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Energy & Transport

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Nordic Sustainable Logistics Network

Policy recommendations for the transformation of the Nordic transport logistics to become sustainable

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Content

Content Annex

Executive Summary

Although having common image and considered as a region, the Nordic countries have very varying geography, density, distances and regulatory setup that makes it hard to define one solution to fit all the countries. However, through an analytical approach a number of main challenges have been identified for all the Nordic countries and the current policy recommendations are meant to address these common challenges.

The common denominators for the transport logistics industry are:

- It is an industry with a very wide array of companies with significant size differences from multinational companies to small one-person companies.
- The opening of the European Union towards low cost countries has put pressure on the industry with high competition with lower prices.
- For the same reason most of the companies are dealing with a tight economy that leaves little room for risk connected investments.
- The industry is relatively conservative and has not undertaken major changes in many years.
- The primary motivation for change is the economic and not the environmental aspect
- Governments in all countries have high targets of reduction of CO_2 in several areas and including transportation

Political interference with the very commercial market of transport logistics is something that should be done with caution. When looking at the areas of potential policy influence it needs to reflect investments, running costs, usage of the vehicle as well as the change of action wished for. Sudden changes in policies can in worst cases result in the bankruptcy of companies due to investments made, that will not pay off under the new rules and regulations. Therefore, when implementing new policies in this area, it is important to:

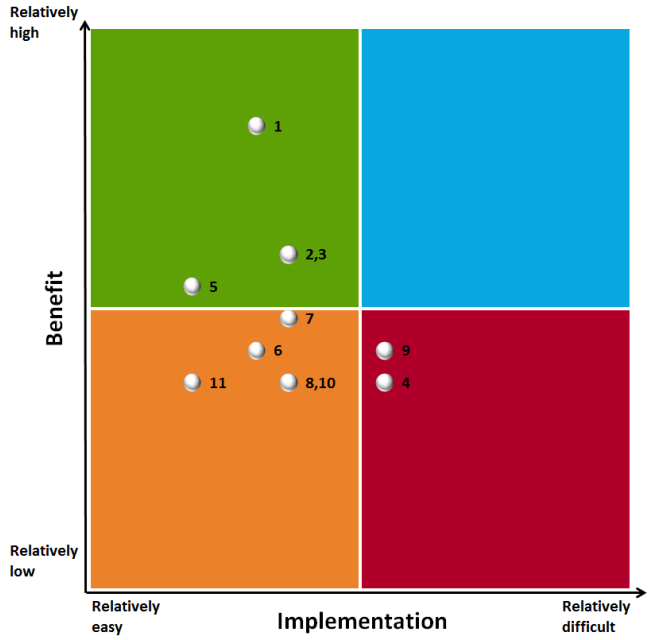
1. Acknowledge that it is possible to reduce emissions
2. Accept that one will be tampering with a commercial market and therefore the risk of critical voices is high
3. Create an incentive package that is both big and impactful – needs to be verified and afterwards discussed with the organizations who will be affected by it
4. Make certain that the framework will exist for at least 3-5 years and will not disappear from one day to another
5. Communicate it clearly and simply

With this framework in mind the following policy measures and public support actions have been identified in order to drive the change towards greener technologies. They have been identified as a result of analytical work on both transport logistics and similar industries and are primarily focused on creating a technology shift to greener solutions.

Policy objective	Policy measure/Initiative
Increase sales of greener vehicles and fuels	1. Vehicle taxation based on CO_2 emissions 2. Positive support on greener fuels through taxation/subsidies
Reduce city congestion	3. Congestion charges with green zones

Reduce marine emissions	4. Emission restrictions for marine harbour areas
Public organizations to catalyse sustainable transport logistics	5. Inclusion of green aspects such as CO_2 emissions in call for tenders on transport logistics 6. Creation of necessary certification to answer to call for tenders 7. Own investments in greener fleets
Creation of a basis for a long-term strategy	8. Creation of a technical road map for the combined Nordic area
Create green long haul logistics	9. Creation of green corridors 10. Test of new technologies
Optimized and intelligent transport	11. Optimization of existing fleet 12. Promote smart operations, support to open data

When evaluated on their effect and necessary implementation, the policies score as seen in the matrix below, which thereby showcases the most promising initiatives.



Introduction and delimitations

This project involves a selection of participants, active on the different Nordic markets with slightly different objectives and activities, however all devoted to the task of enabling sustainable transport logistics. The condition for creating solutions that enable sustainable transport logistics obviously differs between the Nordic countries, such as availability of renewable primary energy and industry structure just to mention two aspects. During the project it became obvious that there are numerous initiatives in each country that provide a unique knowledge platform that has the potential to take us towards sustainable transport logistics.

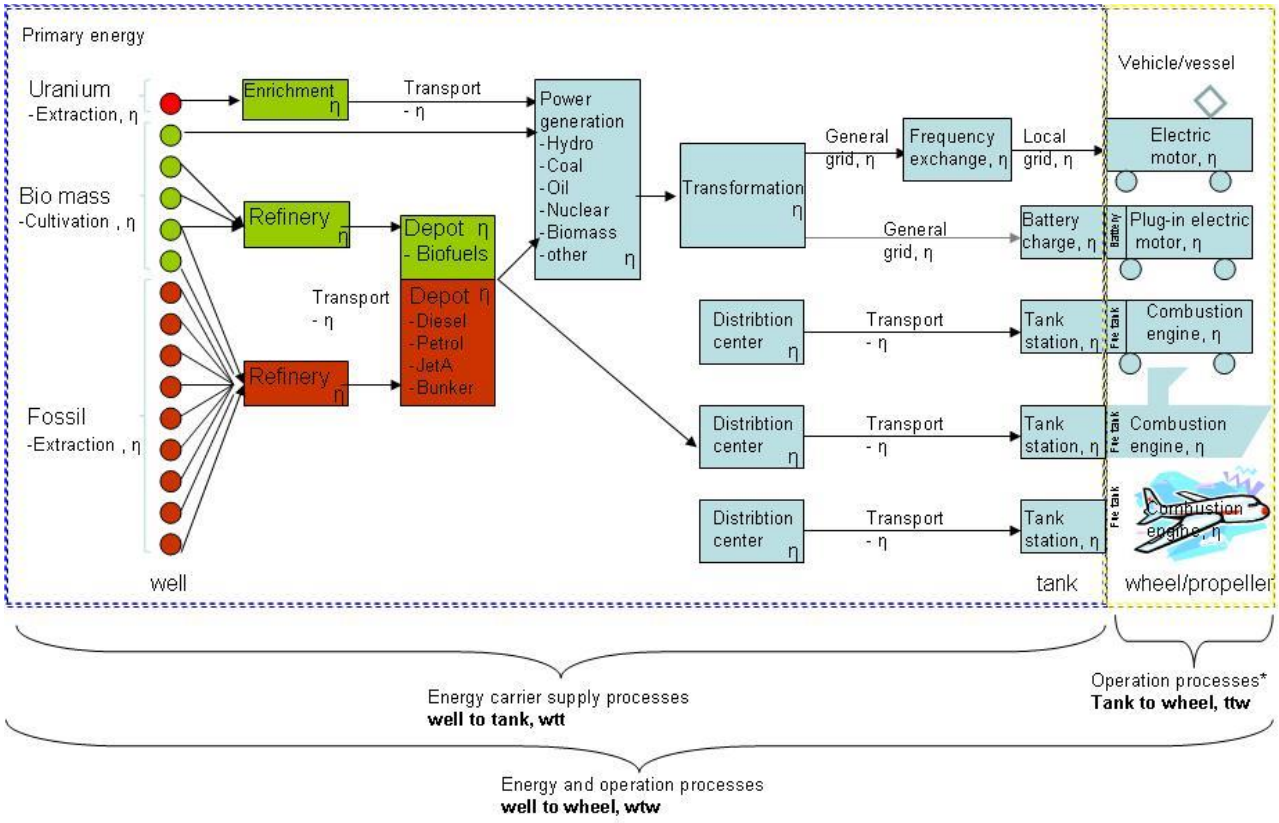


Figure 1 – The well to wheel principle

One of the key questions is a definition of sustainability. Priority is often given to environmental, health and energy security aspects. Wider scope includes also safety, social and ethical issues. However, one issue that should not be forgotten is the economical sustainability. In order to assess the benefits from various improvement measures it is essential to consider performance for a relevant system boundary. In the recent launched CEN standard, EN 16 2581 it is stated that this should be done in a well-to-wheel perspective. This means, for example that all green-house gases (GHG) related to transport services should be taken into account. This definition of the system boundary is specifically relevant when analysing electric motor propulsion versus the combustion engine propulsion. It is

equally relevant when comparing a fossil based fuel with a biomass based fuel. Upstream GHG-emissions from biomass production for example must not be neglected.

The idea behind this report is to understand these regional differences and richness, encourage local "best-fit" procedures, promote the use of transferable elements when possible rather than trying to align geographical and cultural variations. By doing so, and learning from each other without judgments, this may well be the perfect platform for developing the required solutions for tomorrow that can also be utilized in other countries outside the Nordic region. In this context it is important to understand that a success or a failure in one country may well turn out in the opposite way in another area. This is due to either specific differences in technical, organizational performance or the mere fact that timing was different.

A fundamental and key experience from this project is that a Nordic collaboration has the potential to deliver sustainable transport logistics solutions that are state-of-the-art in an international context. A unique attribute in the Nordic region is a strong willingness and ability at an early stage to implement future-oriented, more sustainable, transport techniques full scale and thereby improving actual present performance as well as enabling practical experiences. This fact should be better utilized in the Nordic community for improvements and input to the next generation of solutions. Implementation seems, however, to come through different measures that strongly relates to the underlying national differences in conditions.

By "walking the talk" of sustainable transport logistics a secondary effect is that existing and new industry can benefit and develop and thereby create new companies or business areas, hence job opportunities.

In this project a selection of a few solid and practical experiences is included and serves as a sample from the full Nordic "smorgasbord". This is also the rationale behind the report itself, Nordic differences; different approaches towards the issue are embraced by the report rather than trying to fully align these differences.

Finally the consortium behind the project strongly believes that collaboration and sharing the different experiences in the Nordic region will lead towards more sustainable transport logistics as well as creating a competitive edge on the global market.

Transport logistics in the Nordic countries

The Nordic countries are in many respects different from each other in terms of type of goods being transported, the density and value of these goods, geographical topography, and population. But there are also many similarities, such as the internationally recognized focus on sustainable development.

- Stronger incentives are needed
- The primary motivation for change is the cost and not the environmental aspect
- Large price competition in all countries
- In general slow uptake of new technologies
- Main focus is on getting more out of existing solutions

- A need to increase innovation in the transport sector
- Improving existing and allowing for new types of business models
- When all the Nordic countries work together as one and approach vehicle manufactures the success rate is higher than when they are approached individually – larger market share.
- There is competitive advantage available for hauliers who monitor and improve their energy efficiency and report to their customers as it enables long-term planning of transport logistics. This is beneficial to both shippers and hauliers.

The development of variables	Denmark		Finland		Norway		Sweden	
	%-change (00->10)	Average (00-10)	%-change (00->10)	Average (00-10)	%-change (00->10)	Average (00-10)	%-change (00->10)	Average (00-10)
Total tonnage [million t]	-23 %	197	-4 %	442	13 %	278	0 %	377
Modal split [% of tons by road]	-2 %	91 %	0 %	89 %	1 %	86 %	-2 %	87 %
Road tonnage [million t]	-24 %	180	-4 %	395	14 %	238	-2 %	327
Avg. length of laden trip [km]	24 %	69	1 %	61	24 %	66	8 %	81
Road haulage [billion tkm]	-4 %	11	-6 %	27	22 %	15	5 %	33
Avg. Load on laden trips [t]	9 %	8,5	-4 %	14,2	10 %	12,6	-9 %	14,8
Laden mileage [billion km]	-12 %	1,2	0 %	1,7	27 %	1,2	17 %	1,8
Empty running [% of total kms]	-8 %	17 %	-1 %	27 %	-6 %	25 %	-21 %	23 %
Total mileage [billion km]	-13 %	1,5	0 %	2,3	25 %	1,6	10 %	2,3
Avg. fuel consumption [l/100km]	3 %	32,5	-4 %	36,2	0 %	32,0	-3 %	35,7
Energy consumption [TWh]	-11 %	4,8	-4 %	8,5	25 %	5,3	7 %	8,5
CO2 emissions [million t]	-11 %	1,3	-4 %	2,2	25 %	1,4	7 %	2,2
Energy efficiency [tkm/kWh]	8 %	2,28	-3 %	3,15	-2 %	2,83	-2 %	3,92

Table 1, Summary of status of a set of transport logistics indicators for the Nordic countries between 2000-2010 (except Iceland). (Source: Noffren)

Finland: Alternative fuel types

The first natural gas buses were introduced in Helsinki in 1996. Now a total of about 800 natural gas vehicles are running. Natural gas is imported to Finland from Russia but there is increasing interest in the use of biomethane for transport. In total, production of biogas could be around 150 ktoe in 2016. LNG infrastructure is currently being built up in Finland for marine transport due to oncoming sulphur regulations.

Petrol containing 10 vol-% ethanol (E10) was launched in 2011 in Finland. There are around 2,500 flexi-fuel vehicles in Finland today. The total production of fuel bioethanol in Finland was some 7 ktoe in 2011. The majority of bioethanol consumed in Finland is imported. The target for 2020 is to produce some 150 ktoe bioethanol (300,000 m3) per year. Hybrid electric vehicles (HEVs) have not made a major breakthrough in Finland. However, the new CO_2-based purchase tax has increased the competitiveness of hybrids.

A national law requires fuel distributors to provide biofuels to the market. The use of biofuels is expected to yield a 10% reduction in GHG emissions by 2020. Biofuels are exempted from the carbon component tax and the annual vehicle tax

is linked to CO_2 emissions. Special funds have been made available to stimulate research and demonstration of next-generation biofuels.

Sweden: Heavy duty transportation

Since a law was passed allowing longer and heavier trucks for Finland and Sweden (before entering the European Union in 1995) the energy efficiency has not improved, and CO_2 emissions have not decreased in these countries for the period 2000-2010, see table 1. Furthermore, the average load, which can be seen as a proxy for the utilisation rate, has decreased. Also, the average fuel consumption has only marginally been improved for Finland and Sweden during this period.

From the energy efficiency point of view, the Norfren study gives both arguments for and against longer and heavier trucks. On the one hand, the energy efficiency is higher in both Finland and Sweden compared to the other countries, so the decline in energy efficiency is taking place from higher levels. This could partly be due to the higher degree of low value high-density goods but it could also partly be because longer and heavier trucks were allowed before 2000, and thus the efficiency increase is already accounted for.

Whether to allow for longer and heavier trucks is a rather controversial issue. From this study it cannot be concluded whether the higher energy efficiency in Sweden and Finland can be attributed to the longer and heavier trucks or to the higher degree of low value high-density goods that is being transported.

Norway: Light duty electric transportation

With many of the Nordic countries having great distances and low population density the long-haul transportation has some challenges, such as operational uncertainty and a bad financial business climate. But for short-haul transport, and especially for urban last-mile distribution, the situation is different. In this segment, there are economically viable, electric alternatives to conventional ICE delivery vans readily available for purchase. In this sense cost is the key to success and due to Norway's good incentive package for battery electric vehicles the economics of substituting a regular diesel van with a similar electric van can be quite good.

For some reason, in spite of good economics by going electric, the market for electric vans in Norway is still lagging. This is likely due to several factors:

- Real or perceived operational limitations of electric vans are seen as a barrier
- Little experience with electric vans adds uncertainty and risk for businesses
- Battery leasing model for Renault Kangoo is unfamiliar in the market place
- Peugeot Partner only just introduced (deliveries started in summer 2013).

355 electric vans were sold in Norway in 2013. Grønn Bil expects the market to pick up gradually in 2014. A notable driving force behind this development will be VAT exemption on EV leasing, which will come in to effect sometime in the first half of the year. The city of Oslo has decided to switch a significant part of its fleet over to electric vehicles, notably the Peugeot Partner. Furthermore, the Norwegian Postal services are also introducing electric vans in line with their aggressive target of a 30% CO_2 emissions reduction by 2015. The

expectation is that increased positive experience from electric vans will increase the sales in the coming years.

As more and more electric vans find their way on to Norwegian roads, and the market gains more operational experience and confidence, the willingness for private business owners to consider electric vans is expected to grow.

Iceland: Marine applications

Most of Iceland's transport of goods is land based but all international transport logistics is with airplanes and marine applications. Around 1/3 of all fossil fuel consumption is in the marine sector and therefore alternative fuel in the marine sector is of high interest. Various RD&D activities have taken place or are under current testing such as using hydrogen, batteries, DME and bio-diesel. Still, these activities are at a much smaller scale than land transport but currently the government wants to put more emphasis on this specific topic and has aligned specific funds for that. It is therefore likely that there will be an increasing number of projects in this field in the coming years.

Marine activities play a very big role in all of the Nordic countries, and marine transportation in the area is widely used both inland, inshore and cross ocean. It might encourage transport logistics companies to switch over to different technologies if there was a CO_2 emission regulation for inland and inshore marine deliveries (ferries, water taxi etc.). Also, in many cases the government should in general encourage increased transport via marine pathways, as in most cases marine transport of goods is more environmentally friendly than land transport. Here though, fuel costs are relatively low compared to land transport and therefore it is more difficult to convince marine operators to convert to alternative fuels. The taxation of fuels can be used to encourage marine operators to increase the use of alternative fuels.

In Iceland there is a joint public-private partnership with over 70 members, including all key players such as ministries, utilities, car importers, industry associations etc. This is as a very effective network and with the public and private actors working together towards the same goal, the policy changes recommended by the partnership are usually well approved and accepted by both industry and government. Due to the high interest in Iceland and the NoSlone activities there are now two international projects that have already been funded and are in the starting phase.

1. ***Rensea*** is a Nordic project with partners from Iceland, Faroe Islands, Denmark, Sweden, Norway and the Netherlands, which with innovation aims towards replacing fossil fuel with renewable electricity and biodiesel at sea.
2. ***Marina*** is a project created through the Icelandic presidency of the Nordic council 2014 and is part of the Icelandic NordBio project. This is a Nordic project including all the Nordic countries. The goal is to create recommendations ("white paper") for government policies regarding reduction of harmful emissions from marine activities and increase the use of environmentally friendly fuels.

