

EVE - Electric Vehicle Systems 2011-2015

Tekes



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EVE
- Electric Vehicle Systems
2011-2015

Tekes

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Foreword

One of the most important drivers to electrify traffic and transportation are the zero emission levels – at least locally – of CO₂, NO_x and particles. Another significant driver is the energy efficiency of electric vehicle which is substantially better than in conventional combustion engine powered vehicles. According to some studies the total efficiency of electric vehicles from well to wheel is three times as good as the total efficiency of petrol driven vehicles.

The European and national emission reduction target levels for traffic have been set for 2020 and beyond. It is quite obvious that the targets cannot be met without reducing remarkably the use of fossil fuels, and shifting to electric power in transportation. Similar mindset was also in the background in 2009-2010 when the studies about the meaning and importance of electric cars and electric mobility for Finnish society in the years to come were carried out. The main result of these studies was the identification of business possibilities for Finnish industry in the fields of mobile machinery electrification, vehicle software, charging technology, automotive industry components and electric mobility infrastructure.

All these significant business potentials gave Tekes a good motivation to launch a specific programme in the field of electric mobility in 2011. The five-year programme called EVE – Electric Vehicle Systems, started in 2011. The total budget of the programme was estimated to be roughly 100 million euros and the Tekes share being about 35 million euros. The main target of the programme was to create an electric mobility ecosystem that could generate new knowledge and competence in EV related technologies and services. From the very beginning all the development was focused on international business opportunities. The programme wanted to establish contacts also to international programmes and important business actors.

The main approach in the EVE programme was to emphasize piloting, testing and demonstration projects. To reach this goal a call of consortia was announced. Tekes was looking for collaboration projects with partners from different kinds of EV business areas. In the beginning five consortia were formed. They focused on electric passenger traffic and services, electric commercial vehicles, testing services for EVs, testing environments for EVs and ecological urban living. Automotive industry was not seen as a special focus since Finland has only one company assembling passenger vehicles. The general understanding was, that big global automotive companies would sooner or later conquer the markets. Now we can see this happen when new EV models have been launched continuously by big players.

A problematic issue has been the slow development of the number of EVs in Finland. In the EVE programme the goal set at the beginning was to create a fleet of hundreds of EVs that could be used to collect information for R&D purposes. This was seen essential in developing new services for EV users. To promote this idea the Ministry of Employment and the Economy granted an additional support for purchasing electric vehicles and for building the necessary charging infrastructure. This support scheme was not successful in the beginning, but has newly had better impact and the number of EVs has been increasing rapidly. During the programme a low number of EVs has naturally delayed the development of certain service businesses. The domestic market has an important role in creating references, and must not be underestimated.

This five-year period of the EVE programme has had exceptionally good impact from the business point of view. Roughly ten new start-ups have been founded and existing companies have increased remarkably their business volume

in international markets. Two good examples of the start-ups are Liikennevirta or Virta and Linkker. Both companies were founded during the programme and have already created business outside Finland. It can be regarded as an honourable achievement. In this report you will find several, more detailed portraits of companies and businesses in the Finnish electric mobility ecosystem.

Now at the end of the programme, I have a confident feeling that the investment on the EVE programme has had an exceptionally good impact on Finnish society. This is exactly what Tekes wants to see. I also believe that the business volume target of two billion euros in 2020, set at the beginning of the EVE programme, is still realistic. The volume would

thus be tenfold compared to the situation at the beginning of the EVE programme in 2011.

With the contribution of the EVE programme a good basis for business development for the coming years has been created. Tekes will naturally have a role also in the future to ensure that the competitiveness reached will be maintained and strengthened.

January 15, 2016

Martti Korhikoski
EVE programme manager
Tekes



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Background – The growth continues

Normally when we talk about electric mobility, we refer to passenger cars and their infrastructure. However, the Finnish vehicle industry has strongly focused on heavy duty machinery, vehicles, and buses. Some of the companies have already been able to launch products utilizing electricity as the only or parallel source of energy. Also, some component manufacturers are active in the electric mobility industry. The only significant Finnish passenger car manufacturer has been Valmet Automotive. For Finnish IT experts the services in electric mobility are a potential business area, but the success is highly dependent on the growth of the volume in the other fields.

According to Global EV Outlook (GEO) of OECD and IEA the estimated number of electric passenger vehicles reached 665,000 at the end of 2014. The market has been growing rapidly and the limit of million vehicles was exceeded in September 2015. When the Tekes EVE – Electric Vehicle Systems programme was launched in 2011, the number was a little over 20,000. The leading market has continuously been the USA, but China is estimated to have reached the number one position at the end of 2015. When compared with per capita figures, however, Norway has had the leading position with a market share of around 15 per cent of sold new vehicles. The number of charging points has increased eightfold in two years since 2012.



