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Energy & Transport - the Nordic countries as a test ground for electric transport solutions

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Abstract

The Energy & Transport Programme funds projects that contribute to the vision of the Nordic region as the leading European region for the development, testing and use of electric transport solutions. The paper presents the programme, its main vision and objectives and discusses why Nordic cooperation in this field is of relevance. It looks into the programme's contribution to advancements in the field of electric transportation with respect to technologies, but also with respect to business opportunities and supporting framework conditions and presents the projects currently being funded.

Keywords: energy, demonstration, business models, infrastructure, standardization, fuel

1 Introduction

This paper presents the **Energy & Transport Programme** funded by the Nordic Council of Ministers. This programme runs between 2010 and 2013 and funds cooperation projects in the field of sustainable transportation. One of its core areas is of electric transportation.

The Energy and Transport Programme was created to contribute to the Nordic region[1] becoming a testing ground for sustainable transport solutions. Thereby, the Nordic countries should become the leading European region for development, testing and use of sustainable transport systems, and particularly of electric ones.

The programme is connective and communicative: it brings together ideas and people across borders. Transport and energy associations as well as businesses and research institutions work together to address common challenges. Additional to the focus on electric transportation, the programme also finances projects in the field of sustainable freight transportation. The programme funds the projects with a total of around $3.37 billion, which is matched by external public and private financing.

1.1 Why cooperate at the Nordic level?

The Nordic countries have great experience in cooperation, development of common policies and joint projects to solve common challenges. A good example of effective Nordic cooperation is the development of the Nordic market for electricity. Another is the long-term cooperation to reduce border barriers to trade and commercial activity in the region.

The Nordic Council goes back until 1952 and concentrates on inter-parliamentary cooperation, while the Council of Ministers, established in 1972, is responsible for inter-governmental cooperation. It consists of the ministers of state of the member countries, as well as other ministers with responsibility for different subject areas, including that of energy. The Council of Ministers

[1] Denmark, Norway, Sweden, Finland and Iceland together with the self-governing regions of Greenland, Faroe Islands and Åland Islands

provides funds for a large number of joint Nordic institutions and projects.
To achieve a reduction of 50 % of greenhouse gases by 2050 (one of the goals set by the Intergovernmental Panel on Climate Change - IPCC), a global energy technology revolution is needed [1]. This, however, requires appropriate funding and cooperation in energy research, development and demonstration activities. Cooperation between countries can unlock added value and avoid overlaps, enabling far greater progress than is possible as individual nations.
Refocusing the transport sector on a more sustainable path is an area where Nordic cooperation is self-evident, necessary and feasible. Knowledge, networks, communication channels and routines already exist; they reduce time efforts and increase quality, a major comparative advantage.
Here, the Nordic region offers a prime example. It has the potential to become a test bed for sustainable transport solutions based on the already existing regional competencies on sustainable transport and a strong renewable energy sector. The well-functioning Nordic electricity market and the relatively low carbon footprint of the Nordic energy mix means that electric transportation in the Nordic region has a very low greenhouse gas intensity and a great potential for further development.

1.2 Why do we focus on sustainable transport?

Transport accounts for 25 % of global energy-related emissions of greenhouse gases and over half of the world's oil consumption [2] and demand for transportation is projected to grow. Transport is therefore a very important component in solving the climate crisis and is of high importance to reach the EU's climate commitments of 10 % sustainable energy in the transport sector, 20 % renewable energy in the energy sector and a 20 % reduction of emissions [3]. A sustainable transport sector is therefore a vital stepping stone for reaching the EU's climate commitments.
Reducing greenhouse gas emissions and energy dependency and creating new competitive markets is at the very top of the Nordic political agenda. Making transportation more sustainable is an important step towards solving all three of these crucial issues. Sustainable transportation is also a pressing concern from the perspective of energy security, considering the large share of global oil consumption that transport represents. The Nordic Prime Ministers have agreed that the region should strive to become a world leader when it comes to development of energy efficient and sustainable transport solutions.
The transport system of the future is unlikely to be based on one single energy source, but will most likely be connected to a whole portfolio of different energy sources adapted to the relevant transportation requirement. The development and implementation of diverse transport solutions will also create new opportunities for the Nordic economy. In this respect, it is of vital importance that governments support investments in innovative and sustainable transport solutions.
The overriding challenge is to find the right modes of transport and to make renewable fuels more attractive to consumers. To achieve this, the traditional division between the energy sector and the transport sector must be replaced by a more cooperative governance mode and this was the starting point for the Energy & Transport programme.