Denmark: E-mobility business models and commercialization

A trend and mutual goal of all transport logistics companies cannot be identified,

but as an example, one of the largest transport logistics companies that operates both in Denmark and in Europe states that improvement of the reverse logistics percentage is a core strategic goal for them. Others state that the aspect that needs improvement is their delivery success rate. The improvement focus is both a matter of size of the company and their route types – international, national and city logistics.

Many companies have their focus on the revenue, causing the utilization of load capacity and reduction of harmful substances emitted not to be a priority for them currently. Therefore, the price of the electric vehicles is an issue in Denmark.

The Danish transport logistics industry is, however, becoming aware of the need to become greener and their own industry association has published a series of easy to follow advices to save money and work for a better environment. Another public initiative, which hold an interesting potential to make the transportation and logistics industry greener, is the on-going discussion about reducing taxes on gas for transportation. Especially the combination of biogas in collaboration with heavy transportation is seen as a method of significantly reducing the CO_2 emission from transportation.

The transportation and logistics industry is mainly focusing on known technology and business-as-usual but with a touch of efficiency in order to keep up with the international competition, but in between these many traditional companies, there are a few interesting cases from which a different view on the business models can be learned.

Clean technologies and solutions for passenger and goods transport

There are a number of ways to reduce the negative environmental impact from transport services. The selected solutions are dependent on what system boundary is being analyzed and improved. The common assessment scope includes transport operation, traffic related aspects and propulsion related issues, normally named tank-to-wheel assessment. As electricity and biomass based fuels are increasingly introduced, the processes producing these energy carriers require an extended scope, i.e. well-to-tank or in total well-to-wheel. In addition to this delimitation one could argue that infrastructure and production and scrapping of vehicles and vessels should be included. This assessment is, however, only valid for the well-to-wheel assessment.

Measures

Clean propulsion technologies are available, such as electric vehicles and hybrids. Many new clean or renewable fuels are considered such as (bio)methane and ethanol. A number of improvements could be adapted even without implementing new propulsion technologies by using for example engine downsizing, improved aerodynamics, auxiliary devices and thermo equipment. A more systematic approach towards a future sustainable transport logistics system is to develop a more intelligent transport system.

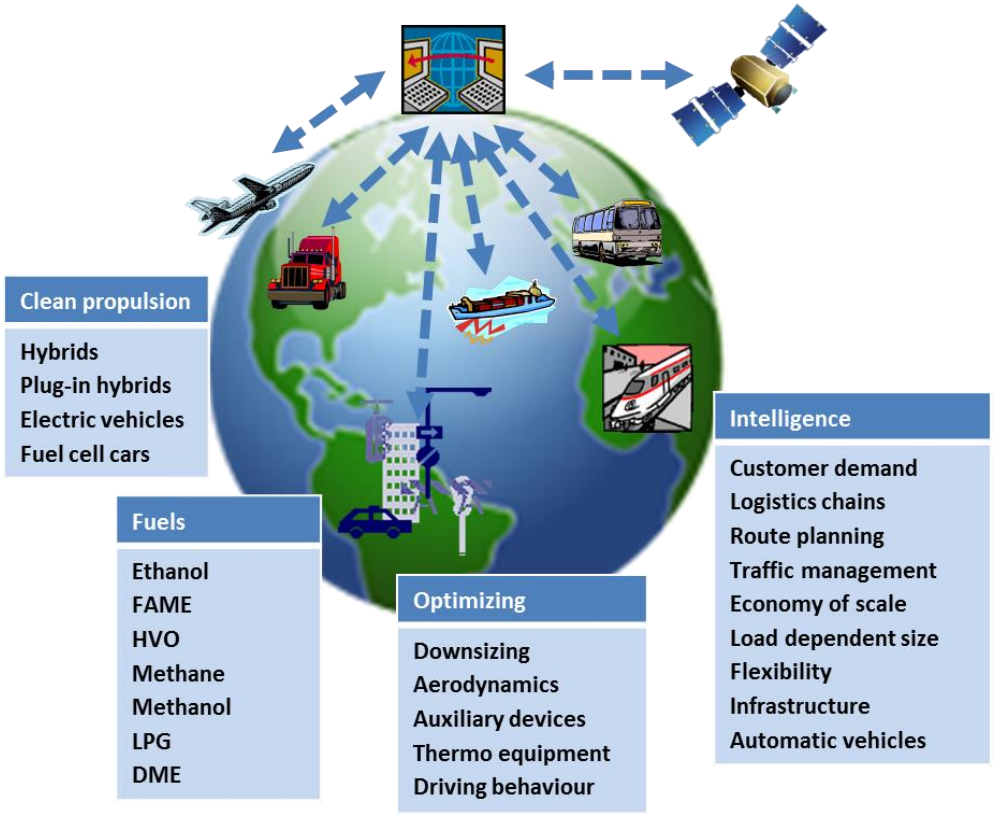


Figure 2 – Clean technologies and solutions for passenger and goods transport.

For transport logistics the main trend is to focus on increasing efficiency through various measures. Fuel consumption and CO_2 emissions of cars have diminished because of tightening regulations and guiding taxation systems. Competitive purchasing rules could play a key role when advanced greener technologies are promoted[2]. Transport demand management and guidance to change driver and customer behaviour are also important aspects.

Improving supply chains is pivotal when aiming at logistics with less negative environmental impact, even though clean technologies and sustainable fuels also play an important role. A holistic view must be considered, covering, for example, issues such as air quality and sufficient services offered by the transport systems. Intelligent transport is a common tool aiming primarily at customer demand fulfillment while increasing resource efficiency. A routing and scheduling system is one way to reduce vehicle kilometers driven and still carry out more transport services. Another crucial function is the traffic management that enables continuous optimization i.e. fulfillment of customer demands while resource efficiency is kept at a sufficient level. In the future, automated vehicles and modules would enable maximizing the benefits of intelligence in transport: traffic streams could be fluent and safe, parking areas could be rationalized.

A well-known fact in transport logistics is how economy of scale reduces relative energy use and emissions in relation to the transport service carried out. If load factor can be kept at a high level, the larger vehicle or vessel is better than the smaller

[2] NTM presently launches NTM*E*$_2$*cap* (energy and emission of CO_2e) in order to provide solid and helping guidelines for the transport procurement process.

option. However, the large mode solution may reduce flexibility and in addition increase the sensitivity regarding various disturbances. Still consolidation of goods volumes in corridors is a common way of being more resource efficient. This can also be linked to the development of robust transport infrastructure e.g. TEN-T network.

Clean Propulsion

Hybrids (electric motor and combustion engine) offer energy savings in certain driving conditions. Examples are Volvo's hybrid technology for buses and trucks. Many manufacturers have introduced diesel hybrid cars. Hybrid cars are clearly more expensive than normal cars. Hybrids are not yet popular in the heavy-duty sector, but they are used for example as taxis.

Plug-in hybrids relates to charging at grid and onboard charging while driving in combustion engine mode. Driving distance with electricity is typically 20 – 50 km. For longer distances an internal combustion engine is used. Plug-in cars are already on the market. Plug-in hybrids are presently available to a limited extent for heavy-duty sector, although Volvo is testing a plug-in hybrid bus and expects commercial production to begin in a couple of years.

Electric vehicles are coming to the market, and in 2014 the European manufactures are joining. The Mercedes eVito and Renault Kangoo Z.E. are examples of electric vans. EVs are expensive to buy and driving distances are limited, especially in winter conditions. Their usage is mainly in city logistics as they are not applicable for heavy-duty vehicles other than buses, which are already produced. Trolley buses use electricity, and trucks with the same technology are being considered, but infrastructure for this option is expensive.

Fuel cell cars offer acceptable driving distances. However, the cars are expensive, and only minor hydrogen infrastructure is available. Many car manufacturers have announced a market introduction of fuel cell cars by 2015. Fuel cell buses have been demonstrated.

Clean and renewable fuels

The best biofuels can efficiently reduce greenhouse gases (GHG), but quantity of such fuels is limited. For biofuels, it is important to use a life cycle perspective in evaluations, because upstream energy use and GHG emissions may diminish the total gains. In addition, some biofuels may increase the emissions of air pollutants from the engine.

Some alternative fuels can be used as such in existing engines, while other fuels require new engine technology and/or infrastructure. The easiest biofuels are compatible with the existing vehicle fleet without blending limitations (drop-in). *Renewable paraffinic diesel* can be used even as neat in conventional diesel engines, but blending of other biofuels is limited. *FAME-type biodiesel* can be used up to 7% in diesel fuel. Most gasoline cars are compatible with *5-10 % ethanol in gasoline*. Mixtures of *gasoline and up to 85 % ethanol (E85)* can be used in flex-fuel (FFV) cars, which are slightly modified gasoline cars (additional price of FFV only some 500 €). *Ethanol with ignition improver additive can be used in modified diesel engines.* Scania's ethanol engines, for example, are used in the city busses in Stockholm.

Methane can be used in cars by using otto-type mono-fuel or bi-fuel engines. Bi-fuel cars are not dependent on methane infrastructure (gasoline as a back-up fuel). *Heavy-duty methane* engines are traditionally stoichiometric or lean-burn otto-engines, which show higher fuel

consumption than diesel engines. *Dual-fuel methane-diesel engines* use small diesel portions for ignition and methane as the main fuel replacing some 50–80 % of diesel fuel. The benefit of this technology is high efficiency close to that of diesel engines. *Methane can be fossil or biobased.* Compressed methane requires large and heavy tanks. Special infrastructure is needed for gaseous fuels.

Fossil LPG is quite widely used in LPG cars and vehicles. *DME (dimethyl ether)* resembles LPG, but its cetane number is high enough for diesel engines. Fuel properties of DME are problematic in some respects and a special injection system is needed. Volvo was running a field test with DME. DME can be fossil or biobased.

Downsizing, optimizing

Car manufacturers have offered less consuming options by using, for example, direct-injection technology, turbocharging and engine *down-sizing*. The market share of diesel cars has increased in Europe, but this trend seems to level off as the availability and competiveness of small gasoline cars seem to regain its market share. In addition, diesel engines equipped with after treatment devices tend to suffer from increased NO_2 emissions, which presents substantial air pollution problems today.

Total fuel consumption has not been reduced in the heavy-duty sector in the same way as in the light-duty sector. Markets, regulations and taxation may not be guiding enough, or the professional transport sector has always been focusing on fuel costs i.e. it is more difficult to improve from a fuel efficient level. *Improved aerodynamics* may reduce more than 20% of the fuel consumption in highway conditions. *Driving behaviour* can be improved with on-line education, monitoring and (on-line) guiding systems. A demonstration in Finland showed that guided bus drivers on average consumed approximately 5% less fuel than unguided drivers. *Auxiliary devices* could be improved, for example, a heater of a city bus may consume 20% of total energy consumption in cold weather. *Thermo equipment* for trucks may consume as much as 50% of the fuel in city logistics. Normally the number is closer to 20%.

Intelligent transport systems

Intelligent transport systems can improve efficiency, flexibility and services of transport. Customer demand can be fulfilled with the greatest resource efficiency and with the cleanest technologies. Logistics chains, route planning and traffic management can be improved and adjusted depending on the conditions. For example, energy savings of optimum speed deliveries could be achieved. Intelligence in transport requires easily accessible data for modelling, prediction and planning. In the future, automated vehicles and modules would maximize benefits of intelligent transport systems by acting as extensive data sources and by readily adapting guidance. An example of intelligence in transport is the real-time slippery map to reduce road accidents[3]. With similar tools, traffic jams or poor air quality in cities could be reduced. Intelligent management of transport chains and logistics in general is a challenging approach.

[3] "Automatic slipperiness detection system for cars" by VTT (http://www.youtube.com/watch?v=_k7HGg2MP8s&feature=youtu.be)

Experiences from existing Nordic policies

When it comes to policy and economic incentives that encourage investments in clean vehicle technologies, Norway is the frontrunner with special focus on ZEVs, see table 2. These incentives are the central reasons that Norway has ten times as many EVs than Denmark although the total fleet size is of similar size, whereas Sweden with a total car fleet double the size of Denmark and Norway only has the same amount of EV's as Denmark, and Finland is lacking further behind.

	Norway	Sweden	Denmark	Finland	Iceland
No import/registration tax	X	-	X	Low tax	X
No VAT	X	-	-	-	X
Low/none annual fee	X	-	X	-	X
Free public parking	X	-	(X)	-	X
No road toll	X	N/a	N/a	N/a	N/a
Access to bus lanes	X	-	-	-	-
Free admission to road ferries	X	N/a	N/a	N/a	N/a
Increased mileage allowance	X	-	-	-	-
Company car tax benefit	X	-	-	-	-

Table 2 - Incentives for ZEVs in the Nordic countries

Incentives are a measure to influence the users to a certain type of behaviour, and based on the experiences from Norway it is clear that fiscal incentives are an important measure to achieve this. Calculations show that an EV is 7.000 € cheaper than an ICE in Norway over a period of 5 years, which is a significant argument towards investing in one. The same experience is found in Stockholm and Gothenburg, where congestion charges have been applied to the inner city and as an effect the traffic has been reduced with around 20 % in both cases. A relief for clean vehicles of this expenditure has caused a measurable increase in the sales of these.

For the non-fiscal incentives, an effect is also present. Comparing Denmark to Norway the most central of the fiscal incentives are available in Denmark; however the uptake of EVs has not reached the same heights as in Norway. Analysis made in Norway has shown that the most central incentive apart from the relief of import tax is the access to bus lanes[4] which especially has been an advantage for people living in the outskirts of Oslo. Now however, the largest increase in EV fleets is seen in smaller outskirt areas; Oslo has therefore acted as a motor for the nationwide implementation.

The structure of the incentives depends on the maturity of the market and products and should therefore both reflect the status of this and include long-term planning for the customers to know what they are investing in, see figure 3.

[4] http://safeproject.eu/Publications/1-Publications.aspx

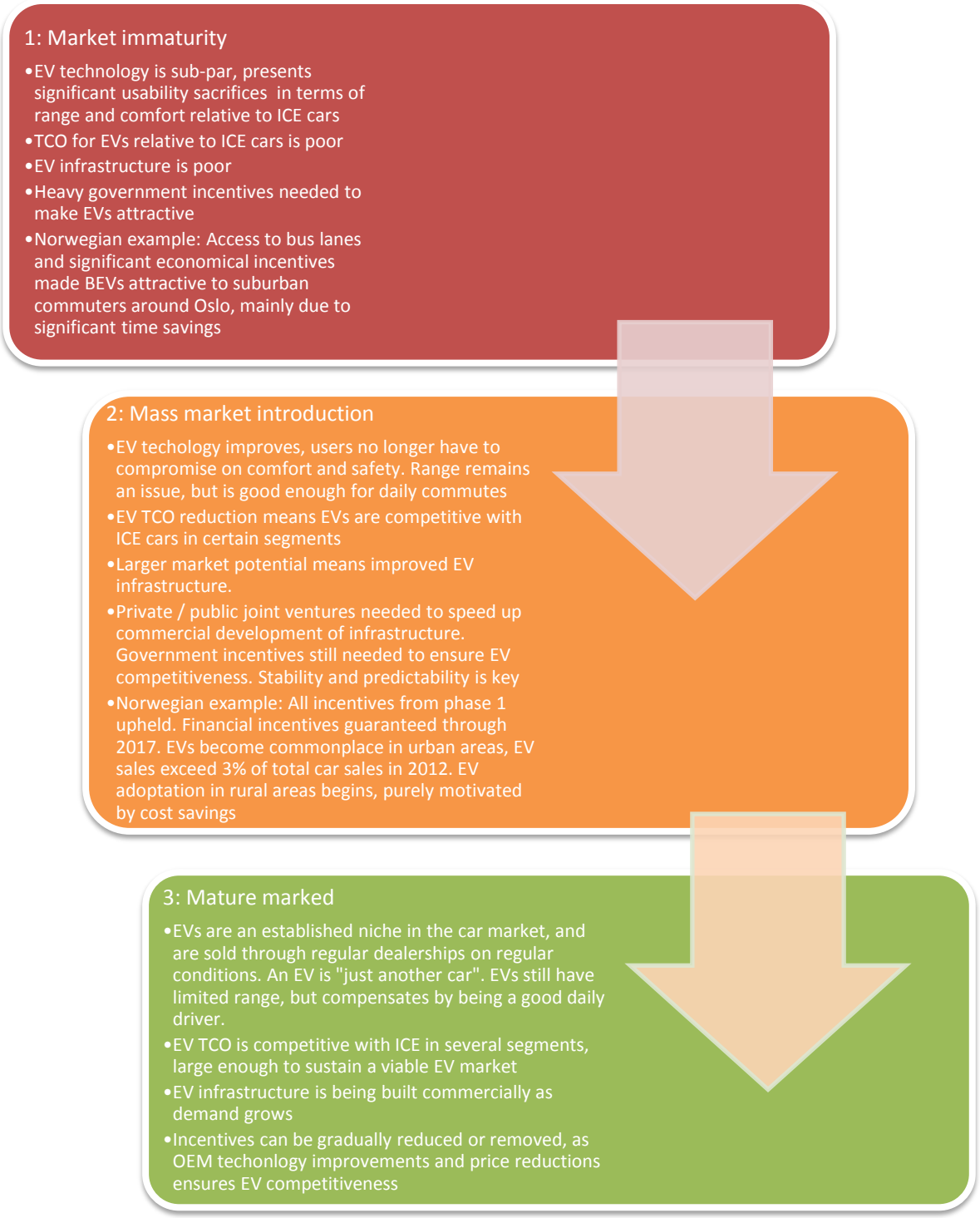


Figure 3 – Incentive structure based on market matureness

Policy recommendations

Policy interference with the very commercial market of transport logistics is something that should be done with caution. As described in the mapping of the transport logistics industry in the Nordic countries a very large amount of the companies acting in this business are small companies, and the road transportation market is experiencing high competition from low cost countries from especially eastern Europe. These elements cause a high focus on costs, profit and return on investment and therefore leaves very little room for larger investments in newer technologies if they are not immediately cost efficient. The transport logistics industry is, however, also a major player when it comes to the CO_2 emissions in transportation, and therefore an industry who can play a major role when it comes to making transportation more sustainable and greener.