The electric mobility market growth of passenger cars and their infrastructure has been very much supported – financially and with different incentives – by public authorities, the motivation being climate change mitigation and the development of domestic industry in the area. Between 2008 and 2014 the public spending for electric mobility is evaluated to have been some 15 billion dollars (GEO). Over 2.5 billion dollars of the amount was spent in infrastructure, 7 billion dollars in R&D, and 5 billion dollars in financial support and other incentives. Climate change is the clearest motivation in the countries that have no automotive industry, such as Norway and Holland. Although in Norway the support was originally initiated also to support the domestic EV production.

It seems that the growth of the EV market correlates significantly to the amount of incentives in each country. In Europe, especially France and Holland have been the fastest growing markets after Norway. For instance in Holland the lucrative taxation has made company PHEVs most popular in Europe. In Norway the support is very generous in comparison with other European countries. Among the big automotive industry countries, Germany has been the last one to apply instruments for boosting the sales. Only recently, the German manufacturers have been launching their BEV and PHEV models in the markets.

The development of public charging network is essential for the mass deployment of EVs. Utilities, traffic stations, and automotive companies have been investing in charging network but it is evident that public spending is continuously the significant factor to secure the charging services for EV drivers. For instance, in Norway the temporary pause in 2015 in the public charging station investments increased anxiety amongst the Norwegian over 70,000 EV drivers (September 2015). RWE, a German energy giant, has joined forces with some 100 local utilities to enable country-wide charging network. Utility independent technical platforms with tools to find and reserve a charging point, and pay for the service are available for charging service providers and customers. The idea of an EV driver being able to drive through Europe and be invoiced for the energy in his electricity bill has become reality.

Though the electric passenger car market continues to grow the earnings in the industry seem still to be very much dependent on public support. In heavy duty machinery the business success is nearer, in some cases at hand. Mining equipment and forklift manufacturers have long had electricity as power source, and in the fields, such as forestry, construction, harbours, marine vessels, and buses the electrification of the vehicles has gained speed. Solutions enabling fuel savings and productivity improvement in harvesters, stone crushers and mining machinery have been developed. There are investments in electric ferries. Numerous European cities – including the Nordic



capitals – have announced that in public traffic they plan to replace diesel to electricity, and to other environmentally acceptable solutions. In China a normal order for electric buses is said to be 600 buses.

The Nordic countries have taken different approaches to electric mobility. Norway has had tax reductions and incentives since the 90's, Denmark and Sweden have also financial supports for EV buyers whereas Finland has been a little bit more conservative with a limited support from the Ministry of Employment and the Economy. Moreover, the support has been linked to the participation in the EVE programme. Denmark has focused on the building of charging network, in Sweden its automotive and machine industry is an important driver, and Finland with the Tekes EVE programme has had perhaps the most comprehensive innovation incentives.

All the Nordic countries have small populations, and that is why they cannot necessarily gain a significant role in the global electric mobility market although they have high competence on several fields of energy, IT and clean technology. The rehearsals of joining forces have already been started with the help of Nordic Energy Research (NER), a platform under Nordic Council of Ministers. The first initiatives have been focusing on electric buses. Also the Nordic delegation of 14 enterprises at the Korea Electric Vehicle Symposium 28 in May 2015 was supported by NER.

In 2010, the electric mobility turnover of the Finnish companies was 200 million euros, practically all euros coming from heavy duty machinery. When the Tekes EVE programme started the target was set to two billion euros for 2020. We have still five years to go, and the target seems plausible. The mobile machine producers, such as Kalmar, Sandvik and Rocla, are developing new electric solutions. On the other hand, the component manufacturers, such as ABB and Visedo are getting their technology applied internationally, and electric bus system start-up Linkker has begun its operations successfully. Heavy duty vehicles have the potential to cover a major share of the two billion euro target.

Biofuels have had an important role in passenger transportation in Finland – it can be seen in the energy policy of the Finnish government. Aside of the CO₂ emission dependent taxation there have been no special incentives for EVs. At least partly due to this, the number of electric vehicles has grown slower than e.g. in other Nordic countries. However, in spite of the minuscule Finnish fleet of about 1,500 EVs in 2015– the growth during the Tekes EVE programme has been notable: in 2011 there were about 40 EVs in the country. At the same time also the IT based service providers have been successful internationally, Virta Ltd being the best example. When the market starts really to boost in Europe the Finnish companies are in good position in the markets.

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EVE Consortia were significant enablers

In the first two years after the start, the Tekes EVE – Electric Vehicle Systems programme consisted of five consortia, three of which – Eco Urban Living, EVELINA and Electric Traffic – focused mainly on passenger cars and services, whereas WintEVE was active in testing services for automotive industry and Electric Commercial Vehicles in the electrification of public transportation and heavy duty vehicles. During the years 2014 and 2015 three of the consortia continued as a part of the EVE programme whereas the activities of Eco Urban Living and EVELINA were directed elsewhere.

The consortia had a networked way of operation, and it enabled the utilization of domestic and international business opportunities as well as research collaboration in Finland and abroad. Thanks to the above mentioned factors the generation of business for established operators as well as for start-ups in all the areas of electric mobility was viable.