2 Electric transportation

From the beginning on, key Nordic actors both from the energy and transport sector have shown great interest in the programme. Before the calls for project proposals, workshops in all the five Nordic countries gathered representatives from energy and transport companies, governmental and non-governmental organisations, car importers and scientists. They discussed what developments in the field of sustainable transport were of highest relevance and where the greatest added value of Nordic cooperation could be unlocked. This was followed up by a thorough mapping of sustainable transport initiatives in the Nordic region. One of the main findings from both exercises was that there is no doubt that electric transportation should be on top of the funding priorities.
As the Nordic countries have high shares of renewable electricity production and electrification offers an energy efficient and realistic path to renewable transport solutions. Electric vehicles are more energy efficient as traditional gasoline and diesel vehicles [4] and offer an opportunity to significantly reduce the energy consumption for land transport. Electric vehicles sourcing their energy from hydro-power, which is the main electricity supply in Norway, only have a quarter of the 'foot print' over their lifetime than those using electricity from mineral coal (calculated in tons of CO_2) [5]. Staying with the Norwegian example, only 5% of the nation's hydropower supply would be sufficient to power the nation's

vehicle fleet if this would be entirely electrified [6]. Thus, using electricity as an energy carrier improves energy efficiency and enables the transport sector to utilise renewable energy.
In the coming decade, the rise of new power grid technologies, energy storage technologies and electric vehicles may make renewable energy more competitive and practical at a large scale, benefitting both the energy and transport sectors.

2.1 The Energy & Transport Programme's focus on electric transportation

The Energy & Transport programme covers a broad array of technology areas and solutions, but its first call for proposals was concentrated on electric transportation. This followed the over-riding objective to turn the Nordic countries into the leading European region for developing, testing and using electric transportation.
To reach this goal, both passenger transportation (private and public) and freight transportation are relevant. Funding is available under a number of support schemes including: analysis projects, testing and implementation of Nordic transport and energy solutions and Nordic networks. Projects can thereby focus on technical aspects, but also on business development and framework conditions.
For the Nordic region to truly become leading in electric transportation, a considerable share of work still needs to be invested into new technical solutions, both with respect to an appropriate infrastructure and the actual vehicle. Technology related to charging is a prior focus. The building up of a network of charging stations and other services require a holistic approach and the active cooperation of public institutions, local municipalities and companies. Due to the many interrelationships and the often small distances between Nordic countries, this is particularly also relevant to happen over national borders.
In the same time, the conversion of the Nordic transport sector towards a more sustainable direction does require authorities to provide effective framework conditions, including regulations, incentives, laws and rules for both consumers and industry. As harmonisation and standardisation between the Nordic countries offer a great added value, cooperation in this field is also highly relevant.
Finally, the transformation towards electric transportation will also create many new business opportunities for Nordic companies, which need to think in new ways about the interaction of demand, technology, infrastructure and services. The programme's projects are supposed to contribute to Nordic economic development in the field of energy and transport. To achieve this, the Energy & Transport Programme aims at creating multilateral business platforms. These can help to create economic and/or social benefits by bringing together two or more individual but related user groups.
The programme aims at supporting the Nordic region to develop its own production of electric transportation solutions – and this accounts both for the development and production of vehicles as well as of other solutions linked to the sector. Furthermore, it is also important for the Nordic region to become an attractive market for foreign investments in the field.

3 The projects

The Energy & Transport Programme funds 6 innovative projects in the field of electric transportation. These are presented in the following.