When looking at the areas of potential policy influence it needs to reflect investments, running costs, usage of the vehicles as well as the change of action wished for. The NTM model for improvement pictures these considerations, see figure 4.

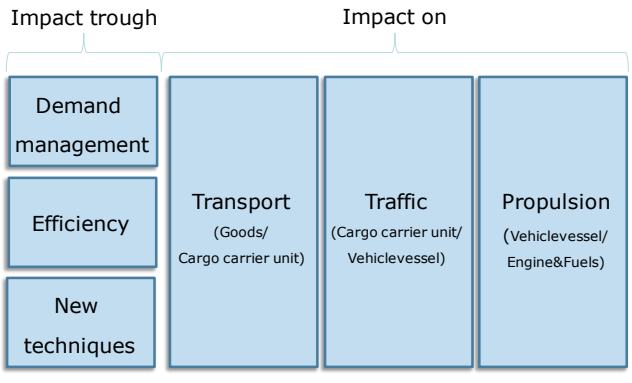


Figure 4 - Categorization of improvement actions[i]

Once these decisions have been made it is then important to secure predictability in the policies put into place – they should at least be in place for 3-5 years, as this is the minimum life time a vehicle will have in a fleet. Sudden changes in policies can in worst case result in the bankruptcy of several smaller companies due to investments made that will not pay off under the new rules and regulations. Therefore, when implementing new policies in this area, it is important to:

1. Acknowledge that it is possible to reduce global and local harmful emissions
2. Accept that tampering with a commercial market will create the risk of critical voices
3. Create an incentive package that is both big and impactful – needs to be verified and afterwards discussed with the organizations who will be affected by it
4. Make certain that the framework will exist for at least 3-5 years and will not disappear from one day to another
5. Communicate it clearly and simply

With this framework in mind, the following policy tools and public support actions could be implemented in order to catalyse the transition to a greener, sustainable transport logistics.

Policy objective	Leverage	Policy measure/Initiative	Consequence
Increase sales of greener vehicles	Comparative TCO Support to infrastructure creation	1. Vehicle taxation based on CO_2 emissions 2. Positive support on greener fuels through taxation/ subsidies	Change in the mix of fleets to become greener – primarily gas and biofuels
Reduce city congestion	Limitation of city traffic	3. Congestion charges with green zones	Expected drop of traffic in the zone of 15-20 % Will reduce sales
Reduce marine emissions	Emission reduction in Harbours	4. Emission restrictions for marine harbour areas	Slow transition of clean fuels and potentially electric propulsion in harbours
Public organizations to catalyse sustainable transport logistics	Public green tenders Public green fleets	5. Inclusion of green aspects such as CO_2 emissions in call for tenders on transport logistics 6. Creation of necessary certification to answer to call for tenders 7. Own investments in greener fleets	Significant investments in greener fleets for suppliers of transport logistics services to public organizations.
Creation of a basis for a long-term strategy	Technical evaluation and strategy	8. Creation of a technical road map for the combined Nordic area	Necessary basis for creation of predictable policies
Create green long haul logistics	Specific focus on high priority roads	9. Creation of green corridors 10. Test of new technologies	Ease implementation of new technology
Optimization and intelligent transport	Transport system optimisation	11. Optimization of existing fleet 12. Promote smart operations. Support to open data	Efficiency, flexibility and services of transport increases

Table 3 – Policy recommendations for greener transport logistics

Total cost of ownership

The main focus for the industry of transport logistics is to generate a profit in a short and long time horizon. It is therefore important that investments and running costs are balanced. Especially with the high cost competition, the willingness to large investments is dropping. At one point, however, there will be a necessity to invest in new vehicles, and in this situation it is important that the price for greener solutions is at least comparable with that of regular solutions. Furthermore, based on the case from Norway, non-fiscal incentives should be in place (will be addressed later) to provide further benefits for the greener solutions. As seen from the experiences in Denmark, a similar TCO will not make it alone if there is any uncertainty surrounding the new technology.

Since the taxation and cost structure differs in all the Nordic countries, a solution to achieve this will partly have to be made locally. In order for it to be effective and greener at the same time, it should be related to the CO_2 emission, as this is

central in the green transformation of the transport logistics. These, however, only cover the costs related to the procurement of the vehicle. In general, the running costs of the vehicle are connected with the fuel consumption and therefore an increase through taxation of regular fuel or subsidy to clean fuels could provide a further and important incentive.

In order for the industry to accept new technologies based on new fuel types it is also important to have governmental support for the establishment of the infrastructure, which has partly been shown by the initiative by the EU, who has defined the needed infrastructure for new clean fuels such as natural gas, hydrogen and electric charging infrastructure. In order to avoid the chicken and egg problem the national governments will need to make funding available for these investments.

Best practice examples:

- Incentive system from Norway and Iceland
- CO_2-based taxation system on both fuels and vehicles (Most Nordic countries have CO_2 taxation on vehicles, however not Denmark)
- Co-investments in infrastructure in Denmark – 70 million DKK invested to create green infrastructure

Reduce city congestion

Experiences from London, Gothenburg and Stockholm all show that the construction of a system with congestion charges for entering into the city centre will have a positive effect on the traffic, as all three cities have reported reduction of traffic by 15-20 %. These reductions will influence both travel time through the centre, air quality and public transportation, however on the opposite side the congestion charge will also influence the business in the centre of the city as they will experience a reduction of potential customers.

Experiences from the mentioned cases show that through exemption of the congestion charges the sales figures of greener technologies can be increased significantly. This is supported by the experiences from Norway, where EVs are exempted from tunnel and ferry fees, which in the TCO of the vehicle over 5 years is approximately 5.000 € saved. These exemptions need to be taken into consideration from the creation of the congestion charge system in order to work proactively with the system.

Best practise examples:

- Stockholm congestion charges
- London congestion charges

Emission reduction in harbours

In general, the restriction on emissions for marine vessels is relatively low – especially when it comes to smaller vessels. A restriction on emissions for vessels traveling in the harbour area would promote greener technologies to be implemented into the current and especially new vessels. As all Nordic countries are naval countries, this is an incentive that would affect all countries and cross border logistics as well. However, most of the transport logistics done at sea are by very large container ships which will not that often reside in Nordic harbours. The application of restrictions on harbours would therefore mainly affect vessels such as ferries, water taxies etc.

Fuel costs are relatively low compared to land transport and therefore it is more difficult to convince marine operators to convert to alternative fuels, and alternative solutions are therefore needed to change this sector. It could encourage transport logistics companies to switch to cleaner

technologies if there was a CO_2 emission regulation for inland and inshore marine deliveries. In general, transport via marine pathways is more environmentally friendly than land transport when considering emission pr. ton. Most vessels are made to custom fit requirements of the owner and new technologies can relatively easy be implemented in new vessels. The challenge is, however, that the lifetime of vessels is high (up to 20 years) but larger vessels that have the long life time can be retrofitted with new technical solutions.

Best practice examples:

- No legislative examples
- Iceland and Norway have several relevant projects on-going and high motivation to increase those activities

Public green tenders

Public organizations play a large role as purchasers of transport logistics and transportation services and are therefore able to influence the choice of technology used by their services suppliers. This could primarily be done via setting demands for CO_2 emissions, certain functionalities (e.g. soundless) or usage of specific technologies in the call for tenders. This will force companies to invest in greener technologies if they want to continue to work as suppliers to the municipality. This will especially be beneficial in larger cities where the number of potential technical solutions is larger (gas, electric, hydrogen).

These demands could be further supported if an official certification was to be made on companies, and this would be a demand for the suppliers of transport logistics services to municipalities. Already different tools to measure, evaluate and even certify fleets exist[5,6] and inspiration should be taken from their experiences in creating a Nordic certification for greener logistics and transportation. Already now, freight forwarders request data on emission from their suppliers and the data will to some extent be available.

The public organizations also have their own fleets which could be changed to greener vehicles as a priority to further support the market build and at the same time gain experience with the new technologies, which they are to buy from suppliers. That way the organizations will better understand the challenges of the suppliers and at the same time become frontrunners and set an example.

Best practise examples:

- Copenhagen municipality
- Gothenburg municipality

Technical evaluation and strategy

Several of the areas of the future development of society have already had technological road maps developed in order to define when the solutions are ripe for different applications and usages. The vehicle and clean fuel area is, however, not included in this, even though countries such as Sweden and Denmark expect their fleets to be 100 % CO_2 neutral by 2050. Experiences have been made in the Nordic countries on all the greener fuels and solutions for transportation and should therefore be gathered into a common technological road map, where the significant milestones of the development, types and areas of applications and critical pricing points should be defined. This tool would aid both policy makers, transport

[5] Danish certification system for green fleets: http://www.trafikstyrelsen.dk/DA/Groen-Transport/Certificeringsordning-ny.aspx
[6] NTM has a calculation system to support the mapping of emissions for fleets – www.ntmcalc.org

logistic companies and researchers as it would create a basis for decisions and long-term, predictable policies.

Best practise examples:

- IEA[7]
- Danish Energy Agency – Hydrogen strategy[8]

Specific focus on high priority roads

From European side there is a very high focus on creating a better multi modal transport logistics system through all of the member states, which has resulted in the creation of the TEN-T project[9]. One of the leverages that is described as a part of the TEN-T strategy is the creation of green corridors, where the flow of traffic is constant and will be based on cleaner technologies. It is important that the Nordic countries support this roll out via investments in these corridors, creation of ITS systems here and usage of these roads for new technology development. Already, the initiatives from TEN-T have had spin-off effects in the Nordic countries with the creation of the Midnordic Green Transport Corridor[10] which is currently mainly a desk research project.

Best Practise Examples:

- TEN-T – A European framework initiative[11]

Transport System Optimization

Achieving greener logistics does not necessarily have to include large investments in zero emission vehicles, although these will be necessary at some point in the future. For a large number of haulers and freight forwarders there are adaptions which could be done to existing equipment and operations that can increase the efficiency of the services or improve the fuel economy of the vehicles, such as aerodynamical parts retrofitted to in-use trucks. Driving behaviour of bus drivers improved through education and feedback systems. Auxiliary devices of in-use vehicles can be improved to achieve better fuel economy in cold weather.

Intelligent transport systems are in the developing phase. One discussion item regards "open data", which would enable modelling and planning of, for example, condition-dependent optimization of logistics chains. Intelligent transport systems would improve efficiency, flexibility and services of transport. In future, automated vehicles and modules would maximize these benefits. The main purposal is to support the cost benefit calculations to promote a sufficient number of companies to make the investments – after this word of mouth will act as a positive marketing tool.

Best practise examples:

- DTL's folder on how to become greener[12]
- Public support for green additions to in-use vehicles
- Public support for "drive green" course
- The real-time slippery map to reduce road accidents in Finland

[7] http://www.iea.org/publications/freepublications/publication/name,3851,en.html

[8] http://www.ens.dk/sites/ens.dk/files/ny-teknologi/teknologi-strategier/brint-braendselsceller/Strategi%20for%20brint.pdf

[9] TEN-T = Trans-European Transport Network - http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/

[10] So far a project funded by the European Union and Baltic Sea region - http://www.midnordictc.net/

[11] http://ec.europa.eu/transport/themes/infrastructure/index_en.htm

[12] http://issuu.com/sandgreen/docs/dtl-klima-brochure-2009

Annex

Background

Transport logistics, manufacturing and trade have developed much of today's´ societal structure and economic wealth. In the beginning cities grew in connection to where sea transport routes connected to ports, but as industrialization and rail transport developed, inland cities also grew in connection to railroad junctions.

The industrialization boosted the correlation between economic growth and transport. Through specialization and large scale production where products reached larger markets made transport essential. This development is well illuminated by the example that the total Swedish transport activity [tonkm] in 1880 was roughly 2 billion tonkm. Today the total number is close to 100 billion tonkm.

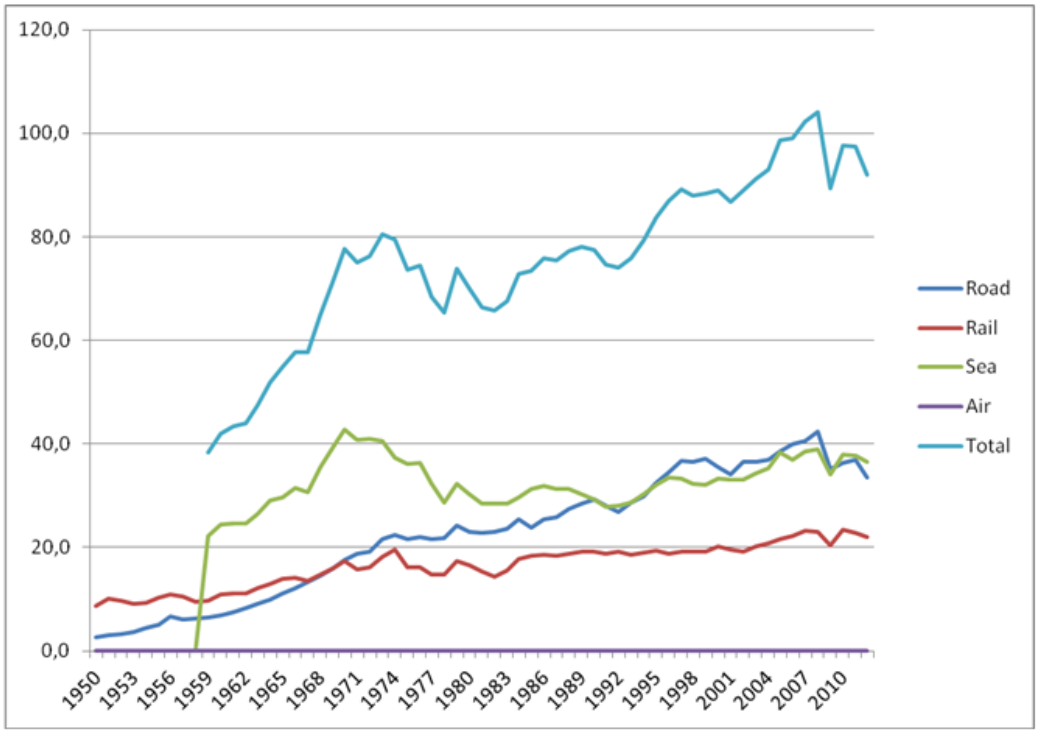


Figure 5 - Goods transport in Sweden, billion tonkm[ii]

The mobility in society at large during the same period has also developed significantly due to the introduction of primarily the passenger car.

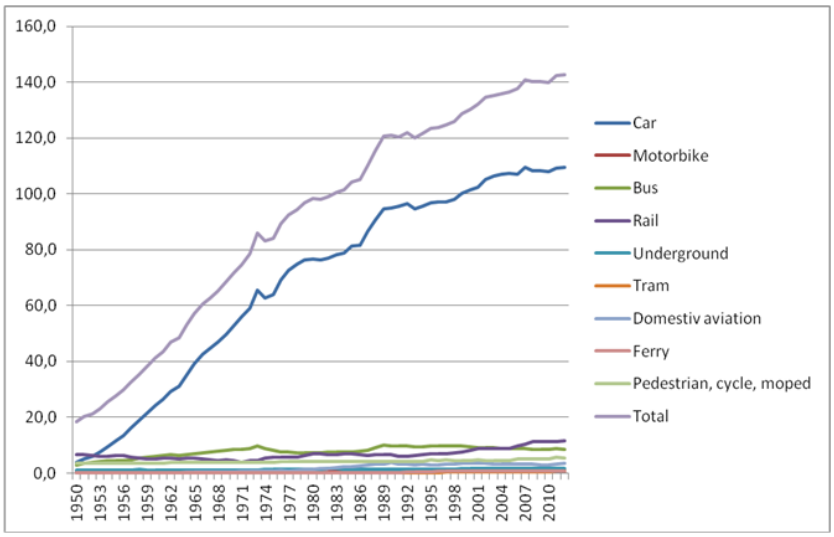


Figure 6 - Development of the number of passenger km in Sweden[iii]

The transport sector of Sweden uses a quarter of the total annual energy use. As the transport sector is highly dependent on fossil fuels the need to change towards other renewable energy sources in order to address the climate impact this will include several challenges and make significant impact on the society.

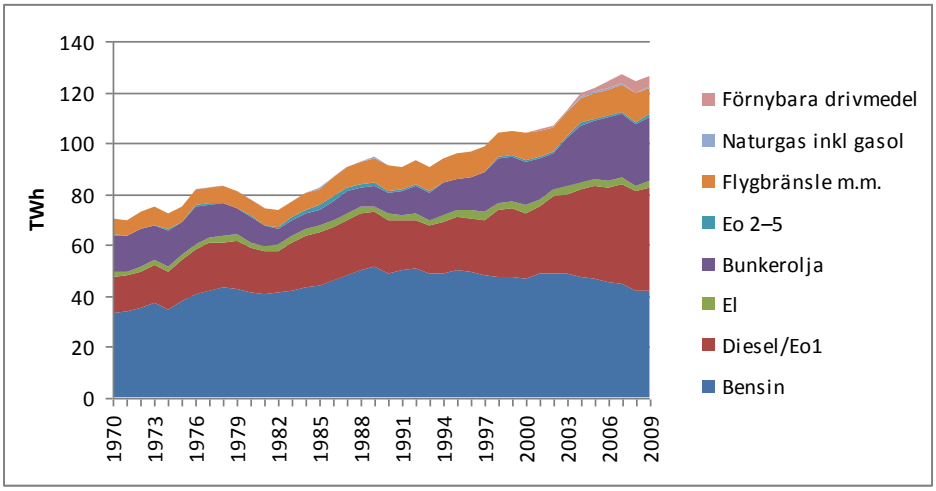


Figure 7 - Present situation on final energy use in the Swedish transport sector 1970-2009[iv]

The main challenges for the transport sector in summary is thus to develop solutions that uses less energy that can be fed by renewable fuels. As transport demand is expected to grow by 60% to 2050 this is a significant challenge.