Eco Urban Living (EUL)

Eco Urban Living (<http://www.eco-urbanliving.com/>), coordinated by Synocus Oy, was the first city level pilot in Finland. The City of Espoo that targets to be an electric mobility forerunner also in the future, launched the pilot in 2011 with the mayor in lead. Electric buses were added into the pilot in 2012, but later transferred to another EVE project, Electric Commercial Vehicles (ECV) coordinated by VTT Technical Research Centre of Finland.

World Alliance for Low Carbon Cities (WALCC, <http://walcc.org/>) was founded as a work package of EUL. WALCC is a non-profit, independent alliance seeking research and demo possibilities between cities, academia and corporates, in the fields of urban planning, urban transportation, green

building, and renewable resources. WALCC has also been an important platform in the development of collaboration between cities such as Malmö in Sweden and Tampere in Finland.

After EUL, Synocus is participating in a new project called Systemic Architectures for Sustainable Urban Innovation (SASUI) focusing on social innovations that promote important objectives such as low carbon transportation – in the development of cities.

Electric Commercial Vehicles (ECV)

Electric Commercial Vehicles (<http://www.ecv.fi/in-english/>) is a project entity that has focused on the electrification and development of business in the field of commercial vehicles including buses and trucks, utility vehicles, cargo transport and work machines. The ECV consortium has created extensive testing and development environments for heavy duty electric vehicles and their components. The core themes have been testing and research as well as modelling and simulation. The consortium has gathered together a large number of companies in the industry, research institutes and universities, and public stakeholders. The entity has been coordinated by VTT Technical Research Centre of Finland.

The ECV consortium has been active in research projects concentrating in electrochemical energy storages, electric bus technology, hybrid-electric working machine, and system engineering, power grid and charging. Also, international projects, such as ZeEUS (Zero Emission Urban Bus System) and EBSF_2 (European Bus System of the Future 2) have been tightly linked to the context of ECV.

The ECV participants have been able to benefit from the support of the ECV environment, they could even partici-



pate in the construction of the environment. They have also gained added value from networking and sharing testing expertise, and from competent purchasing of required components. With the help of the consortium the participants have been able to expand their competence base with training and recruitment.

Electric Traffic

The first wave of electric vehicles consisting of more than 1500 cars has entered the streets on Finland. The number of electric vehicles has doubled every year since 2011, and more than 400 charging points have been installed several new stations being under construction. To make things easy for EV drivers, a free application and a website for locating the chargers have been created to guide the pioneers of EV driving. New commercial solutions are on their way. It can be said that Electric Traffic consortium, together with its partners, brought EVs on the streets in Finland.

To enable the future commercial activities, new charging business models have been created within Electric Traffic consortium. Consecutively, Finnish charging systems and related infrastructure have been introduced to key international EV markets by companies like Virta Ltd and Fortum. Virta Ltd, innovation leader in consumer driven smart energy services, was a spin-off from the Electric traffic consortium.

New technologies are still to be introduced within Electric Traffic. A commercially scalable solution for EV charging network participation in frequency controlled demand response market is being developed along with price demand solution services allowing private charging point owners to minimize their electricity bill and reduce their CO₂ emissions. These new services developed within the consortium will cut CO₂ emissions of charging, make the energy system smarter and more flexible and enable new export possibilities for Finnish companies.

Electric Traffic consortium has taken the position of flag bearer in the field of electric transportation in Finland and is now the leading expert organization that offers independent and unbiased info about electric transportation and acts as the contributor and guardian of the new born industry.

The Electric Traffic consortium has consisted of the following organizations: Aidon, Ensto, Finavia, Fortum, Eltel, Helen, HOK-Elanto, Lemminkäinen, Siemens, Secto Leasing, SE Makinen, Sixt, SLO, Vantaan Energia, Veho, Elenia, Fingrid, Jyväskylä Energy Group, Turku Energia, Oulun Energia, Vantaan Energia, Virta and Reaktor, cities of Turku, Helsinki, Vantaa, Espoo, Kauniainen and Lahti, Aalto University, Metropolia University of Applied Sciences, Consumer Society Research Centre and governmental bodies, such as Finnish transportation agency LiVi, Finnish transportation safety agency Trafi. The consortium is coordinated by Eera Oy.

EVELINA – National test environment for electric vehicles

The EVELINA consortium was set up to demonstrate the viability of electric vehicles and to develop new services for electric vehicles. The main objective of the EVELINA consortium was to establish a national test environment for electric vehicles. The consortium targeted in supporting the development of electric vehicle industry in Finland. The EVELINA project covered the following themes: information management, vehicles, traffic, energy systems and test environment.

The information management theme focused on collecting data from electric vehicle driving. Ten of the 13 vehicles consortium owned were equipped with versatile measuring equipment. The collected data was stored in a database with application programming interface. Based on the data the impact of driver, route and vehicle on the energy consumption was analysed. Also methods to analyse batteries were created. Other developed solutions included components, drivers, a charging point map application, information management and traffic system. A service for coach drivers (Driveco) to improve their driving behaviour with hybrid cars was developed.

