossil free – to be reached 2017 (three years ahead of their own target).

Norway has a blending mandate for road, maritime, non road and air.

Norway wants to change their Short haul airport network from fossil to zero-emission planes.

Norway has a program with pilots for Green land transport (GLP) and for Green sea transport.

4.4 Key areas of Nordic expertise (fuel shift)

University in Iceland – <u>Hydrogen expertise</u>, with research about producing hydrogen from Aluminum waste and from seawater.

Complex system integration.

Current, innovative research, like at <u>VTT</u> on clean hydrogen derivatives based internal combustion engines, especially for **very heavy road transport** and for maritime.

The Nordic countries are currently regarded as international pioneers within areas such as **electric vehicles**, **electrified roads and Mobility-as-a-Service** (Maas).

Reducing marine emissions, Lighthouse – Swedish Maritime Competence Centre

Techno-optimization and fuel shift predicted in models – showing CO-emissions and NOXemissions reduction. Universal templets, built on Nordic data. For instance in these three projects: <u>SHIFT</u>: Sustainable Horizons in Future Transport - with a Nordic focus <u>NEO</u>: Test of transport sector in Nordic scale, air emissions in focus. Fuel choice options investigated. <u>HOPE</u>: Test of fuel cells solutions in shipping.

Nordic clean energy <u>scenarios</u>.

Carbon capture & storage connected to zero-carbon fuel production.

Incentives, Policy instrument – modelling to see effects, like; Bonus Malus (Sweden), Reduction VAT (Norway), Super Rebate Car, Local measures, Kilometer Tax, Public Procurement



Sep 15th 2023



Image: VTT Finland's Research Roadmap for Medium-Heavy Duty Transport.

Figure 2 illustrating the rationale behind shift measures: rail has the lowest energy intensity in the passenger transport sector and the second lowest (after shipping) in freight transport. Therefore, shifting transport activity from private modes of transport or aviation to public transport enables energy demand to be limited significantly.



Figure 2. Comparison of the energy intensities of different transport modes (passenger and freight). The boxes indicate the range of average energy intensity in various countries, while the horizontal black lines represent the world averages. Source: (IEA, 2019a).



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