Transport logistics status in Iceland

The majority of all goods are now transported via trucks which is a change from few decades ago when most transport of goods was via marine transport. However as an island society almost all international trade is via marine transport and air. The transport logistic industry has grown and the fleets of different companies

vary in size and shape depending on emphasis, i.e. transporting marine products, food, or other general bulk, etc.

Transport technologies – land transport sector

Iceland has for the past years tested many different technologies when it comes to alternative fuel in transport. Hydrogen and fuel cell technology was for example tested for busses, passenger vehicles and as an auxiliary engine on a tourist boat the years 2003-2012. Bio-diesel has been in use and research is now being conducted on DME. There has been a very high interest in finding a good solution to reduce the emissions from land transport – though the success of using alternative fuel is currently very little in this sector.

Today, there are mainly two technologies that are already commercially mature and ready for the market. These are methane (captured from the Reykjavík landfill) and battery electric vehicles. Methane cars have become popular in the past 4-5 years although there are only two filling stations in Reykjavík. The fuel is cheaper than gasoline/diesel and has therefore been very attractive option for the general public. Due to this increased interest companies have changed from conventional cars to dual-fuel cars with methane. Currently there are many different possibilities with clean fuel vehicles in Iceland:

1. Battery Electric Vehicles (BEV's)
   - In 1998, 12 Peugeot cars were imported, lack of interest. The cars had similar range to current models.
   - VAT revoked on electric cars in July 2012 – still disappointing sales numbers only ~ 65 cars sold in the following 1½ years.
   - Reykjavik Energy along with partners aim to have a minimum of 10 fast chargers (Chademo) available for electric vehicle by end of 2014.
2. Hydrogen Cars
   - Positive outcomes from demonstration and research projects the years 2003-2011.
   - Mass production has been delayed multiple times but is now stated to commence 2014-2017 and the first rollout from Hyundai has already started.
   - In Iceland it has been difficult to bridge the gap between demonstration phase (first adopters) and the mass production.
   - No VAT and no CO_2 taxes.
3. Methane cars
   - Methane produced in landfill. Production capacity from such production might be able to serve 5-15% of the total Icelandic car fleet. Already looking into possibilities with other types of waste.
   - Large increase in numbers of methane cars, currently >1.200
   - So far lack of infrastructure; only two stations in Reykjavík. Plan to increase number of stations
   - Taxation incentives are in place
4. Plug-in hybrids
   - Few types of plug-in hybrids and only introduced recently
   - Disappointments with lack of interest in the market
   - No import taxes and rebate on VAT.
5. Methanol
   - Produced by CO_2 capturing from a local geothermal power plant.
   - Used in local biodiesel processes – most of the production is currently exported.
6. Biodiesel

- Number of companies are exploring biodiesel production
- Small production units, certification processes are difficult due specifically to cost.
- Experiments conducted by using biodiesel on ships.
- Public not keen on buying biodiesel mixed diesel oil – lack of information?

7. Dimethyl ether (DME)

There are several options to look into, but it should be noted that methane, biodiesel and DME are all potentially competing for the same resource in order for them to be able to expand the production.

Transport technologies – marine sector

In Iceland there is a lot of interest also regarding using alternative fuel in the marine sector. Around 1/3 of all fossil fuel consumption is in the marine sector. Various RD&D activities have taken place or are under current testing such as using hydrogen, batteries, DME and bio-diesel. Still these activities are at a much smaller scale than land transport but currently the government wants to put more emphasis on this specific topic and has aligned specific funds for that. It is therefore likely that there will be an increasing number of projects in this field in the coming years.

Green Logistics network

During the last months of 2012 a contact list of the main transport logistic companies in Iceland was made, the companies were then visited as part of the project[13].

In the meeting two networks were presented, NoSlone and Græna Orkan (Eco-Energy) which is a network for environmentally friendly transport in Iceland. Also, the meetings were used to hear whether the transport logistic companies had started planning or thinking in the direction of making their fleet more environmentally friendly.

During these meetings it came apparent that all of the companies had looked into these matters, but the status of their progress differentiated. There were few companies that had already taken steps in both purchasing environmentally friendly vehicles and were well aware of the market situation and the availability of these vehicles.

The company that has had the most emphasis on greener transport is the Icelandic Postal Service. The company has made a great effort to include alternative fuels and vehicles in their service fleet and have ambitious goals and a green policy. The Postal Service has accomplished many of their goals and is today operating 21 methane post cars which is 18% of their total fleet (35% of the local Reykjavík fleet). Also, the company has been testing electric bikes and scooters and even a Segway.

Other companies that were visited were very positive regarding joining both the Eco-Energy network and the NoSlone network and a high interest was in attending a conference with key Icelandic players and investigating possible cooperation. Realizing their different needs depending on their operations, e.g. importing/exporting, local, national, etc the companies were very interesting in sharing information and collaborating in this manner. This is a very positive step forward which hopefully will increase the utilization of environmentally friendly fuels in the future. It also opens a pathway for

[13] The Icelandic post office, DHL, Eimskip, Nýja Sendibílastöðin, Icelandair Cargo, Express (UPS)

information flow from other Nordic projects hopefully encouraging Icelandic companies to take larger steps in this field. These companies operate large fleets and if they become key actors, the greener vehicles will be more visible in traffic, hopefully creating a critical mass – leading to increase trust of the general public that the technology is ready.

At the end of the NoSlone project finally cargo electric vehicles are being introduced to the market, i.e. the Renault Kangoo. The network established within NoSlone immediately supported activities as the communication pathway was very short and the interest had already been raised within the logistic companies. Already two of the logistic companies have now (Jan 2014) added electric cargo vehicles to their fleet.

Transport logistics status in Sweden

In the light of the immense climate challenges that the transport logistic sector faces, it is interesting to follow the perceived importance of different performance areas related to transport logistic services. This survey was carried out in 2012 and the results are similar to other surveys. The responders ranked various factor from 1 (low importance) to 4 (high importance) and the results were then put together as an average for the full group. The responders were chosen as a sample of various shippers, covering the full transport demand of Sweden. The response rate was 20%.

Parameter	**Average value (max = 4)**
Deliver on time	3,79
Price	3,71
Transport time	3,56
Flexibility	3,47
Safety and security	3,15
Administration	3,13
Environment	3,00

Table 4 - Ranking of transport performance criterias[v]

The result shows, in contradiction to the urgently needed requirement to meet national and international climate targets, that environmental concern among shippers in general is low. It should however be emphasized that the focus on price also indicates a cost focus that indirectly motivates a need to increase resource efficiency, i.e. also less environmental impact. The driver is however the cost and not the environmental aspect. If national and international levies and dues on fossil fuels and related emission of climate gases are put into the equation this would lead to highest priority of this question. In other words, it boils down to the political willingness and boldness to impose these charges.

Interesting is also the fact that in comparison with an equal survey in 1994, 26% of the responding shipping companies claimed that environment was important when selecting transport supplier. In this survey 94% claimed this as important.

Transport logistics operation

All modes of transport are based on the same production logic. Based on customer requirements regarding capacity, delivery time etc. the transport operator strive for achieving economy of scale. In brief this means the usage of maximum sized

vehicles and vessels that can be sufficiently utilized. The way to obtain this situation is to use nodes in the transport system where cargo can be reloaded to larger or smaller transport units. If possible i.e. sufficient cargo loads, the nodes are bypassed as they add costs to the transport chain.

The fundamental driver in transport production is to decide on the most suitable size and thereafter maximize its load factor at sufficient service degree for the customers.

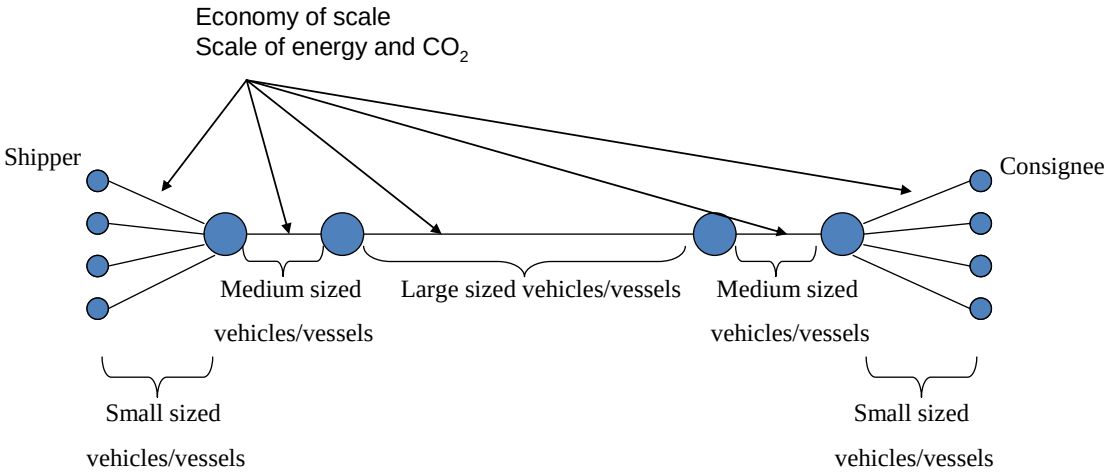


Figure 8 - A typical transport chain that aims at economy of scale in all transport link[vi].

When addressing the environmental challenges facing the transport sector one has to be aware of the organizational complexity that rules much of the business logic. Very often the transport service is sold by a transport logistics provider that in turn uses a number of different transport suppliers. Hence the impact of new stringent environmental demands must potentially follow a number of supplier's layer.

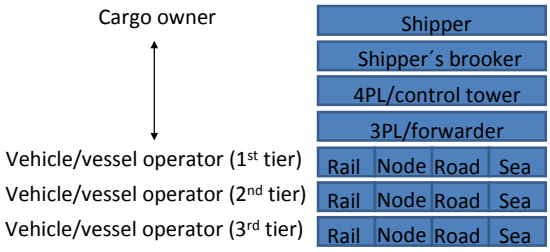


Figure 9 - A simplified description of the structure regarding operation and intermediary parties in the transport sector

Market summary

In brief it is obvious that both freight and passenger transport demand increases, leading to increased emissions of greenhouse gases and use of fossil energy. The introduction of new technologies and improved operational skills seem to have started to reduce the total emissions of air pollutants but it will not compensate the expected growth rate regarding total emissions of climate gases and use of fossil fuels.

In summary this leads to the conclusion that there is a need to look into all aspects of the transport system. This broader perspective makes the challenges even more difficult. In an attempt to describe the transport system it is clear that fulfilling societal demands on a carbon neutral society related to transport it is necessary to look into various areas.

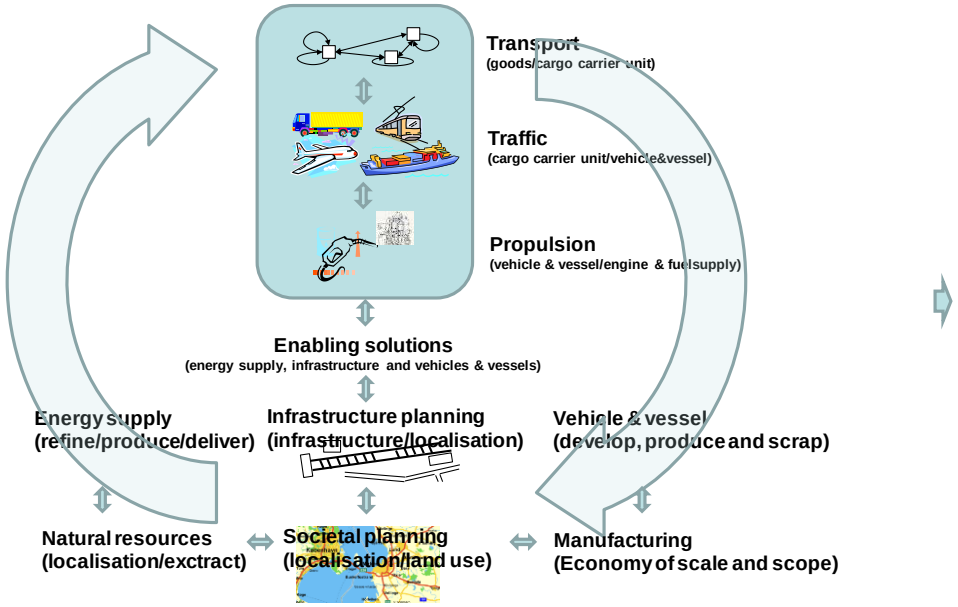


Figure 10 - As can be seen, transport is fully interlinked to societal development and planning. For example, new transport solutions (top) enable new localization (bottom)s that in turn may induce new transport demands[vii].

Efforts carried out in the Swedish transport logistics market

In order to delimit the number of challenges somewhat the main focus is on actions within transport, traffic and propulsion. For these three areas one must use the tools demand management, increasing efficiency and introducing new techniques.

Below are some concrete actions presently taking place in Sweden.

Demand management

- For some modes of transportation there is a distance charge related to environmental performance to the vehicle or vessel. Environmentally better ships are being charged lower when entering ports.
- Some main city areas have a prohibition to enter the area unless certain environmental requirements are met by the vehicle.
- In the city of Gothenburg and Stockholm there is a system where all vehicles pay when entering or leaving the city. This reduces congestion, hence reduces transport times and emissions in the area.
- Depending on the vehicle environmental performance the taxes on the vehicles varies. For electric cars this has the lowest costs
- Presently producers of biofuels are subsidised up to a certain level of blend in of biomass (15%). The idea is to make these fuels cost neutral relative traditional fossil fuels. The condition is that these fuels meet the requirements described in the Renewable Energy Directive. As there is a lot of debate presently with regard to inclusion of indirect land there is a significant uncertainty to this initiative at the moment. This has led to a limbo situation regarding the fuel producer's willingness to take on new challenges through considerable investments.
- Trading emission allowances is in different use in small scale as malus

bonus systems and as a part of compensation activities as carbon neutral transport services offered by transport service providers.

Increasing efficiency

- In order to coordinate goods flows and make best use of transport resources a strong trend is to launch and use "Logistics control towers" that ensure performance and continuous improvements. Very often this means that several shippers coordinate their goods flows and thereby reduces costs and emissions. Potentially this may sub-optimize other parts of the shared transport system.
- Long distance transport is presently being developed in many ways. One vehicle for change is the concept Green corridors. Another is the TEN-T network. A key element for improvement is larger vehicles and vessels that requires sufficient infrastructure. Examples are longer freight trains, road vehicles, and large container ships. The common denominator of these solutions is that energy use and emissions per transported ton is lower.
- The fact that there is a global trend of urbanization there is a need to improve the city logistics. There are a number of projects going on where different actors coordinate their goods flows, often through common logistic hubs. The successful projects are at present those initiated in order to coordinate public transport of goods, for example food and materials delivered to schools.
- According to several experts the potential by eco driving for trucks is somewhere between 5 and 9% fuel savings. Similar or even higher potential has been obtained within other modes of transport. For some specific short sea transport solutions the savings were 20%. In common for all these training activities is the need to follow up on a regular basis.

Implementing new techniques

- The present congestion on all infrastructures requires more space efficient transport solutions. For rail transport new, longer trains (750 m) are being developed, for road transport, the high capacity vehicles are tested (B-doubles). For sea transport the ships are gradually growing in size. The latest example is the triple-E ship developed by Maersk.
- Hybrid trucks are gradually introduced for city logistics. The potential in a stop and go traffic situation with a plug in hybrid is savings close to 30%. For long haul vehicle the potential is less, and estimated at 6%. Considering the total fuel used in long haul the total savings are however significant.
- Electrified roads for trucks are presently investigated. According to a study, electrification of the 1000 km densest roads would cover 25% of the total transport activity [tonkm]. This field is only in its early beginning, however technical tests north of Stockholm show promising results.
- In the fuel market there is a rapid change where various diesel fuel qualities are offered, including different blends of biomass. The Hydrotreated Vegetable Oil (HVO) has most success as its molecules equals the diesel molecules i.e. technically enables 100% use. OKQ8 presently offers this fuel in a small test fleet. Preem offers their fuel Evolution, blending in some 15%

HVO at large scale. Other fuels are ethanol, biodiesel, methane (LNG, CNG and CBG). The niche fuels are mostly used in captive fleets.

- The ambition to shift towards more rail transport from road does not make a dramatic progress, but there are some very good examples where this shift is successful. The main challenge is to accomplish sufficient reliability in the new multimodal solution.

Summary of improvement measures

In summary there are a number of available measures that has the potential to improve overall environmental performance. One has however to consider that measures increasing efficiency and introduction of new technologies often reduces relative transport logistics costs, i.e. there will be an increasing demand of these services that may lead to a rebound effect with regard to total energy use and emissions to air. Thus, performance needs to be measured and improved as relative and absolute numbers. The expected general growth of transport demand indicates an overall insufficient development. This is the rationale why also transport demand is a key element for the environmental sustainable transport system.

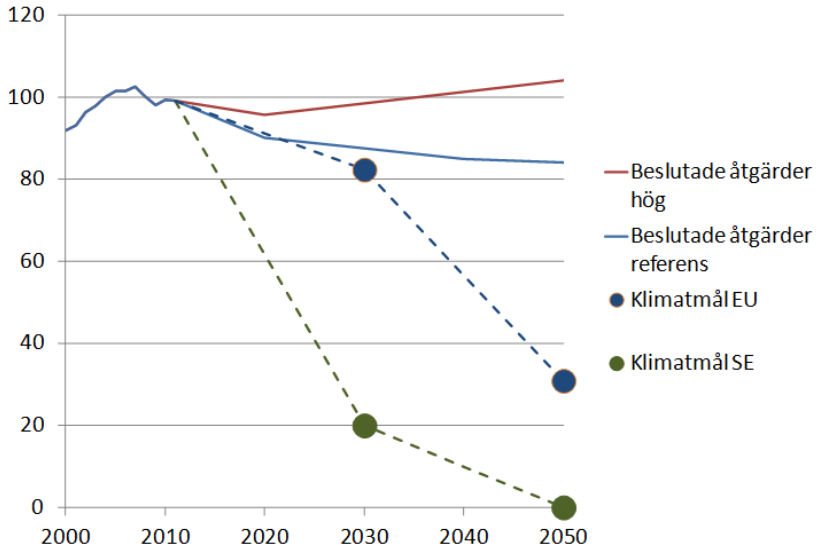


Figure 11 - Graph of deviation from required improvements in the transport sector in comparison with EU and national targets from today´s level[viii].