The grid impact on charging and the grid malfunction impact on charging were tested with a unique electric grid test, and with a learning environment developed in cooperation with research and enterprise partners and Tampere Adult Education Centre. The consortium also researched energy distribution systems. As a result new information on smart charging, the charging business models and smart grid concepts were generated.

WintEVE – Winter operability for electric vehicles and electric vehicles go arctic (EVGA)

The WintEVE (<http://winteve.fi/>) consortium and its successor the EVGA (<http://evga.winteve.fi/>) project coordinated by Centria University of Applied Sciences had the participants from the northernmost parts of Finland. That is why they have had a strong emphasis on the development of vehicle testing in arctic conditions.

The Centria projects have focused on the development of a metering and safety system for testing of EVs. The system has been commercialized by Northern Engineering that is the owner of Lapland Proving Ground (<http://laplandpg.fi/>), one of the biggest testing facilities in Scandinavia. Within the WintEVE consortium University of Oulu has been developing information safety of the vehicles, and a modular battery solution. Other significant WintEVE enterprise projects have been run by Kemppi and Satavision. Kemppi was developing quick charging stations and Satavision a 3D presentation solution for vehicle retailers.

The development achievements within the WintEVE and EVGA entities have had a decisive role in launching of electrification in Northern Finland. New charging stations have been installed in Oulu region as well as in several positions above the arctic circle. Participating the EVE programme has helped the operator network coordinated by Centria to open also the doors for collaboration with European research institutes and enterprises.

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Timeline of EVE 2011-2015

Dec 2011 - Jun 2012

The launching of the EVE – Electric Vehicle Systems programme aroused huge interest

The kick-off of the Tekes EVE – Electric Vehicle Systems programme reached its peak in Helsinki in December 2011 when the Minister of Employment and the Economy, Jyri Häkämies arrived to the event with a Fisker Karma plug-in hybrid EV manufactured by Valmet Automotive in Finland. The event that was well observed in media introduced about 40 electric mobility enterprises and products to an interested audience. In February 2012 when the temperature was well below -20 degrees Celsius, a dozen of bold EV drivers drove a route around Helsinki and proved that the vehicles run also in the conditions not found everywhere.

The EVE programme started properly in January 2012 when Tekes made the decision of the funding of 51 enterprise and research projects coordinated by the five active consortia of the EVE programme. The total budget of the funded projects was 27 million euros, the Tekes funding share being 12 million euros. Simultaneously, the Ministry of Employment and the Economy launched its 10-million-euro investment to support purchasing of electric vehicles and building up the charging infrastructure.

In addition to the effort of the participants of the EVE programme, the Federation of Finnish Technology Industries launched its Electric Traffic Branch Group with 56 member organisations. The target of the group is to enhance the cooperation and business of the electric mobility enterprises and communities.



The EVE consortia kick-off

The five consortia of the Tekes EVE – Electric Vehicle Systems programme were kicked-off during the spring of 2012. The consortia organised several events and their development projects were launched. The participating cities initiated the planning of public charging network and began preparations for the charging point premises reservations.

The events organised by the consortia were attended by interested audiences. In the Electric City Transport of the Future event organized by the Electric Traffic consortium in February, the focus was on the impact of electrification of traffic on the planning of cities. The participants represented research, public authorities, transportation and energy sectors. The WinTEVE consortium presented in its event in March an electric snow mobile and several EVs with a possibility to test driving. Similar events were organised by the EVELINA and the Eco Urban Living consortia in April 2012.

Electric buses test-driven in Nordic conditions in Espoo

The city of Espoo and Veolia Transport started an electric bus test project as a part of the EVE programme in March 2012. The target of the project was to drive the buses in normal traffic and study their performance in Nordic conditions. The project and its participants were also presented in international media emphasizing the fact that the buses will be test-driven in temperatures between +30 and -30 degrees Celsius.

The EVE event looked for Finnish strengths in electric mobility

In April 2012 the participants in the workshops of the Concreteness in Internationalisation event were looking for ideas for the Finnish industrial potential in electric mobility. The event was facilitated by experts from Frost & Sullivan from the

United Kingdom and the Finnish company Eera Oy. Before the workshops the representatives of three benchmarking companies, Aidon, Greenstream, and Planmeca clarified the backgrounds of their international success.

In the workshops it was shown that there are great opportunities for Finnish enterprises in the following fields: electric and hybrid machinery (e.g. for mining, warehouses and harbours), electrical drives and power electronics (small and medium/heavy) for hybrids and EVs, electric mobility service integration, and an electric mobility operator with regional utilities including platform for service developers and piloting. Scandinavian collaboration was underlined as very important. Open platform for software business with links to consumers and manufacturers, providing EV specific testing facilities and services in harsh conditions in Lapland, alliance of Finnish EV know how, and demos globally were seen as potential for the Finnish electric mobility network.



Valmet Automotive

Valmet Automotive (VA) is a leading service provider for the global automotive industry. Today, the VA service range covers engineering, manufacturing, roof systems and consulting. The company has locations in Finland, Germany and Poland, employing over 2,000 automotive professionals.