3.1 Electrifying the seaways

Ship traffic is a basis for 90 % of global trade, which makes it by far the biggest freight transport segment [7]. The contribution of marine traffic on greenhouse gas emission is considerable [8]; still, there are only few efficient global sustainability initiatives targeting this sector. One promising trend is the increased usage of electric ship motors and the "all electric ship" concept is more and more visible on the market. This enables advanced and multiple choices for energy carriers, energy supply chains and energy sources. These new possibilities need to be explored further in order to minimise the emissions from ship traffic globally.
The 'Electric Ship Traffic' project responds to this challenge by analysing the possibilities for electric ships and identifying options for emission free ship traffic. Energy behaviour functions of different ship traffic segments - from small ferry to merchant ship - are modelled. The project identifies, specifies and simulates the most promising energy carrier, conversion and supply chain options for ship traffic. It is based on criteria such as emissions, initial financials, development possibilities, sustainability and lifecycle emission targets.
The information established in this project can assist the design of more emission free ship traffic

systems. In addition, the results will be available for decision-makers when developing new regulations to make the ship transportation sector more environmentally friendly.

3.2 Nordic incentives for electric cars (INTELECT)

The relevance of increasing the use of environmentally friendly vehicles has been strongly emphasised over the last few decades in all Nordic countries. However, as the market price for electric vehicles is still very high, the Nordic countries have consumer incentives in place to stimulate higher sales and the growth of the electric car park. What have been missing until the present day were an overview and a comparison of the incentives in all Nordic countries. The INTELECT project is working on filling exactly this gap.

The objective of the project is twofold. The first step is to map available incentives in all of the Nordic countries, including Greenland and the Faroe Islands. An important goal is to compare existing incentives in order to identify the most effective ones. Thereby, both financial and non-financial incentives are mapped. In addition to incentives at the national level, the project maps incentives at the level of the three biggest cities of each country. Especially non-financial incentives vary not only across, but also within, different countries. The mapping of incentives will serve as a basis for relevant policy advice.

The second step is to use the information that is gathered to produce a calculator. This will first and foremost be beneficial for potential buyers, who can use the calculators to make comparisons on the actual costs and benefits of traditional cars and electric vehicles, based on the incentives. Such calculators already exist in Norway and Iceland, and INTELECT will build on these to produce a single Nordic calculator. An overall goal is to create market acceptance for electric vehicles. A common test protocol for electric vehicles will strengthen the Nordic position as a prime market for the introduction of new models.

3.3 Nordic Electric Avenue

Due to many still existing barriers, electric transportation has not yet been fully utilised. This is why the 'Nordic Electric Avenue' wants to facilitate a change in mobilisation behaviour and to work towards a society where electric transportation is not limited to those who can or want to afford their own electric car. Thus, owning an electric vehicle can be replaced by renting.

Building on existing models, the project sets up and expands electric car pool fleets in Denmark (Copenhagen), Sweden (Helsingborg, Gothenburg) and Norway (Oslo). The project also develops solutions to make renting an electric car more attractive, such as easy booking options from a carpool in whichever Nordic country a costumer may be located. Secondly, the project aims at enabling seamless electric travel throughout the Nordic region by creating a 'Nordic Electric Avenue' along the existing railway infrastructure from Denmark via Sweden to Norway. This entails setting up car pool stations where cars can be charged and/or switched.

3.4 Testing driving range (REKKEVIDDE)

Compared to the traditional internal combustion engines driven cars, electric vehicles are still immature regarding their range. This implies that a car has to be charged more often than traditional cars, which can be up to every hour depending on the distance. So far, the most common range figures are between 100 and 160 km and even the best batteries offer only 300 km driving with one charge. Adding to this shortcoming is the battery's sensitivity to external factors such as weather conditions and traffic. This unpredictability contributes to the "range anxiety" that is strongly associated with electric vehicles.

Realistic range estimates are pivotal to establish a sufficient level of security and comfort for normal users. Since there is no reserve battery or possibility to lend "fuel" from a by-passer, an electric vehicle user needs to know for sure how far the vehicle will go, also in the worst possible conditions. The 'testing driving range' project is working on producing a complete picture of the energy use of an electric vehicle, including not only the driving aspect but also the variables of preheating, heating while driving, as well as battery management and control during parking. The project is also looking into finding out what kind of testing is necessary to establish higher levels of security with respect to the driving range.