Transport logistics status in Finland

Energy and transport in Finland[14]

Finland is a sparsely populated country with long distances. Transportation work per capita, for both people and goods, is among the highest in the world. Transportation consumed about 222 PJ of Finland's primary energy, which is around 16% of total energy consumption in Finland in 2011 (Figure 12; lipasto.vtt.fi, Statistics Finland).

[14] By *Päivi Aakko-Saksa, VTT and Heikki, Liimatainen, Verne Transport Research Centre*

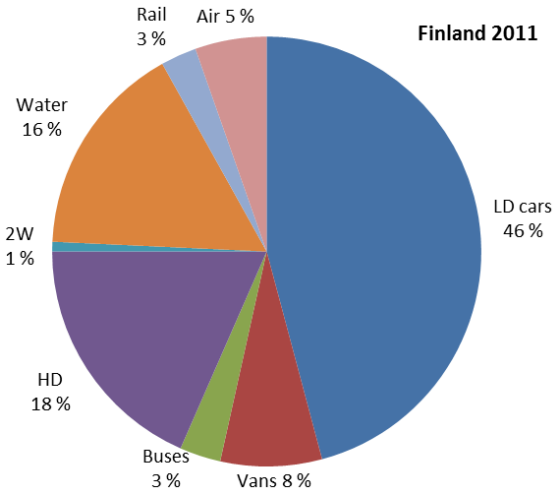


Figure 12 - Energy Consumption in Transport Sectors in 2011 in Finland (Figure by Aakko-Saksa; data by lipasto.vtt.fi)

The total number of vehicles is approximately 3.48 million[15].

- 2.979 million passenger cars, share of diesel cars ~19%
- 0.366 million vans
- 0.123 million trucks
- 0.014 million buses
- 0.516 million 2-wheelers

From this vehicle population, alternative fuel technologies represent minor share. Around 2,500 flex-fuel vehicles (FFV) are capable of using high-concentration ethanol fuel (E85), which is available at around 40 refuelling stations. There are around 850 natural gas vehicles (NGVs), and 18 refuelling stations that carry methane (natural gas and biomethane). From NGVs, 100 are busses and the rest are cars and vans. In addition, 131 electric vehicles are running.

Average ages of in-use vehicles in 2012 were as follows: passenger cars 10.8 years, vans 11.6 years, trucks 11.2 years and buses 11.3 years[16].

The dominant fuels are petrol and diesel. In 2011/2012 the total consumption of fuels was as follows[17]:

- 4.0 Mt of fossil fuels: 1.6 Mt gasoline and 2.4 Mt diesel. E10/E5/E85 petrol: 0.86/0.71/0.005 Mt
- 0.25 Mt alternative fuels (non-road not included):
  - Ethanol and fuel ethers 0.131 Mtoe
  - Bio-origin diesel 0.109 Mtoe, mainly HVO-type paraffinic renewable diesel fuel
  - Natural gas and biomethane 0.005 Mtoe

[15] Sources: vehicles in use, ; NGVs Suomen Kaasuyhdistys ry.

[16] www.stat.fi

[17] Sources: Petrol, diesel: Finnish Oil and Gas Association; Biofuels: Finnish Customs, Biofuels Barometer 2011; Natural gas: Suomen Kaasuyhdistys ry; Biomethane: Suomen biokaasurekisteri n:o 15.

Transport logistics sector in Finland

Freight transport market

The size of the Finnish freight transport market is in total about 300 million tons and about 30 billion tkm, road freight being the most important mode with around 90% share of tonnage and 66% share of haulage (Figures 13 and 14). The transport market has decreased significantly since 2008 due to financial crisis and sectoral economic changes in Finland, mostly the decrease in the production of forest industry.

Figure 13 - Transport of goods and passengers in Finland.[18]

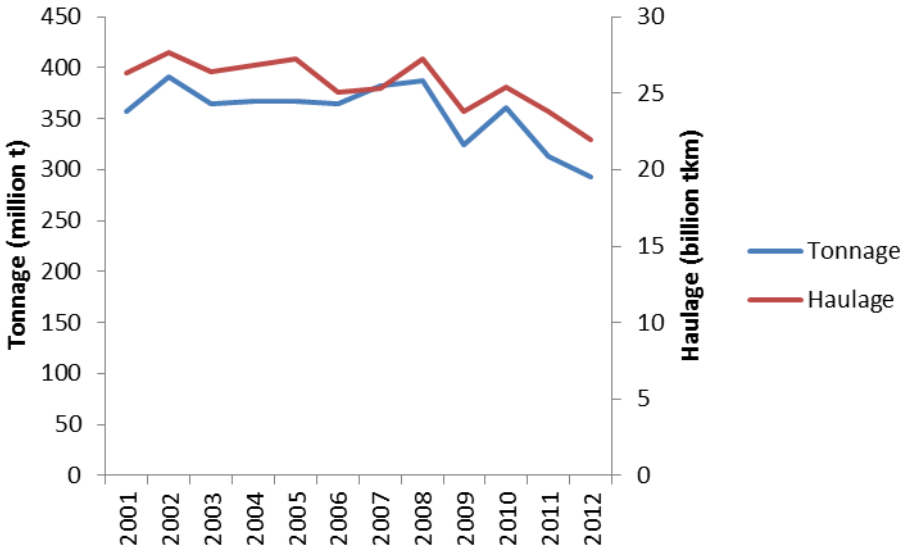


Figure 14 - Road freight tonnage and haulage in Finland 2001-2012.[19]

[18] Aakko-Saksa, P. Transport in Finland – towards sustainable logistics. "No Slone" miniseminar, 4 June 2012.
[19] Statistics Finland. Goods transport by road statistics. (http://www.stat.fi/til/kttav/tau_en.html)

The demand for freight transport as well as its environmental effects is highly dependent on the economic development of the different sectors of the economy. Table 5 highlights the differences between sectors in road freight transport indicators.

Sector	Forest	Food	Energy	Construction	Chemical	Technology	Waste	Trade	Total (w/o services)
Value added (billion €)	9.7	4.6	2.4	9.5	3.5	23.2	0.3	15.1	68.3
Value density (€/road t)	129	202	139	48	400	637	17	907	173
Avg. length of laden trips (km)	94	116	110	19	143	86	44	125	59
Avg. load on laden trips (t)	28.5	13.5	27.8	17.7	26.0	7.9	5.5	8.0	13.9
Empty running (% of total kms)	34%	21%	32%	36%	30%	24%	27%	21%	27%
Avg. fuel consumption (l/100km)	49.4	39.6	42.7	40.7	40.8	29.3	37.7	31.8	37.2
Road freight CO2 intensity (g CO2/€)	47	50	42	38	19	19	876	24	33
Transport intensity (tkm/€)	0.70	0.58	0.61	0.50	0.37	0.19	3.67	0.22	0.38
Energy efficiency (tkm/kWh)	3.9	3.1	3.9	3.5	5.2	2.7	1.1	2.5	3.0

Table 5 - Sectoral differences in road freight transport indicators in Finland in 2010.[20]

[20] Liimatainen, H. 2013. Future of energy efficiency and carbon dioxide emissions of Finnish road freight transport. Doctoral dissertation. (http://URN.fi/URN:ISBN:978-952-15-3060-9)

Environmental issues in the freight transport market

Information from transport logistics service providers is needed to perform environmental analysis of supply chains. However, a Finnish shipper survey20 showed that currently environmental reporting to the shippers by their logistics service providers (LSPs) is nearly non-existing. Almost half of the shippers want to improve the environmental reporting of their LSPs. Reporting of the CO_2 emissions, fuel consumption per haulage and vehicle utilization rate are mostly wanted, but all of these are currently difficult for the LSPs to produce. Many shippers said they prefer an LSP which can provide good environmental reporting. However, shippers are not willing to pay any extra for environmental reporting and this fact may effectively undermine improvement efforts of the LSPs.

There seems to be competitive advantage available for hauliers who monitor and improve their energy efficiency and report to their customers. Reporting may improve the trust between the companies, and thus lead to a deeper cooperation which enables long-term planning of transport logistics. This would be beneficial to both shippers and hauliers. Monitoring is the prerequisite for improving energy efficiency, and monitoring just fuel consumption is not enough. The monitoring system should also include data on the determinants for fuel consumption, i.e. on loading, route characteristics and vehicle specifications. Each operation should be recorded accurately to be able to analyse the effects of energy efficiency actions and report the CO_2 emissions and energy efficiency to the shippers.

In order to improve the environmental monitoring in transport logistics and to achieve the energy efficiency improvement and CO_2 emissions reduction targets, the Finnish Ministry of Transport and Communications, Ministry of the Environment and Ministry of Employment and the Economy together with freight transport and logistics associations set out an energy efficiency agreement for freight transport and logistics in 2008. In accordance with the European energy services directive (2006/32/EC) the agreement comprises a 9% energy efficiency improvement target by 2016. The signees committed to promote the research and development of energy efficiency in transport sector, as well as to educate and guide transport companies towards more energy efficient operations. For transport firms joining the agreement is voluntary. The national target is to involve at least 60% of road haulage companies or of commercial trucks in the agreement by 2016. For joined hauliers the agreement means a continuous commitment to improve their energy efficiency and report their energy use monthly into a national energy efficiency database called PIHI. Additionally, the company should establish an environmental management system. Currently only about 750 hauliers have signed the agreement whereas the target is about 5000 hauliers[21].

Road freight companies

There are around 11,000 road freight companies in Finland. The total turnover of the road freight transport sector was around 5.7 billion euros in 2011, down from 6.1 billion euros in 2008 and 525.000 euros/company on average. The economic situation of the companies is not very good. The average profit margin is just 1.5%, down from 3% in 2008. The number of employees in the road freight companies is around 40.000, so the average is 3,7

[21] Ministry of transport and communications. (http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-18457.pdf&title=Julkaisuja%2023-2012)

persons/company[22]. The average turnover and number of employees per company highlight that the road freight transport market is very scattered. 54% of Finnish road freight companies have only one truck (Figure 15).

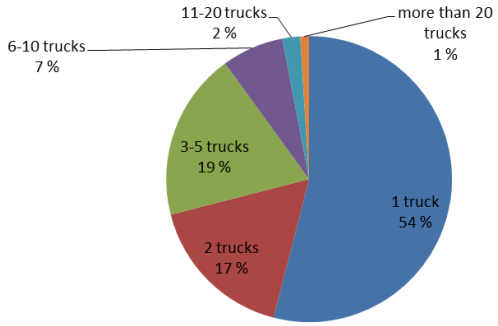


Figure 15 - Finnish road freight companies by number of trucks.[23]

Environmental issues in road freight companies

According to survey results[24], the Finnish hauliers seem to not notice the shippers' growing demand for environmental reporting. Currently 5-15% of hauliers report their fuel consumption to the shippers and less than 20% considered it likely that they will regularly report their energy efficiency to the shippers in 2016. There also seems to be a lack of knowledge among hauliers on how to monitor the energy efficiency. 13% of hauliers do not even monitor their fuel consumption actively and only 11% of hauliers said they monitor tonne-kilometres. 60% of companies have set themselves fuel saving targets and a clear difference in the company size of active and non-active hauliers was found.

The hauliers are familiar with possible energy efficiency actions, but have mostly implemented only measures which are inexpensive and easy to implement. Idling avoidance, choosing the right truck for each operation, reducing cruising speed, monitoring tire pressure and ecodriving training are commonly in use (Table 6).

[22] Statistics Finland, Financial statements statistics of transportcompanies. (http://193.166.171.75/Database/StatFin/yri/litipa/litipa_fi.asp)
[23] Finnish transport and Logistics SKAL (http://www.skal.fi/files/9326/yrityskoko_luvanvaraisessa_tavaraliikenteessa.pdf)
[24] Liimatainen, H. 2013. Future of energy efficiency and carbon dioxide emissions of Finnish road freight transport. Doctoral dissertation. (http://URN.fi/URN:ISBN:978-952-15-3060-9)

	Energy efficiency action	Potential fuel saving	Utilization by the 295 hauliers: # of vehicles	Utilization by the 295 hauliers: % of all vehicles (N=1459)
Tactical measures	Hybrid vehicles	15%	6	0.4%
	Purchasing trucks with low consumption	5%	669	46%
	Lightweight trucks and trailers	5%	436	30%
	Choosing the vehicle size according to the load	10%	863	59%
	Computerized routing and scheduling	8%	457	31%
Operational measures	Ecodriving			
	- Theoretical ecodriving training	2%	102	7%
	- Ecodriving course with driving and theory	4%	92	6%
	- Regular monitoring of ecodriving	6%	420	29%
	- Ecodriving bonus scheme	8%	142	10%
	Avoiding idling	2%	868	60%
	Limiting driving speed	5%	662	45%
	Aerodynamics			
	- Aerodynamic trucks and trailers	7%	86	6%
	- Add-ons which improve aerodynamics	7%	67	5%
	- Both design and add-ons	10%	324	22%
	Low rolling resistance tyres	3%	512	35%
	Using oils that improve energy efficiency	2%	533	37%
	Regular monitoring of tire inflation	1%	725	50%

Table 6 - Level of implementation of selected energy efficiency measures by Finnish hauliers (N=295).

The hauliers do not expect great changes in their operations and energy efficiency practices by 2016. Only the driver-specific monitoring of fuel consumption is seen likely to increase and also the use of aerodynamic fittings is expected to become more common. The Finnish energy efficiency agreement for freight transport and logistics, on the other hand, seems to be unattractive both now and in 2016.

Alternative technology options in Finland

Diesel-type alternatives: Hydrotreated Oils and Fats (HVO) and FAME

HVO is a dominating biocomponent in Finland. Neste Oil's proprietary NExBTL[25] is

[25] NExBTL is paraffinic fuel, which has a high cetane number, excellent ignition properties, and no sulfur, nitrogen, aromatics, or oxygen. No modifications are required in the fuel distribution infrastructure or

already producing close to 2 Mt/y in Finland. Production of NExBTL is mainly based on palm oil and animal fats. In 2011, the percentage of waste and residues in NExBTL production was 40.3%, and the percentage of non-food feedstocks is expected to increase in the future.

Minor amount of conventional esterified biodiesel (FAME) is used. RME (rape methyl ester) has been produced on small scales, mainly on farms. In 2005, approximately 1 000 tons were produced.

Two bio-refineries , each with a capacity of 100 kT/y, are planned for construction in Finland and use hydrotreatment to produce biofuels from crude tall oil or wood waste. Both have received significant grants from public side to develop and setup of the production system.

Bio-alcohols and ethers

Petrol containing 10 vol-% ethanol (E10) was launched in 2011 in Finland. Now E10 sales are around 55%, and the rest is E5 fuel. The energy company St1 also sells a high-concentration ethanol, RE85, at 36 refuelling stations in Finland. FFV cars and St1's RE85 were introduced to the Finnish market in the spring of 2009. At the moment, around 2500 FFVs are operating in Finland[26].

Finland has a number of smaller production sites for Ethanol with St1 as one of the major drives. The total production of fuel bioethanol in Finland was some 7 ktoe in 2011. The majority of bioethanol consumed in Finland is imported. Ethanol in petrol is used also in a form of fuel ethers, which Neste Oil has processed since 2004. In 2011, 59 ktoe of bioethers, mainly ETBE and TAEE, were blended in petrol in Finland. The target for 2020 is to produce some 150 ktoe bioethanol (300 000 m^3) per year.

Natural Gas and Biomethane

The first natural gas buses were introduced in Helsinki in 1996. Now a total of about 800 natural gas vehicles are running, consisting of some 100 busses, 10 heavy-duty vehicles, and 700 cars and vans. There are 18 public natural gas refueling stations, and construction of new stations is continuing. Natural gas is imported to Finland from Russia. In 2011, biomethane was introduced into the natural gas transmission network in Finland by Gasum. In 2012, up to 50 local buses had access to biomethane produced in the Suomenoja wastewater treatment plant. The new upgrading facility produces up to 20 GWh (1.7 ktoe) of biomethane.

There is increasing interest in the use of biomethane for transport. In total, production of biogas could be around 150 ktoe in 2016. LNG infrastructure is currently being built up in Finland for marine transport due to oncoming sulphur regulations. This offers an opportunity to consider LNG options for long-haul and heavy-duty transport.

Electric and Hybrid Vehicles

Hybrid electric vehicles (HEVs) have not made a major breakthrough in Finland. However, the new CO_2-based purchase tax has increased the competitiveness of hybrids.

One of Tekes' research programs, EVE, is dedicated to electric vehicles[27]. A test bed consisting of an estimated 400 EVs and 850 charging points will be created in Helsinki, Espoo, Kauniainen, Lahti, and Vantaa.The

existing vehicle fleet. The EN590 specifications for diesel fuel can be met with blends containing up to about 30% NExBTL. Paraffinic diesel fuel is covered by a European pre-standard (CWA 15940).

[26] FFV classification was not systematically registered for the Euro 4 car models, which may lead to underestimation of FFV car population.

[27] http://www.tekes.fi/

first Finnish demonstration of fully electric buses started in Espoo in 2012. The electric bus fleet of Veolia Transport Finland is expanding with rented buses from Portugal, China, Sweden, and the Netherlands. In addition, manufacturers will test electric buses in Finnish weather conditions. VTT and Helsinki Metropolitan University of Applied Sciences built an electric test bus to accelerate the development of Finnish components for future EVs and machinery, battery systems, and components of various types. The Finnish company European Batteries manufacture large automotive lithium-ion batteries.

Hydrogen and LPG

At the moment, there are no significant activities on hydrogen in transport sector in Finland. Demonstration of fuel cell–powered working machinery will commence in the harbor of Helsinki in 2013. The same applies to Liquefied Petroleum Gas (LPG). In the 1990s, there was also some interest in using LPG to power heavy-duty vehicles, but interest has faded and no vehicles are running on LPG in Finland today.