Since 1969, VA has manufactured over 1.2 million cars at the Uusikaupunki plant for premium brands such as Saab, Opel, Porsche, Fisker and Mercedes-Benz. Just recently, VA and Daimler announced another manufacturing contract for the Mercedes-Benz GLC SUV, starting in 2017.

In engineering services, VA caters for product development, manufacturing and process engineering. In R&D, VA focuses on EV solutions and car engineering from components to complete vehicles. In cooperation with the international RLE engineering, VA can rely on resources of around 1,500 engineers worldwide.

VA is the third largest convertible roof system provider in the world. The locations in Germany and Poland design, test and manufacture a wide variety of different roof systems for brands like BMW, Mercedes-Benz, Porsche and Bentley.

During the past five decades VA has consolidated its position as a leading automotive service provider with world-class knowhow and experience, flexibility, short lead times and high quality.

www.valmet-automotive.com
www.facebook.com/ValmetAutomotive

Milestones Dec 2011 – Jun 2012

Launching of EVE in Helsinki

LinkedIn Group started

The Electric Traffic Branch Group started

EVs driven under -20 degrees Celcius!

The Electric City Transport Event of HSL

WintEVE kick-off in Oulu

Concreteness in Internationalization Event by EVE

Eco Urban Living Event for EV Experts

EVELINA kick-off in Tampere

Electric City Traffic event in Helsinki

Electric Vehicle Symposium 26 in Los Angeles

Low Carbon City World Forum in Beijing

Jul 2012 - Dec 2012

Charging network growing fast

Several operators published their plans to invest in public charging network during 2012 and 2013. The city of Helsinki announced its plan of 33 charging points (later 100 more), as well as the Pori region utilities the installation of 17 new charging points. New charging stations were opened in Oulu region, Espoo and Tampere. In December 2012 Vantaa, the neighbouring city of Helsinki, came out with its plan of the installation of 100 charging points. The companies Fortum and Nissan published the investment of the first 20 quick charging points alongside the main roads. Also, a project to collect the information of all the public charging points in Finland into a single data base was initiated by the Electric Traffic consortium.

Framecar speeded up product development of Valmet Automotive

Valmet Automotive, the leading Finnish service provider in automotive industry, implemented a Framecar test platform project as a part of the Eco Urban Living consortium of the EVE programme. The test platform was designed to support laboratory tests and offer practical experience of the functions of systems. The platform was also designed to speed up the product development projects. Electric mobility has been selected as one of the focus areas of the company.

The Framecar platform has served as a tool for the component development in Valmet Automotive. The platform has been used for battery system development, integration of control systems, and mechanical solutions. The testing of the integration verifies the compatibility of the components at an early stage, hence ensuring the safety and functioning of

the entity. As a result Valmet Automotive has applied for several technology patents concerning e.g. electric drive train and batteries. The platform can be easily modified to fulfil the special needs of different customers.

The Framecar platform has been part of the customer service that Valmet Automotive offers its customers. The tool has enabled the testing of components and systems at a very early stage of the development process and helped to speed up the process.

eSLED snow mobile tested in Lapland

The eSled project studied the challenges of the electric conversion of snow mobiles, the focus was primarily on an electric snow mobile concept for tourists. In the first phase of the project, the studies concentrated on converting snow mobiles to electric. The suitability of battery and fuel cell hybrid technologies for snow mobiles was tested in the second phase.

The four-year project was launched in 2010. Arctic Power that is part of Lapland University of Applied Sciences, was the coordinator of the project and its partners included battery



manufacturers, utilities, a vehicle manufacturer, a tourism company and public authorities. The project was funded by the business partners and Tekes.

In the tests the electric powertrain of eSled snow mobile proved to be silent and exhaust free offering an excellent way to experience nature. Later, in 2014, the project manufactured an entire fleet of electric snow mobiles, and they have been tested by tourists in arctic conditions in Lapland.

179 EVs registered during 2012

The number of EVs increased in Finland in 2012. The size of the fleet grew from 42 in January to 221 at the end of December, the growth rate being about 400 per cent. However, internationally, Finland was a minor player when compared with the numbers of the EVs. The leading models were Toyota Prius Plug-In Hybrid, Nissan Leaf and Opel Ampera.

Although the majority of the EVs were purchased with the investment support of the Ministry of Employment and the Economy, the support was not known wide enough in the potential market. Also, the prerequisite of the support which required the installation instruments for the collection of information into the EVE programme data base confused the customers.

Hybria

Hybria offers complete electric drivetrains and system components for off-road mobile machinery and special vehicles. The company has a goal to maximize the productivity and efficiency of heavy off- and on-road vehicles.

Hybria has a product range that includes control software for hybrid-electric drivetrains, compact power distribution unit, Li-Ion batteries optimized for mobile machinery, and electric power packs (battery + electric drive). Complete drivetrains contain the Hybria design and proprietary control software. The components that are utilised in the products are chosen from the selection of their own drivetrain components and the third party motors and inverters.