3.5 Cleaner City Freight Transport

The growing significance of city freight transport and logistics is related to increased population and the global emergence of megacities. As the majority of the population in Europe lives in urban areas the bulk of industrial production is

dispatched to these areas. The result is an increased demand for freight transport. Already now, goods transport in cities represents from up to approx. 20% of road traffic. The importance of city freight transport and logistics systems is therefore growing at the pace of the world's population. Current distribution systems are straining city logistics and - on top of that - the pollution in some larger cities is alarming. Furthermore, as urban freight transport primarily deals with the distribution of goods at the user end of the supply chain, many deliveries tend to be made in small loads and frequent trips, resulting in many vehicle kilometers.
The SAFE Urban Logistics project addresses a number of the above issues by establishing a best practice overview of the potential use of electric vehicles for inner city logistics and works on matching business models including proposals for sustainable suitable technical solutions. It also works with convincing both urban planners and industry stakeholders to consider their potential.
By analysing if and how electric vehicles can be of benefit to this, the SAFE project helps to lay the ground for developing cleaner cities for the future. The two key advantages of electric cars (they do not pollute and do not make noise) make them appealing for solving some of the transport challenges of megacities. Furthermore, the distributors of goods and thus also the owners of the fleets require economic incentives in order to change their fleets to electric vehicles. The project therefore also looks into economic incentive schemes.
The analytical insights gained from the SAFE Urban Logistics project will be the preparatory ground for a subsequent demonstration project that will test the project findings in real life. For this purpose, the project is looking for additional partners to join in.

3.6 Mapping electric fuel stations

With the number of electric vehicles likely to increase over the coming years, it becomes highly important to solve the remaining challenges for drivers and electricity providers. The limited range of electric vehicles combined with the high efficiency of electric engines demands a dense network of charging stations. Drivers of electric vehicles require reliable information on charging stations. The project 'Mapping Electric Fuel Stations' will provide drivers of electric vehicles with information on the location of charging stations as well as information on the optimal route between them to efficiently find their way between places in the Nordic region. The analysis will take the possible influence of topographic and meteorological conditions into account and test if these and other parameters can be included in the model. The result will be an open source prototype service, a common database with information on the charging infrastructure in the Nordic countries.
The project uses the currently available databases and routines developed by the Norwegian association for Electric Vehicles. Data is added for Iceland, Sweden and Denmark.

4 Outlook

The vision of the Energy & Transport Programme is to create a Nordic testing ground for sustainable transport solutions. Thereby, the Nordic region is hoped to become the leading European region for development, testing and use of sustainable transport systems, particularly electric ones. The Energy & Transport Programme is important as the initiator and creator of international networks that can take on this great challenge. This vision clearly demands long term commitment and efforts in order to be achieved.
With all its practical implementation activities, its industry as well as governmental partners, the Energy & Transport Programme is already acting as a virtual Nordic 'test centre'. All projects are currently under way and first results will be available by summer 2012.
Together with its projects, the programme evaluates means and suggests solutions for more energy efficient transport systems. With the projects progressing, it will become more important to assess how they have been able to identify the areas where joint Nordic efforts could unlock the greatest added value. This will be an important finding to build further work onto, to focus future funding activities or rather to broaden them to other aspects than those taken into account so far.
Nordic cooperation is vital when it comes to business development for green growth and for bringing together the best R&D institutions to develop innovative green solutions. Still, the experience of the Energy & Transport Programme has shown that the framework conditions (including political ones) can be very different in the Nordic countries (e.g. with respect to incentives for green transport) and that this area is also highly relevant for the Nordic added value of cooperation.

Along with the creation of tangible results, new knowledge is being created and new insights are opening up new opportunities for cooperation and policies. The programme has been able to take important new steps and by 2013, a considerable amount of results will have paved the way to have come closer to the vision of a testing ground for Nordic sustainable transport solutions.

Programme stakeholders have started a process of joint reflection on the successes and challenges of the current programme and on joint lessons learned both with respect to the cooperation fields as well as to organisational aspects of the programme. Moreover, during 2012 they will jointly discuss how a future Nordic initiative that continues the efforts of Energy & Transport to build a Nordic testing ground could look like.

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