Promotion of new technologies in Finland

A national law requires fuel distributors to provide biofuels to the market (Law 446/2007, amendment 1420/2010). The obligation is flexible, and the fuel distributors can decide how best to meet the targets, and they may transfer all or part of their obligation to another company. The national transport bioenergy targets are 6% for 2011–2014, and then incrementally increasing from 8% in 2015 to 20% in 2020. In Finland, meeting a 20% biofuel target would mean some 730 ktoe of biofuels, or a lower amount when using "multiple-counted" biofuels according to Directive 2009/28/EC.

The Ministry of Transport and Communications presented its 2020 climate policy for the transport sector in 2009 stating that the **use of biofuels will yield a 10% reduction in GHG emissions by 2020 and that the most efficient measure to cut GHG emissions is the renewal of the passenger car fleet with fuel-efficient vehicles**. Finland's goal is to achieve average CO_2 emissions of 143 g/km for all cars and of 95 g/km for new cars by 2020. The long-term (2050) energy and climate policy, presented in 2009, calls for energy efficiency, use of biofuels, and electrification of transport. The target for the average fossil CO_2 emission of the passenger car fleet is set at 20–30 g/km for 2050.

A fuel tax system takes into account volumetric heat value, CO_2 emissions, and local emissions such as nitrogen oxides and particulate matter. Low volumetric heating value of biofuels, such as ethanol, are compensated. **Biofuels are exempted from the carbon component tax**, depending on their ability to reduce well-to-wheel GHG emissions. A bonus is given for paraffinic diesel fuel and methane because of their low local emissions.

In **passenger car purchase tax** system the minimum tax is 5% for cars with 0 g CO_2/kilometer, meaning battery electric vehicles, and the maximum is 50% for cars with 360 g CO_2/km or more. In addition, **the annual vehicle tax is linked to CO_2 emissions**; the new range is 43–606 €/a (CO_2 0–400 g/km). The CO_2-based purchase tax has been an effective instrument: the average emission value dropped from some 180 g/km in 2007 to below 145 g/km in 2011. Annual vehicle tax comprises also **a "fuel-fee" tax** for energy sources other than gasoline motor. This tax is for example in the case of a 1500-kg car

301 € for diesel, 82 € for electricity, and 170 € for methane.

Special funds have been made available to stimulate research and demonstration of next-generation biofuels. Also tax exemptions have been granted for demonstration projects on biofuels. The TransEco research program, spanning 2009 to 2013, focuses on energy efficiency and renewable energy in the road transport sector[28]. In 2013, a new research program called TransSmart was started by VTT. TransSmart (Smart Mobility Integrated with Low-carbon Energy) that will focus on four core areas: low-carbon energy, advanced vehicles, smart transport services, and transport systems. Tekes has launched a research program dedicated to electric vehicles, called EVE, which will run from 2011 to 2015 with the total volume of some 80 M€. Tekes also has a research program on fuel cells, but this program is mainly devoted to sectors other than transport.

[28] www.transeco.fi

Transport logistic status in Norway

Transport logistics in Norway, with its low population density, mountainous terrain and great distances, provide for some extraordinary challenges.

Much of long-haul transport between major logistics hubs is carried out by trucks, often on challenging roads under challenging conditions. As Norwegian wages are relatively high, competition from foreign operators is strong, resulting in a margin squeeze for Norwegian transporters. While profitability is being challenged, the financial business climate is not ideal for investment in alternative and operationally uncertain technologies for road transportation.

For short-haul transport, and especially for urban last-mile distribution, the situation is different. In this segment, there are economically viable, electric alternatives to conventional ICE delivery vans readily available for purchase. Both Renault Kangoo Z.E. and Peugeot Partner electric are available in volume to Norwegian customers, with distribution and service centres in and around major urban areas. Coupled with Norway's preferable incentive scheme for electric vehicles, the main focus for zero-and low emissions transport logistics in Norway in the short term will likely be focused in this segment.

Cost is key

Because of Norway's good incentive package for battery electric vehicles, the economics of substituting a regular diesel van with a similar electric van can be quite good. Below is a Total Cost of Ownership (TCO) comparison over 5 years between a regular Renault Kangoo diesel, a similar Renault Kangoo Z.E. and a Peugeot Partner electric, for 15.000 km and 20.000 km per year in and around Oslo. The more you drive, the more you save on going electric.

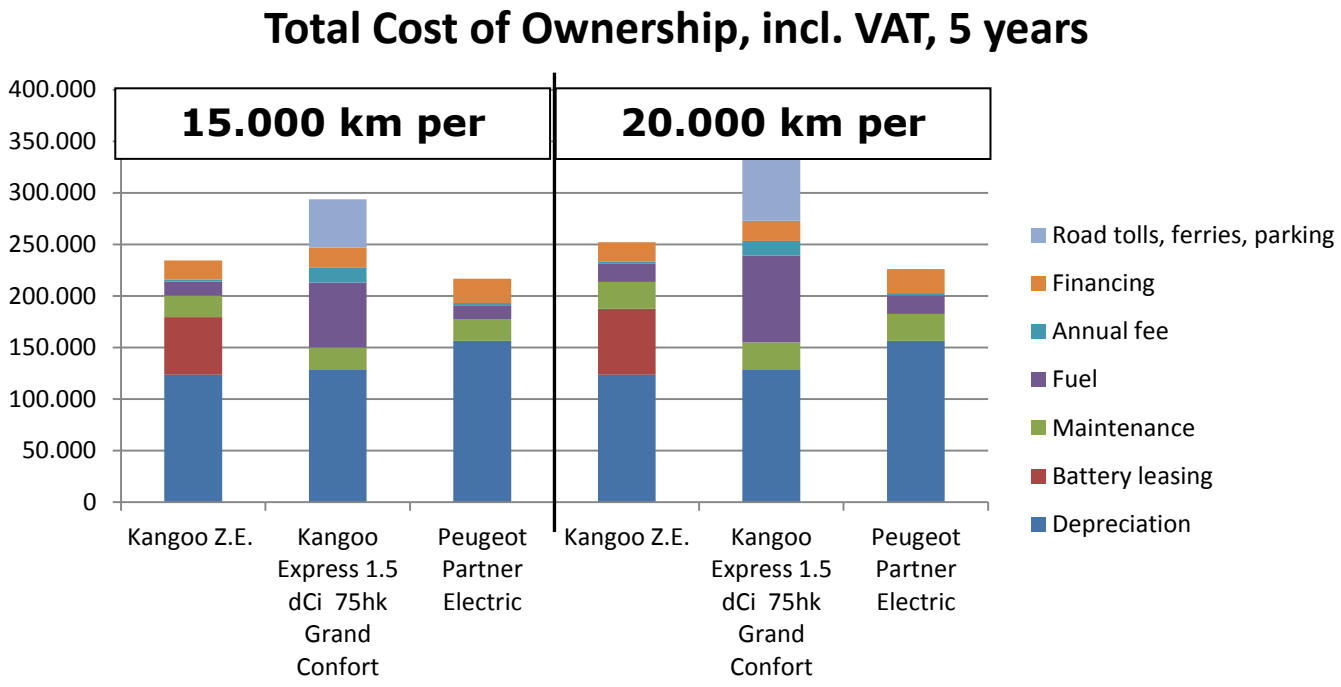


Figure 16 – Total cost of ownership for an EV van in Norway

In addition to direct cost savings, in urban areas distributors could also save significant time by going electric, as electric vehicles are allowed to use the bus lanes.

Electric van sales are still sluggish, even if the business case is good

In spite of good economics by going electric the market for electric vans in Norway is still lagging. This is likely due to several factors:

- Real or perceived operational limitations of electric vans area seen as a barrier
- Little experience with electric vans adds uncertainty and risk for businesses
- Battery leasing model for Renault Kangoo is unfamiliar in the market place
- Peugeot Partner only just introduced.

For all of 2012, a total of 59 of 31.850 vans sold in Norway were electric. This represents a market share of 0,18%. Grønn Bil[29] expects the market to pick up gradually after summer. A notable driving force behind this development will be the city of Oslo's decision to switch a significant part of its fleet over to electric vehicles, notably the Peugeot Partner. Furthermore, the Norwegian Postal services are also introducing electric vans in line with their aggressive target for 30% CO2 emissions reduction by 2015.

As more and more electric vans find their way on to Norwegian road, and the market gains more operational experience and confidence, the willingness for private business owners to consider electric vans is expected to grow.

[29] www.gronnbil.no

Transport logistic status in Denmark

The Danish transportation industry currently faces two major challenges in the form of the European financial crisis which has resulted in lesser need for transportation of goods due to the reduction in consumption and secondary the internationalization of transportation which had led to price competition with other countries where salaries are lower. The industry today consists of more than 2.300 companies of different size from 1-man companies to international freight forwards. The major companies primarily work as freight forwarders and subcontract carriers.

The fleet size varies from company to company as does the size of the vehicles. This variety can for larger companies be a tool to:

- optimize the utilization of capacity and the value chain of a transport logistics company
- avoid bottlenecks in cities caused by congestion as the smaller the vehicle the less the problems
- be able to deliver in the city centers where it is not advisable to do so with a big delivery vehicle.

In order to secure high utilization it should be prioritized to have all sizes of vehicles, however the vehicles used by the fleet should also reflect the services provided to the customers.

Primary focus for the transport logistics set-up

According to several larger freight forwarders revenue and lead time minimization are of the same, high importance for companies. The load of vehicles does not matter if the whole truck is paid for, the revenue is the same and the delivery is made on time. Such orders are however not common and therefore load utilization is a daily focus for the companies.

The same investigation showed that the average load utilization of delivery vehicles when exiting the facilities is around 75 – 100 % which shows a high utilization rate of most vehicles. The percentage of reverse logistics stated by the transport logistics companies is around 50 - 75 % however with larger variations. This is an area which is subject to further exploration due to the potential extra revenue through optimized utilization of resources.

Primary improvement focus

A trend and mutual goal of all companies cannot be identified, but as an example, one of the largest transport logistics companies that operates both in Denmark and in Europe states that improvement of the reverse logistics percentage is a core strategic goal for them. Others state that the aspect that needs improvement is their delivery success rate. The improvement focus is both a matter of size of the company and their route types – international, national and city logistic.

Most of the companies are almost only interested in revenue which is primarily caused by the financial crisis, causing the utilization of load capacity and reduction of harmful substances emitted not to be a priority for them currently.

A group of companies are open to try electric vehicles for trial periods but expect benefits in exchange for this change. The price of the electric vehicles is an issue in Denmark as well due to the long term insecurity.

Danish initiatives to become greener

The Danish logistic industry is however becoming aware of the need to become greener and their own industry association has published a series of easy to follow advices to save money and work for a better environment[30]. The content of the advices is however based on incremental steps that will not move the industry into a paradigm shift when it comes to technology.

From the public side, a certification of green transportation companies has been – see figure 17, however the public acceptance of the certificate has not been high and within the first 9 months only 12 organizations have achieved the relatively simple certificate[31].

Figure 17 – Certification process of green logistic companies

Another public initiative, which hold an interesting potential to make the transportation and logistics industry greener is the ongoing discussion about reducing taxes on gas for transportation. Especially the combination of biogas in collaboration with heavy transportation is seen as a method of significantly reducing the CO_2 emission from transportation.

[30] http://dtl.eu/~/media/Files/Aktuel_politik/Klima/The%20transport%20sectors%20plan%20for%20a%20better%20climate.ashx

[31] http://www.trafikstyrelsen.dk/DA/Groen-Transport/Certificeringsordning-ny/1-Certificering-gron-transportvirksomhed.aspx (Danish)

New Business Models as an activator of greener transport logistics

The transportation and logistics industry is focusing on known technology and business-as-usual but with a touch of efficiency in order to keep up with the international competition, but in between these many traditional companies, there are a few interesting cases from which a different view on the business models can be learned.

ToDoor

A combination of a supermarket, special shop and food delivery combined into one concept based on an online web page is the main driver behind the company ToDoor. The concept is then topped with a completely green profile, where they use electric vehicles for the delivery and biodegradable bags for the groceries.

According to the CEO, this approach has been necessary in order to create a concept that has a sustainable future and where people will be willing to utilize the solution; however the green approach would not be enough, which is why they also have a high focus on user friendliness. Their experience with the use of the EVs is that this is challenging at the beginning to get the drivers used to the range, however once they have achieved this level of experience, they become more reliable and deliver with higher accuracy since there are less deviations.

Recently however ToDoor had to file for bankruptcy and the full business case has yet to prove itself. However the experiences from using the EVs are still valid and relevant for other companies changing to electric propulsion.

City logistics

The concept of city logistics is known from especially Holland where Binnenstadtservice

has created a business in several large cities. This approach is currently being examined by the municipality of Copenhagen[32], where the initial investigations have finished and now the consortium behind are looking for possible placements of the consolidation center for the city logistic solution as well as the companies who would manage the center. The thought behind is that all larger distribution transports would drop off their goods in the outskirts of the city and planned routes would then supply the city with the necessary items in as few deliveries as possible (see figure 18).

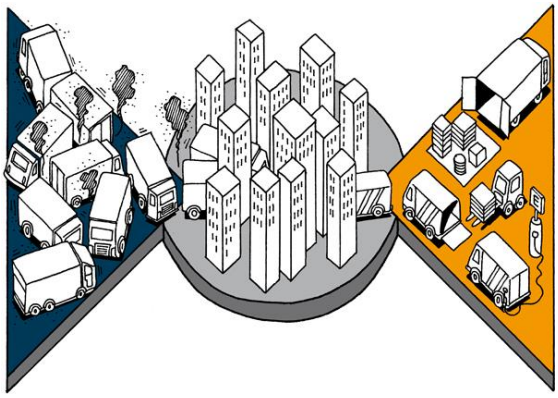


Figure 18 - Concept of city logistic vs. traditional logistics

Maersk Logistics

Being a part of the largest company in Denmark and at the same time working with transport logistics obligates the company Maersk to take part in a social responsibility. According to the manager of the Maersk Logistics' Supply chain development, Erling Johns Nielsen, this is also good business. CO2 emissions are often related to consumption of energy and therefore a reduction on this area would be a reduction of the consumed energy and thereby also running costs.

The basic starting platform in order to create such a reduction is first and foremost a mapping of the emissions and their source based on simple tools that will create an overview which can be used for further development. The second step would be to set higher demands to the suppliers and to ask them to map their CO_2 emissions. Thereby they will also be able to set up plans to reduce the emissions which will affect the downstream side of the supply chain.

Capital region

The Capital region of Denmark with the municipality of Copenhagen as the mail driver, is working hard in order to create a greener transportation solution for Copenhagen. The main target of the region is that by 2015 12.000 EVs will be owned by residents, companies and municipalities inside the region of Copenhagen. In order to achieve this target the region and the municipalities are obliged to invest themselves in EVs and the municipality of Copenhagen are looking to have 85 % of their fleet electrified by 2015. This has amongst other resulted in the creation of the secretariat Copenhagen Electric, who is to support the municipalities in this process.

A leverage, that is just as important, is the setting of the framework in call for tenders from the municipalities where they can set demands for usage of clean technologies. This will be seen by the companies as an important initiative for them to change their technology and will drive a change in the local transportation and logistics industry in Copenhagen. The municipality in Copenhagen is one of the largest purchasers of transportation services in the region.

[32] http://citylogistik-kbh.dk/

Intellect - policy recommendations

The following is a sum up of conclusions for the Intellect recommendations and reflection on which would affect transport logistics. The Nordic governments have sometimes stated the goal of creating the "Green Valley of the North" in the Nordic countries. All have set out strong environmental policies aiming to reduce greenhouse gas emissions and become more environmentally friendly.

The Intellect project was delivered mid-year 2012 and its objective was to map available incentives in all of the Nordic countries, including Greenland and Faroe Islands. The other main task was to build online calculators using all the collected data to make it possible for users to actually see how incentives affect the total cost of ownership (TCO) and in that sense help customers to take investment decisions. This calculator is available in all languages and is the key outcome of this project www.orkusetur.is/intelect. The outcome of the project is a support tool for all interest groups which are working in the field of environmental fuels. It is also a useful tool for vehicle manufacturers to see how aggressive most of the Nordic nations have been in providing incentives for environmentally friendly vehicles.

Most of the Nordic countries have set forward ambitious goals regarding reducing the use of fossil fuels in transport and have now put in place different incentives to stimulate the growth of environmentally friendly vehicles. Norway, Denmark and Iceland have been the most aggressive in this field and environmentally friendly vehicles now get large discounts or free entry into these countries. Norway is leading the way with no taxes on zero emission vehicles (ZEV) and Iceland with very similar policy. Incentives can be very useful as the progress in Norway indicates which now has the world´s largest fleet of electric vehicles proportionally. Taxes on cars are very high in these countries and while ZEV are still more expensive than conventional vehicles these incentives make the TCO almost equal for ZEV´s and conventional fossil fuel vehicles. A summary of the incentives found in the Nordic region can be seen in table 7.