Additionally Hybria offers engineering services and battery characterizing/modelling.

Hybria was founded in 2008. Since then the company has supplied several electric drivetrains with a power range from 2 kw to 1,000 kW. The customers are mobile machine and special vehicle manufacturers.

www.hybria.fi

Milestones Jul 2012 – Dec 2012

Tampere Adult Education Centre opened new learning environment

New charging points in Oulu

Electric bus tests launched

ECV kick-off in Espoo

EVELINA workshop for electric mobility ideas

Nordic Energy & Transport workshop in Sweden

eCarTec 2012 in Munich

New charging points in Espoo and Tampere

EVE annual seminar for research and business

12 Mercedes-Benz Vito E-CELL eVans handed over to customers

Visedo agreement of collaboration with WIMA

EVELINA and WintEVE consortia visited Norway

Jul 2012 - Dec 2012

EU sets targets for charging infrastructure

In January 2013 the European Union published its proposal for a directive on the deployment of alternative fuels infrastructure. Among other things the proposal suggested the obligations for the building of charging network in the European countries. Originally the number of charging points was planned to be 8 million in Europe, out of which 10 per cent i.e. 800,000 public. In Finland the figures were 17,000 and 7,000 respectively.

In April 2014 the European Parliament finally approved new rules for alternative refuelling points, including electric vehicle charging infrastructure. For the EU member states the directive sets requirements for providing a minimum infrastructure for alternative fuels such as electricity, hydrogen and natural gas. Also, common standards for equipment and user information were defined.

The 2014 directive recommends that there should be at least one public charging point per ten electric vehicles in 2020. In Finland this would – according to current estimations – call for installation of 2,000 to 4,000 public charging points in five years. For private charging there are no targets. National plans for charging networks should be ready in 2016.

Electric Traffic develops cooperation and services, and receives recognition

The Electric Traffic consortium of the EVE programme and a German company Hubject GmbH, owned by Central European automotive and energy companies, have started cooperation with the target to create a comprehensive and compatible charging network in Europe. Based on the successful cooperation they were able to inform already in September 2013 that 2,000 European charging points can be utilized also by Finnish EV drivers from the beginning of 2014.

An mobile application that is able to find all public charging points in Finland was launched for iPhone and Android phones. The free app shows the directions and distances to



the charging points close by and guides to the selected one.

The consortium was nominated in the Finals of the Climate Achievement of the Year in Finland and was granted an honorary award.

VTT bus mule ready for tests in Espoo

VTT Technical Research Centre of Finland, the coordinator of the ECV consortium of the EVE programme, started testing with its electric bus mule in Espoo in March. They were testing the functionality and properties of the components of Finnish manufacturers in city traffic. The route of the bus mule that had been constructed by the VTT coordinated group was the ordinary Espoo city line 11. Earlier, a Caetano electric bus had been tested in the same route. However, the bus mule did not carry passengers.

Later during the years 2013 to 2015 the line 11 was a reference line for several electric bus brands operated by Veolia Transport Finland (now Transdev Finland). Thus the buses of different manufacturers could be tested in the identical driving and weather conditions.



Generally, during its two first years of operation the ECV consortium could build research platforms for electric commercial vehicles and mobile machines. The target was to create an industrial development platform for technology companies.

From Helsinki to Paris with a PHEV

The taxi entrepreneur Seppo Rosvall had driven a Nissan Leaf from Helsinki to Munich in October 2012, and he was a real star at the Nissan stand in the eCarTec Munich. He took a similar task again in April 2013 by driving a Volvo V60 PHEV to the eCarTec Paris through Sweden, Denmark, Germany, Holland, and Belgium.

When driving the Leaf the charging had to be planned carefully, because in 2012 there was lack of public charging points along the international route. With the PHEV the trip was easier since the diesel engine enabled driving also when the batteries were empty. Charging was utilized only during the stopovers. In the spring 2013 things were better, the only problem being that the charging points required different membership cards. The ICE brought reliability for driving in the motorways.

According to Seppo Rosvall the best solution for driving long distances is the ICE vehicle, whereas in congested cities electricity is a very economical power source when the speed is between 30 and 40 km/h. He was also keen to see the results from the tests drives of electric taxis.

PlugIt Finland

PlugIt Finland, an electric transportation service specialist, offers electric vehicle charging equipment, installation, and maintenance related services. Among others the services cover mapping, design and installation of charging systems of different sizes.

The customers are residential and commercial real estate entities, such as housing and real estate companies, shopping centres, large enterprises, property management offices, and individual homes. The company also offers training related to electric vehicle charging and charging-related business development services, for example for vehicle importers, property owners and insurance and utility companies.