	Denmark	Faroe Island	Finland	Greenland	Iceland	Norway	Sweden
Gasoline/diesel vehicles							
Import taxes		dkr/g	%		%	NOK per g/km (2012)	
CO2 0-50 grams/km	Registration tax: 105% of taxable value under 10266, 180% of taxable value over 10615	20	5,0	The duty consist of a fixed amount of € 6.706 + 100% of the part of the invoice amount exceeding 6.706 €, but not 20.161 +125% of the rest.	0	-850	No taxes for vehicles produced in Europe - 10 % import tax for vehicles outside EU.
CO2 51-80 grams/km		20	10,6		0	-750	
CO2 81-100 grams/km		20	14,9		10	-750	
CO2 101-115 grams/km		20	19,1		15	-750	
CO2 116-120 grams/km		20	20,1		15	750	
CO2 121-140 grams/km		200	23,8		20	750	
CO2 141-160 grams/km		300	27,7		25	756	
CO2 161-180 grams/km		300	31,6		35	756	
CO2 181-200 grams/km		400	35,1		45	1763	
CO2 201-225 grams/km		400	39,1		55	1763	
CO2 226-250 grams/km		400	42,4		60	1763	
CO2 >250 grams/km		400	50,0		65	2829	
VAT	25%	25%	23	N.A.	25,5	25%	25%
Other import fees		(0-13.333€ - 50% (13.333 > 75% of invoice value					
Bio methane gas vehicles	Registration tax	N.A.		N.A.	CO2 - tax	CO2 - tax	0
VAT	25%	N.A.	acc. CO_2	N.A.	25,5	25	25
Subsidy	N.A.	N.A.	0	N.A.	€ 7.600	N.A.	N.A.
Natural gas vehicles	Registration tax	N.A.	acc. CO_2	N.A.	CO2-tax	CO2 - tax	0
VAT	25%	N.A.	23	N.A.	25,5	25	25
Ethanol vehicles	Registration tax	N.A.	acc. CO_2	N.A.	CO2 - tax	CO2 - tax	0
VAT	25%	N.A.	23	N.A.	25,5	25	25
Hybrid vehicles	Registration tax	N.A.	acc. CO_2	N.A.	CO2 - tax	CO2 - tax	0
VAT	25%	N.A.	23	N.A.	25,5	25	25
Subsidy	N.A.	N.A.	0	N.A.	N.A.	10% reduction in calculation weight	N.A.
Hybrid plug-in	Registration tax	N.A.	acc. CO_2	N.A.	CO2 - tax	CO2 - tax	0
VAT	25%	N.A.	23	N.A.	25,5	25	25
Subsidy	N.A.	N.A.	0	N.A.	CO2 levels below 50g/km € -7.500	10% reduction in calculation weight	N.A.
Battery vehicles	0	0	5% (CO_2=0 g/km)	Temporary zero	No CO2 tax	No CO2 tax	0
VAT	25%	Zero until 1.1.15	23	Temporary zero	25,5	0	25
Subsidy					-€ 10.000		
Hydrogen vehicles	0	0	5% (CO_2=0 g/km)	Temporary zero	No CO2 tax	No CO2 tax	0
VAT	25%	Zero until 1.1.15	23	Temporary zero	25	0	25
Subsidy					-€ 10.000		

Table 7 - Taxation of vehicles in the Nordic countries[33].

[33] It should be noted that some of the incentives in this table are not permanent. An example of this is that the registration tax for battery and hydrogen vehicles is zero until 2015 – except if further changes will be made.

The findings of the project can be used in all different segments of the society. The public can use the calculators in order to get an insight into the difference of cost by shifting from conventional vehicles to electric or other environmentally friendly fuels. In the same manner companies and/or institutions can evaluate the implications of shifting to an environmentally friendly fuel. This is also a good tool for car manufacturers to see their potential market introduction in the region, to make it possible for their newenergy cars to be more cost comparable to other vehicles. Good example of this is the MoU existing between Hyundai, Toyota, Nissan, Honda and key players within the Nordic nations regarding introduction of hydrogen vehicles[34].

The incentives that are in place in the Nordic countries, and are summarized in the Intellect report, are practical for many different users; such as the public, government bodies and/or transport logistic companies. To encourage transport logistic companies to be more active in using alternative options for their transportation, it might be interesting to have incentives that are more focused on the transport logistic companies. It could for example be motivating if there would be an incentive for environmentally friendly fuel for transport logistic companies (e.g. DME trucks from Volvo).

For Icelandic circumstances a model of a public private partnership has proven to be very successful. This model is called 'Eco-energy' (Græna Orkan) and is a platform for both governmental bodies and the industry to meet and work together toward a common goal. The key task is to substitute fossil fuel with domestically produced environmentally friendly fuels.

34 http://newenergy.is/en/en/news/id/507/toyota_nissan_honda_o_hyundai_sign_mou_on_market_introduction_of_fuel_cell_vehicles_in_nordic_coun

This organization is very active in policy formulation and works as a recommendation body for the government.

Marine activities plays a very big role in all of the Nordic countries, and marine transportation in the area is widely used both inland, inshore and cross ocean. It might encourage transport logistic companies to switch over to different technologies if there was a CO2 emission regulation for inland and inshore marine deliveries (ferries, water taxi etc.). Also in many cases the government should encourage in general increased transport via marine pathways as in most cases marine transport of goods is more environmentally friendly than land transport. Here though fuel costs are relatively low compared to land transport and therefore it is more difficult to convince marine operators to convert to alternative fuels. The taxation of fuels can be used to encourage marine operators to increase the use of alternative fuels. Also in general increased RD&D activities are needed to evaluate the possibilities of alternative fuels in marine environment. Considerable effort has been done over the last few years regarding land transport with success, specifically looking towards Norway – and the same should now be done for marine applications – i.e. increased networking which will lead to increased RD&D projects.

For the municipality level, inner city zoning might be helpful to push delivery services in cities to become more environmentally friendly where there would be a fee for non-environmentally friendly vehicles for inner city deliveries (a good example is the city of London). Governments and municipalities should also show an example by being greener in their own actions which can be a motivation for other organizations/companies or even individuals in the society. The government could for example have 'green

governmental tenders' where environmentally friendly delivery would be financially credited (e.g. CO2 emission would be credited in monetary terms).

EU clean fuel strategy 24.1.2013

The European Commission announced on 24th January 2013 a package[35] to promote alternative fuels in Europe. Clean Power for Transport Package includes

1) Communication on alternative fuels strategy
2) Directive proposal on infrastructure and standards[36]
3) Action plan for LNG in shipping.

Clean fuel barriers are identified as high cost of vehicles, low level of consumer acceptance, lack of recharging and refuelling stations. The Commission is proposing binding targets for a minimum level of infrastructure for clean fuels as well as common standards for equipment.

Biofuels already have nearly 5% of the market. A key challenge will be to ensure their sustainability.

CNG is mainly used for cars, currently, 0.5% of the fleet - the industry aims to ten-fold figure by 2020. Publically accessible refuelling points, with common standards, are available Europe-wide with max. distances of 150 km by 2020.

LNG refuelling stations should be in all 139 maritime and inland ports on the Trans European Core Network by 2020 and respectively 2025. These are not major gas terminals, but fixed or mobile refuelling stations. LNG is also used for trucks. By 2020, refuelling stations are installed every 400 km along the roads.

Electricity: The aim is to put in place a critical mass of charging points so that companies will mass produce the cars at reasonable prices. The commission has announced the use of the "Type 2" plug as the common standard for the whole of Europe.

- Denmark: 54 000 recharging points / 5 000 publicly accessible
- Finland: 71 000 recharging points / 7 000 publicly accessible
- Sweden: 145 000 recharging points / 14 000 publicly accessible

Hydrogen: Existing filling stations will be linked up to form a network with common standards ensuring the mobility of hydrogen vehicles. 14 Member States currently have a hydrogen network.

LPG: No action is foreseen for LPG.

Evaluation

The proposed requirements for minimum infrastructure in Europe enable cross-border traffic using alternative fuelled vehicles. The proposal as such is technology neutral. Standardisation is one of the key elements in this respect. For some Member-States, however, flexible transport with Russia remains to be considered. As concerns Nordic countries, Denmark, Finland and Sweden as member states of the EC will follow the directives. Norway as a non-Member State can apply different policies, which could be seen for example as limited LNG and CNG infrastructure. Transport issues between Iceland and other countries concern primarily marine sector,

[35] http://ec.europa.eu/commission_2010-2014/kallas/headlines/news/2013/01/clean-fuel-strategy_en.htm

[36] Proposal for a directive on the deployment of alternative fuels infrastructure. Brussels, 24.1.2013. COM(2013) 18 final 2013/0012 (COD). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0018:FIN:EN:PDF

however national targets for infrastructure could be encouraged by the EC initiative.

The directive proposal is under discussion, and changes may take place. Flexibility may be one of the issues to be discussed. There are regional differences between Member States, and special cases, such as long distances in Finland and Sweden should be taken into account.

Congestion charge: the experiences from London, Stockholm and Gothenburg

Congestion is an example of an overuse of a freely accessible common resource. One way of tackling this is by the use of a congestion charge enclosing a certain area, most notably a central part of a city. This short quoted summary report will go through the scientific literature on the topic of congestion charges implemented in three European cities.

London—overall traffic flow effect: minus 30%[37]

Access to central London costs £10 irrespective of time of entry between 0700 and 1800, Monday to Friday. There is no charge on Public holidays and between Christmas and New Year's.

The outcome shows that within the sample surveyed the congestion charging scheme has caused a significant number to shop less often in central London and only a few to shop more often in the Oxford Street area. Evidence from other travel demand measures on city centre shopping activities suggest that the long-term effects of the congestion charge could be more positive (Schmocker et al., 2006).

The first impact studies showed that the reductions in traffic and congestion met or exceeded predictions. Moreover, the initial reductions have been sustained in subsequent periods. The net result has been a significant change in the composition of London traffic. Private cars, which accounted for almost half of central London traffic before the charge was introduced, now represent just over one-third, a fall of 34 %. The level of commercial traffic (vans and trucks) has fallen slightly, but there has been a sharp rise in taxis (up 22 %), buses (up 21 %), and bicycles (up 28 %) (Leape, 2006).

The impact on traffic was sudden and dramatic. For example, car movements within the congestion-charging zone (21 km^2) were reduced by about 30%. Actual sales from a big retail store on Oxford street match predicted sales up to 19 January 2003 for the store but that actual sales fall consistently below predicted sales thereafter (Quddus et al., 2007a).

The analysis suggests that the charge had a significant impact on sales at the John Lewis Oxford Street store over the period studied. However, it also suggests the charge did not affect overall retail sales in central London, an area larger than but encompassing the congestion charging zone (Quddus et al., 2007b).

The results suggest no statistically significant effect for total casualties in London, but within the charging zone there has been a statistically significant drop in motorist casualties, and possibly an increase in cyclist casualties. There is an associated effect of an increase in casualties of motorcyclists and cyclists in some areas outside the charging zone, suggesting that changes in the design of

37 https://dspace.lboro.ac.uk/dspacejspui/bitstream/2134/5285/3/Quddus_et_al_2006_Transport_Policy_untrackedv1.pdf

the congestion charge may be needed to achieve reductions in casualties (Noland et al., 2008).

Stockholm—overall traffic flow effect: minus 22 %[38]

The costs to enter Stockholm is depending on time of entry, peak hours are the most expensive. The price ranges from 10-20 Swedish kronor (€ 1,1 – 2,3) Monday through Friday; the month of July and public holidays are exempted from charge.

The panel analysis shows that many more people doing congestion charge ring passages to work, home and shopping change from car to public transportation in comparison to the rest of the county. Only really poor households use the car a lot less often and the highest income group tends to continue to drive by car (Becker, 2008).

Effects on congestion reduction were larger than anticipated, which also resulted in favourable economic and environmental effects. The trial showed that a single-cordon toll could affect traffic within a large area, i.e., not just close to the zone limits (Eliasson et al., 2009a).

The system is shown to yield a significant social surplus, well enough to cover both investment and operating costs, provided that it is kept for a reasonable lifetime: investment and startup costs are "recovered" in terms of social benefits in around 4 years (Eliasson, 2009b).

Acceptance of the congestion charge was higher after the trial as opposed to its acceptability judgments before the trial. Respondents believed the charge had more positive consequences (viz., decreasing parking problems, congestion, and pollution) and less negative consequences (viz., financial cost increases) after the trial than they had expected beforehand. Results are that before the implementation of the charge acceptability was significantly related to beliefs about the expected consequences for one's own car use and financial costs, whereas acceptance after the trial was related to beliefs about the perceived consequences for one's own car use and parking problems (Schuitema et al., 2010).

The results revealed that the policy measure could actually tip the scales for the individual towards trying out a new behaviour (Henriksson et al., 2011).

The main conclusions include the identification of a rational actor paying an insurance against unacceptable risk, the importance of the election cycle, and the interplay between risk, acceptance, performance, and cost (Hamilton, 2011).

This study shows that the traffic reduction caused by the charges has increased slightly over time, once external factors are controlled for. Alternative fuel vehicles were exempt from the charges through 2008, and the study show that this substantially increased the sales of such vehicles. The study concludes that objective and subjective effects on the traffic system, as well as general environmental and political attitudes, formed the basis of the strong public support, while institutional reforms and resolution of power issues were necessary to gain political support (Börjesson et al., 2012).

38 http://www.sciencedirect.com/science/article/pii/S0965856408001572#

Gothenburg—overall traffic flow effect: minus 17-20 %[39]

Due to the rather recently implemented congestion charges in Gothenburg, the academic literature is scares. The results from two master student theses are presented below. The cost to enter the city center is 8-18 SEK (1-2 €) depending on time of entry during weekdays, with peak hours being the most expensive time of entry. During July and public holidays the congestion charge is lifted.

The results show that on average 22 % of the individuals in Gråbo compared to 16 % in Särö have decreased their travel by car. There is a corresponding increase in travel by public transport of 13 % in Gråbo and 5 % in Särö. Individuals with a higher income are less affected by the congestion tax than individuals with a lower income (Gräsberg and Göransson, 2013).

The results indicate that attitudes are impacted the most by expectations about the effects of the scheme, the complexity of the scheme, whether it is considered unfair, if the respondent drives a car and to some extent, the stated environmental interest. This implies that the most important policy implication in order for policy-makers to achieve acceptance, is to provide the public with information that emphasises the positive effects of the charge (Muz, 2013).

39 http://www.eltis.org/index.php?ID1=5&id=60&news_id=4188

Which Norwegian incentives have been working – how and when?

Taxation policies – the main driver?

The Norwegian tax system for cars is something that deserves some more comments and reflections. Cars in Norway have always been expensive compared to almost all other countries. This can partly be explained by that Norway has not had a car industry of importance; the same applies to Denmark and Finland. These three countries are at the very top in Europe when it comes to the level of car one-time fee.

It should be mentioned that Norway has had its own production of electric vehicles from 1990. However, the production of the Th!nk City, the most known Norwegian EV brand, was stopped in March 2011 and the company filed for bankruptcy on June 22, 2011. This is actually a part of the explanation on why EVs quite early in Norway (1989) got tax exemptions and later also other market push incentives. Again – promoting a home grown car industry – it's a rather strong driver.

Another key difference that may explain differences in taxation policies is the availability of local resources. There is a higher interest for BEVs and FCEVs in countries which have a large source of renewable electric power like Norway, but higher for bio-fuels in countries like Sweden that have large bio resources.

Still, in most of the Nordic states taxation on fuel and vehicles are a vital income source for their governments. When providing incentives such high taxation can though make things simpler. Revoking taxes (specifically temporarily) is usually a simpler process for governments than providing direct funding or subsidies. Therefore, it is "easier" (that is provides less financial risk) to reduce taxation and, in that way, reduce the cost difference between conventional technologies and new (developing) technologies.

Many of these incentives can be of high value for the customer. Incentives leading to time saving, e.g. driving on bus lanes, priority (free) down-town parking could offset the extra vehicle cost. Non-financial incentives can therefore be of higher value than financial incentives, but so that such incentives become effective it is important to have good cooperation between municipal and national government as some of the incentives touch on both authorities.

From an urban phenomena to a countryside must?

Some of the incentives for BEVs, such as parking, access to the public fields and no road toll, are fitting commuters in urban areas very well. This is particularly evident in the western corridor outside Oslo in the direction of Asker. Along this highway, public transportation is relatively poor (meaning that most people don't live close to the highway or the train stations) and there are therefore long queues, especially in the morning rush hours. (Green car strategy paper of November 2011).

During 2012 we have seen the same phenomena outside other Norwegian cities like Stavanger and Trondheim. In terms of electric car sales per capita, the small island Finnøy outside Stavanger top

the EV sales list of 2012. During 2012 one BEV per 100 inhabitants was sold. The main reason for the good sales is likely to be the new toll road tunnel connecting the island to Stavanger (Grønn bil 2013). This toll road also happens to top the list of being the most costly toll road in Norway in 2012 – if you chose to drive an ICE car.

But this trend is also interesting from another point of view. Slowly, EVs are becoming relevant alternatives for those living outside urban areas. If you drive the same distances every day e.g. to get to work and back home again, then a BEV might exactly be the car that you need.

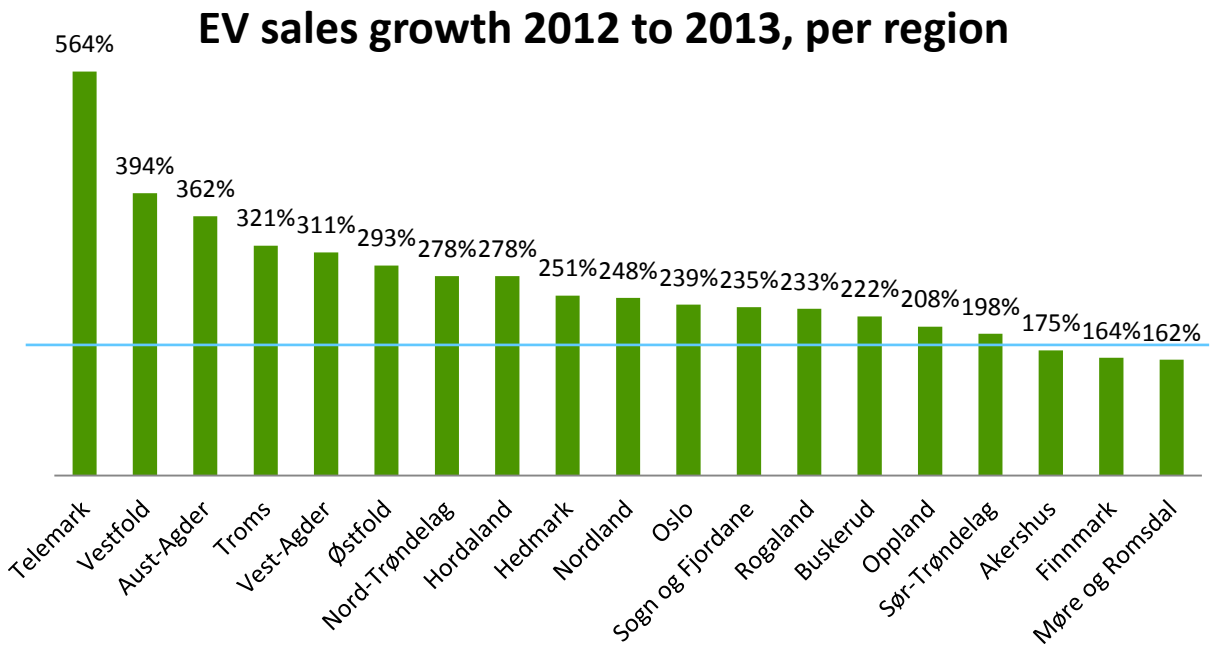


Figure 19 – EV growth per region in Norway in 2013

The graph shows EV sales growth per region in Norway from 2012 to 2013. Although the volume is still higher in urban areas than rural areas, the trend clearly shows a significantly higher growth rate in rural areas than in urban areas for this period. This marks a clear change from previous years, where both the growth rate and the volume were higher in the cities than in the rest of the country.