The company was founded in 2012, and its premises are located in Espoo and Pori.

www.plugit.fi

Milestones

Jan 2013 – Jun 2013

WintEVE on display at Oulu Airport

EVE hosted Norwegian Transnova experts

EVE Research Collaboration seminar

Finnish EV experts in Estonia

World Alliance of Low Carbon Cities workshop

WintEVE Electricity in Traffic event

The Electric Traffic EV gathering in Helsinki

Electric Transportation event in Tampere

WintEVE participates the EV Day in Tallinn

Northern Collaboration seminar with Nordic experts

Electric transportation on display for Oulu city employees

Electric Traffic and WintEVE published EV Buyer's Guides

Jul 2013 - Dec 2013

Rockster's stone crusher equipped with Visedo's electric drivetrain

The Austria-based Rockster R1100DE stone crusher, equipped with the Visedo electric drivetrain technology by the Finnish component manufacturer, gained significant success in the tests performed by a French end customer. In the tests, Rockster utilized in its mobile crusher the strengths of an electric motor in a hybrid solution. Hence, the diesel engine could operate at optimal speed to drive the generator for the electric motor. The crusher met the requirements set for fuel consumption, noise reduction and resource-saving technologies.

The benefits achieved by the new technology were remarkable: savings up to 16,000 litres in fuel consumption, better productivity, reduced losses, and better quality of the end product. In October 2014 the Visedo powered Rockster stone crusher was nominated for the innovation award in the World Demolition Awards.

Visedo got another significant deal to deliver their Electric Power Conversion BV technology to two Gothenburg diesel-electric ferries. Moreover they won a deal for the electric system of the largest electric ferry boat in the world that will be in operation in Denmark in 2017. Also, the Visedo technology has been chosen for electric buses in Finland, France and Sweden.

Calls for international collaboration not always successful

With a mutual call for tenders, Tekes from Finland, Energy Agency from Sweden, and Transnova from Norway were looking for Nordic consortia to collaborate in the field of electric mobility. The potential consortium partners from Finland would have been supported by Tekes and their counterparts respectively by their domestic organisations. Some interest was aroused but no concrete outcome was achieved. This indicated that more effort has to be put in preparation and communication of the calls. Also, without a responsible coor-

dinator the consortium has proved to be almost impossible to operate.

The WintEVE consortium was about to form a consortium with a few French research institutes and companies but the planned project was rejected in the final planning phase due to organisational reasons by one of the partners.

Smart solutions from Finland in the eCarTec Munich

Five Finnish electric mobility companies – AC2SG, Meshworks Wireless, PlugIt Finland, Valmet Automotive, and Visedo – presented their services at the Tekes EVE Smart Solutions from Finland stand at the eCartec Munich 2013 event in October. The Tekes stand together with the Ensto, a Finnish charging equipment manufacturer, stand formed a visible Finnish quarter in the event. The EVA concept car of Valmet Automotive was an excellent eye catcher at the Tekes EVE stand. At the Ensto stand the ERA world record racing car aroused interest.

As a part of the event the Tekes EVE programme and the Network of Automotive Excellence organised a networking event at the Tekes EVE stand. The event that was attended by 50 visitors from nine different European countries was started by the participant presentations and continued with five workshops on selected themes, such as technology and services in electric mobility. Several potential fields of collaboration were discovered.



Visedo

Visedo, an award winning Finnish high tech company founded in 2009, develops and manufactures electric drivetrain components for the heavy mobile work machine, marine vessel and bus applications. Visedo is already serving a wide international customer base.

The products are designed to operate in harsh environments and they meet heavy duty requirements. The company has patented optimal solutions to save fuel and to lower emission and noise levels. The products and systems are developed together with key customers. The drivetrains are suitable for both hybrid electric (HEV) and electric vehicle (EV) solutions. Visedo has technology partnership with Semikron International GmbH in heavy duty hybrid solutions, and with an American supercapacitor specialist Maxwell Technologies, Inc.

Visedo has the headquarters and the factory in Lappeenranta.

www.visedo.fi

Charging service operator Virta started

Liikennevirta, or Virta, was founded by 17 Finnish utilities in December 2013. The company has been successfully building a platform that enables EV charging in Finland at charging points equipped with Virtapiste emblem. In the spring 2014 the Virta platform was already applied by a Swiss company A. Lehmann Elektro AG. In Switzerland it was launched with the name Swisscharge.

In February 2015 the Virtapiste network consisted of 60 charging points and the company also launched its mobile app for EV drivers. The app enables reserving, starting, ending, and paying of charging.

Originally the Virta concept was developed by the Electric Traffic consortium that consisted of 35 Finnish utilities and the energy sector organisation Finnish Energy. In June 2013 the representatives of 12 utilities and the transmission system operator Fingrid signed a letter of intent of the foundation of an operator company.

Helsinki Region Transport targets for 100 eBuses in 2018

HSL, the Helsinki Region Transport company published its plan to acquire 100 electric buses for passenger transport by the year 2018. The electric buses will represent the share of eight per cent of the total transport fleet purchased by HSL. For 2025 the target share is 30 per cent or 400 buses.

In February 2015 HSL announced a major programme for promoting electric buses by acquiring 12 buses. The buses will be handed over to bus operators who in turn can test electric transportation in city traffic.