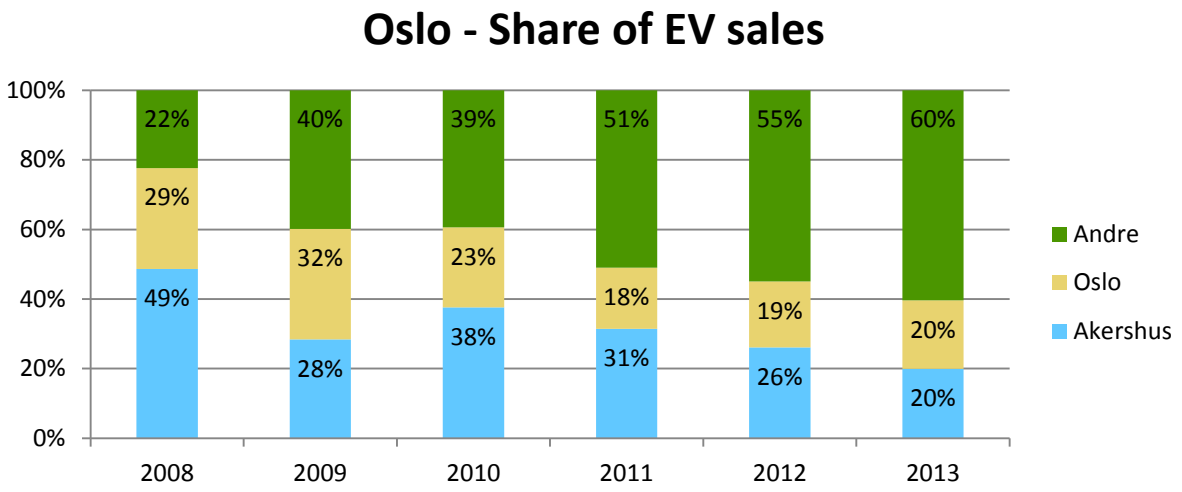


Figure 20 – The share of EVs by region out of the total fleet

One tends to believe that the EV is the household's second car. Especially this has been the case in Norway. But a survey by NTNU (Ecar/sintef) shows that this is not the case. Given that approximately 42 % of Norwegian households have two cars (TØI 2011), the EV serves as the everyday car (NTNU 2011).

Where there is demand, there will be supply…

EVs in Norway were until 2009 largely purchased to save time and money – free parking and no toll road fees. Comfort, performance and status were traded for other benefits. The rapidly growing marked for EVs in Norway, has clearly been driven by private demand. Until recently, one of the main barriers in the market was supply-side issues: The demand was there, but a small number of producers and importers meant limited choice and distribution.

From 2010/2011, more normal cars were introduced such as Mitsubishi i-MiEV, Citroën C-ZERO, Peugeot iOn and of course the record selling Nissan LEAF. An EV that also come with back seats and air condition made EVs interesting for a new group of purchasers. These new and better equipped cars have now started to display their true potential – and they are also offered at a cost competitive level. And suddenly your friends, neighbors and colleagues buy an EV – and this is when you realize that you need one too.

… and increased supply of EVs is bringing the costs down…

EV incentives help automakers to help cover the costs of the initial state so that they can more quickly achieve profitability by producing them. When automakers launch EVs, electricity and production volumes increase, there will be competition in the market, and the cost goes down. And the prices of EVs have been dropping quite much over the recent years.

In the Norwegian market has been able to observe a large price reduction after the major automakers introduced electric cars. In 2009, one could buy a two-seat Think City electric car for NOK 290,000 including winter tires. In 2012, one can buy a Peugeot iOn with 4 seats, better comfort, better guarantees and security

for the car buyer for NOK 190,000 ready to drive with snow tires included *(Figenbaum/Nørbech 2012).*

All suppliers of EVs compete on identical terms according to normal, commercial rules. As a result, increased competition and higher market volumes have led to lower pricing. As of January 2012, the three quasi-identical cars iOn, C-ZERO and i-MiEV all cost around € 24.000, down from around € 30.000 on introduction a year earlier. The competition between the leading manufacturers has continued throughout 2012.

The cost of electric cars is expected to decline further in the coming years, making EVs even more cost effective compared to ICE cars.

… but the ownership cost of an EV is still a question of policies

But a compatible purchase price is one thing; another factor that comes into play is the ownership cost of a car. How has this been developing in Norway? The Norwegian experience is that the more you drive, the more profitable the EV compared to a traditional car-even if one expects a bigger loss in the electric car value. A Nissan LEAF, owned for 5 years and drives 15,000 miles per year was assumed to be competitive in costs compared to a VW Golf already in 2011, even without full use of incentives such as access to bus lanes, free parking etc (Green car strategy paper 2011). If we compare Norway with Sweden and Denmark, we can see some interesting differences:

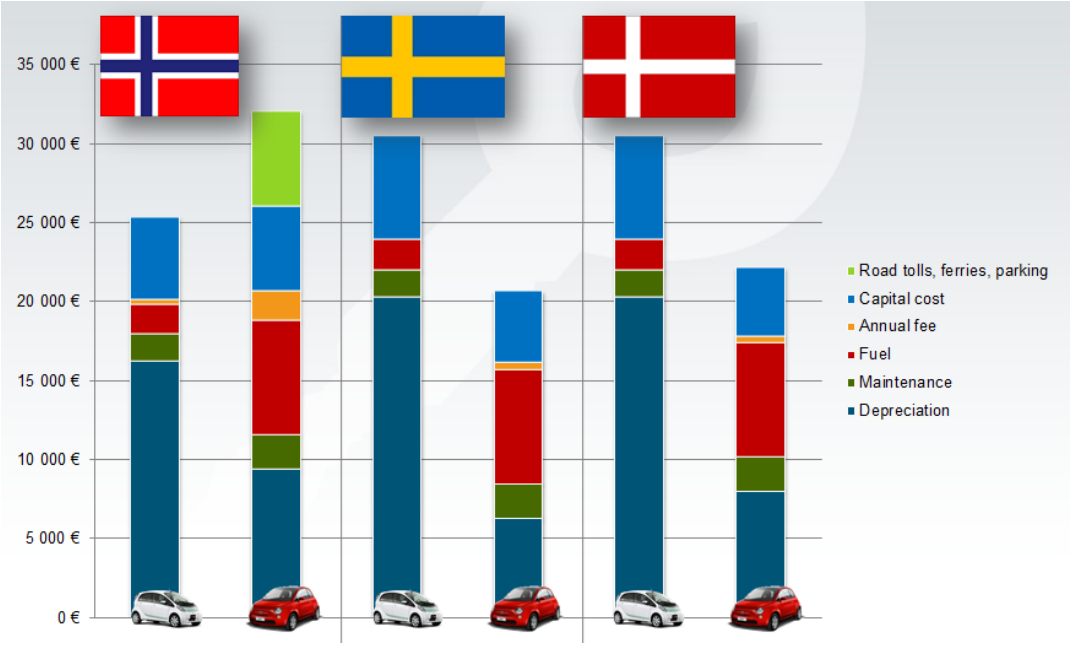


Figure 21 - TCO for mitsubishi i-MiEV vs Fiat 500. 2012 pricing. 5 years of ownership, 15.000 km / year

Estimates only

The figure shows the Total Cost of Ownership for Mitsubishi i-MiEV vs a similar Fiat 500 1.2 gasoline car, based on 5 years of ownership and 15.000

kilometers driven per year, for Norway, Sweden and Denmark. The Mitsubishi i-MiEV comes out much better for the owner in Norway than in Sweden and Denmark. Especially the road tolling and parking fees makes the difference between owning an EV and a conventional car.

This also supports the findings described above where people especially living in or just outside big towns like Oslo, Bergen, Trondheim and Stavanger – towns which also happens to have toll road systems – are also the areas where the number of EVs has been and are growing the fastest in Norway.

What incentives are effective?[40]

The Norwegian EV incentives have been effective primarily because, in sum, they have created a "tipping point" effect for a substantial market segment. This has a quantitative, economical side, as described above, as well as a qualitative side in relation to non-financial incentives like access to the bus lane. Specifically what incentives are important will be an individual assessment for each buyer – but in sum, we can say that the incentives in total have been strong enough to convince around 7% of Norwegian car buyers to choose an EV in 2013.

In figure 2 (on page 16) is an illustration of the various phases of the EV market, as seen from a Norwegian perspective. In the early days, some incentives created pockets of EV users in places where they had significant effects – such as the municipality of Asker, a suburb of Oslo, where residents quickly discovered that EVs cut their travel time to work in half by providing them with access to the bus lane. As the market matures, and EV adoption spreads to other areas, the relative significance of this incentive for the market as a whole declines.

What are the pros and cons of using incentives?

Incentives are used to speed up a transition that would otherwise not happen, or which would happen more slowly. As such, incentives are by nature time-limited, and can be phased out when the transition is completed or able to sustain itself. In Norway, some incentives used to speed up the transition towards EVs are naturally not sustainable in the long run. Incentives such as access to the bus lane have to be re-evaluated if the buslane reaches its traffic capacity limit. Financial incentives have to be re-evaulated when the cost of the incentives start to out-weigh the benefits.

A key issue in incentive management is to manage market expectations. Car manufacturers, car importers and potential customers all value predictability highly. Any sudden changes in incentive schemes, or in communication regarding the incentive scheme creates uncertainty, which in turn makes potential suppliers or customers refrain from participating in the market. This risk-aversion in the marketplace means that without effective communication and a long-term roadmap for incentives, an incentive scheme simply will not work as well as it could have.

An incentive package which is abruptly changed or removed can be more damaging than no incentive scheme at all. In Norway, this was clearly demonstrated when the government first created incentives for biofuels which led to private investment in production of such fuels, before the incentives were removed more or less over

[40] *This analysis is partly based on the paper "Norway: Lessons learned from a global EV success story", by Ole Henrik Hannisdahl, Håvard Maggen Malvik, Guro Bøe Wensaas. See www.evnorway.no for more*

night without prior notice. This meant that large investments in biofuel lost their value, and provided a clear example for investors that political risk will always be present in a politically stimulated market. This also creates a spill-over effect, reducing the credibility and effectiveness of policy stimulation in other market areas. Because of the lessons learnt from i.e. the biofuel case, Norwegian politicians have had to work harder in order to persuade private stakeholders to invest in the EV market.

Incentive suggestions from the Danish EV Road Map

The following analysis is based on recommendations from the Danish EV Alliance on incentives and initiatives to increase the number of electric vehicles in Denmark in general. In order to keep a critical eye on the results it is important to understand that the Danish EV Alliance is a branch organization for the EV industry in Denmark and has as target to get as many electric and plug-in vehicles on the streets in Denmark as possible. However the organization has to convince politicians to change policies, which demands strong arguments based on facts and economic reasonability.

Two documents have been used for this analysis:

- The road to a green car taxation (work by Copenhagen Economics)
- E-Mobility Road map 2020 (work by Catalyst Strategy Consulting)

As the Danish EV Alliance is focusing on the general growth of the number of EV's the incentives suggested in the report will focus on public fleet owners, private fleet owners and private homes. The latter of the three will not be in focus in this analysis, as they are not a direct part of the logistic value chain. Furthermore the incentives proposed are focused on electrical vehicles, but as a part of the analysis this will be put into a framework that in general supports greener transport logistics.

The road to a green car taxation

The main philosophy behind changing the taxation rates to be greener is "cash is king"; understood in such a way that companies will focus highly on the price and total cost of ownership when choosing to buy new vehicles. This is supported by the study from Sweden presented earlier in this document. If the vehicle can do the task it is supposed to, the company will chose the cheapest option available to them (based on a holistic evaluation).

In 2007 the registration tax for especially smaller vehicles was changed in Denmark causing a significant drop in prices and with the later change of leasing and demo vehicle regulations , this price drop was further enhanced. Today micro and mini cars have a market share of more than 60 % in 2012[41] in Denmark and this decrease in size (and price) has resulted in a loss for the Danish government of more than 7 billion DKK[42] in registration tax. This is an unstable situation for the government as they need to keep income at a foreseeable, non-diminishing rate. The Danish EV alliance has therefore developed a cost neutral model for registration tax.

41 http://bil.di.dk/SiteCollectionDocuments/Foreningssites/BIL/Statistik%20doc/Tema%20i%20Fokus%202,%20Lav%20produktivitet%20i%20bilbranchen.pdf

42 http://www.dst.dk/da/presse/Pressemeddelelser/2010/2010-09-23-Historisk-fald.aspx

The model suggested consists of a tax on the vehicle, a tax discount on the vehicle and a yearly tax to the owner.

Tax type	Based on	Contains
Registration tax	CO2 and value of the vehicle	1.000 kr/g CO2 + 150-180 % value tax above 100.000 kr.
Tax discount	CO2 and safety level of the vehicle (NCAP)	Basic 50.000 discount, 1% discount/ g CO2 below 100 g and 5.000 kr. for 5 star NCAP
Yearly tax	CO2, infrastructure, other pollutants	Calculated for each vehicle based on standard facts with average distance of 15.000 km/year

Table 8 – Taxation model suggested by the Danish EV Alliance

Based on these recommendations the effect will be an increase in price on especially the currently most popular segment, mini and micro cars, of 20-30 %, where larger cars will benefit from the tax discount and thereby be cheaper especially as their engines become more efficient.

The solution provided by the Danish EV Alliance is technological independent and based on standardized figures from the CoC document. As for the price increase on the smallest vehicles, this will not affect the transport logistic industry as their vehicles are primarily of larger size; however since the Danish tax system for logistic vehicles is cheaper than that for private owners, on which the calculations have been made, the effect will not be as effective for companies as private people.

When it comes to logistic vehicles it is a very positive incentive if energy efficient and clean vehicles can be supported economically in such a way that they become just as cheap as current mass produced vehicles. As there are many different technical solutions on the market it should be considered to make a tax system that is independent of technology and based on realistic, comparable measurements.

E-Mobility Road map 2020

Building on the recommendation for a new tax structure, the E-mobility road map further develops the incentives with recommendations for infrastructure investments as this is necessary for future uptake of greener technology. Furthermore it puts pressure on public organizations for them to take an active role in the change of technology. 4 main actions with a positive effect on the uptake and usage of greener technology have been identified with relevance for logistic fleets:

- Public organizations as drivers of greener fleets
- Public organizations as drivers of greener procurement
- Infrastructure investments
- Creation of environmental zones

Public organizations as drivers of greener fleets

Municipalities, regions and the government have large fleets for their own usage and especially municipalities, who are limited geographically, can utilize electric vehicles, but also the investment by the Copenhagen municipality in hydrogen vehicles show that greener vehicles in general have beneficial usage in several levels of these organizations. There is a responsibility for public organizations towards the usage of tax payers' money and the TCO therefore

has to be reasonable and the technology proven for this to happen.

Public organizations as drivers of greener procurement

Public organizations also procure large amounts of transportation for both goods and people – e.g. garbage disposal, transportation of elderly etc. These services could be done with greener vehicles with a minimal extra cost associated, however this would have to be stated in the call for tenders published by these organizations. This would be an important pull factor for the suppliers to invest in greener technology. If a certain amount of transports were to be done with greener solutions, the companies addressing the call for tenders will need to have vehicles to do so in their fleet.

Infrastructure Investments

Electric vehicles in fleets will to a large extent use the infrastructure available at the company but other technologies such as hydrogen, biogas and biofuels will need to have a public infrastructure in order to support a fleet of several companies. Investment in this will not be made by the companies themselves and therefore support from the government or regions is necessary in order to create the framework for these technologies to be bought. The installation of EV infrastructure is also connected with extra costs that could be subsidised.

Creation of environmental zones

Environmental zones have already been realized in several of the larger Nordic cities as described earlier. The restriction of these zones could be forced to a larger amount of cities and made even more restrictive to e.g. allow only zero emission vehicles within the zone (as seen in Vicenza, Italy)[43].

These will motivate private fleet owners to change their vehicles to greener solutions if they want to work inside of the zone, which can have a wider effect than having it as a demand in a call for tenders – e.g. carpenters etc. would also have to change their vehicle to enter the environmental zone.

Choosing the leverage

Incentives are means of moderation by public organizations and the suggestions provided by the Danish EV Alliance list a range of possibilities on how greener vehicles could be supported. Some would be associated with costs for public organizations whereas others would demand investments from the private fleet owners if they want to do business either with the municipality or in a distinct area.

As described in the country evaluations, the transport logistic industry is handling a cost pressure partly created by the opening of the EU to the east which causes the companies to be highly cost oriented. Demands from larger customers for investment in new, greener technology could therefore be hard to their business but as seen from cases around the world, this could also lead to more profitable business[44]. This is therefore a measure that is to be considered to be put into use where applicable. Furthermore the greener technologies could be subsidised to a level where the TCO over a 3-5 year life span would be comparable with the existing solutions.

Infrastructure investments are supported all over the Nordic countries and will have to be done in collaboration with companies who are willing to be the operators of these afterwards. Governmental demands in Sweden have created a large infrastructure

[43] http://hal.archives-ouvertes.fr/docs/00/74/28/57/PDF/wctr_Vicenza.pdf

[44] http://ing.dk/artikel/dyr-og-solid-el-skraldebil-er-en-succes-paa-frederiksberg-161993

for E85 in a short period of time and could be reused for similar fuels such as biofuel and biomethanol. With hydrogen and electric charging the setups are proving to be different and no clear conclusion can be made except that the need for economic support is present.

Very important is it that the public organizations acknowledge that they are frontrunners in making the change, and should therefore invest in their own greener fleet. The municipality of Copenhagen is a good benchmark as they have a public target of changing 85 % of the fleet to zero emission vehicles and already they are very active on this area.

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