Milestones

Jul 2013 – Dec 2013

Four new quick charging points in Southern Finland and Oulu

The Electric Traffic Branch Group started vision work

PlugIt Finland launched vehicle cost comparison calculator

Electric Commercial Vehicles – Where's the Business? seminar

eMobility Day by Finnish-German Chamber of Commerce in Espoo

Next-Generation Smart Cities -conference in Malmö, Sweden

Smart Solutions from Finland in eCarTec Munich

Electricity in Traffic event in Oulu

Electric Traffic Lab launched

Electric Mobility Roadmap workshop by Electric Traffic Branch Group

Electric Transportation Experts in EVS27 in Barcelona

Centria Open event

Jan 2014 - Jun 2014

Ensto and Symbicon to integrate charging points and outdoor advertising

Ensto, a Finnish charging technology company and Symbicon, a Finnish digital display pioneer joined their forces to combine outdoor advertising and EV charging. The first-of-its-kind solution was presented at the Helsinki-Vantaa airport in January 2014. Integration of EV charging and advertising platform produces extra media income for the charging service provider, and lowers significantly the investment threshold of charging points.

Clear Channel, an outdoor media company and a marketer of new advertising solutions, has a long experience of cooperation with Symbicon in developing outdoor advertising in Finland. Finavia, the owner of the airport, installed four conventional charging stations in its parking area in addition to this new advertising platform.

EVE eMobility infrastructure seminar for new ideas

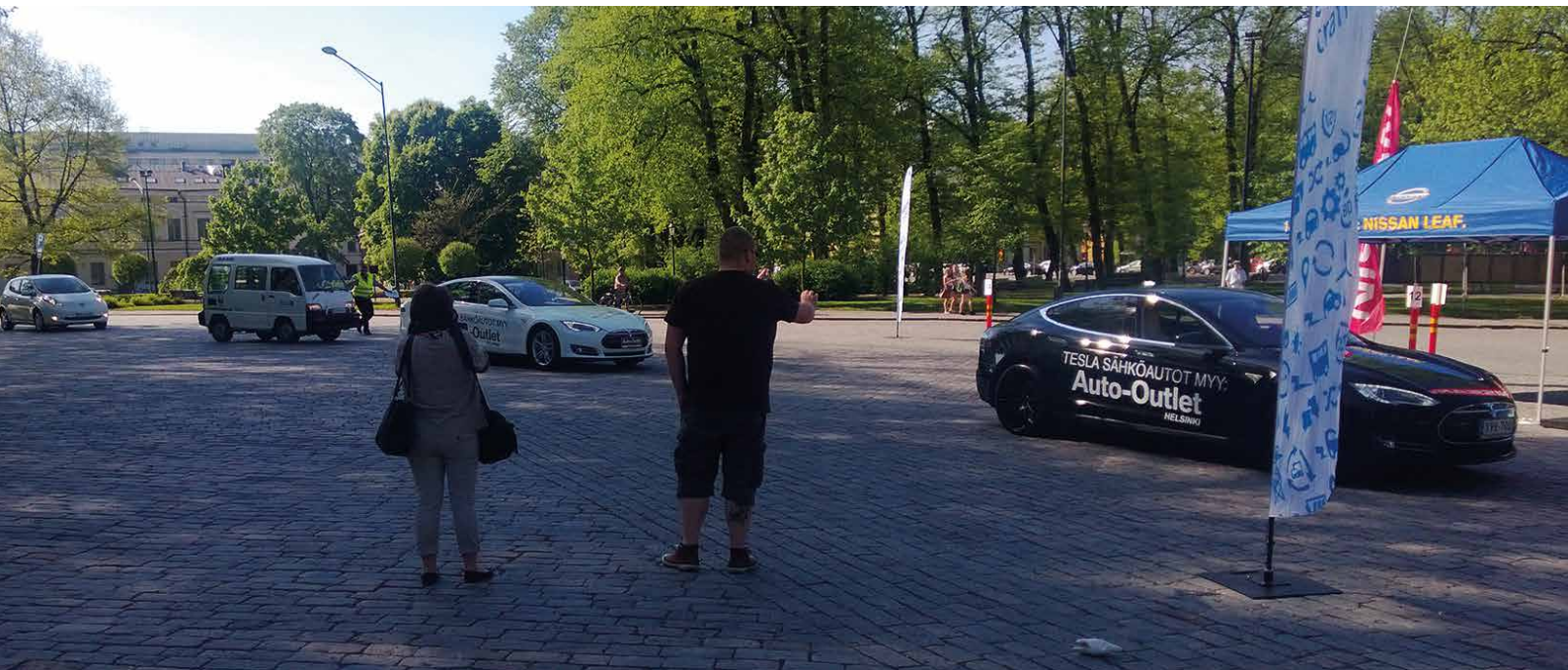
The future steps in electric mobility deployment and infrastructure in Finland, in Europe, and worldwide were mapped at the Hilton Helsinki Airport Hotel. The spring seminar of the Tekes EVE - Electric Vehicle Systems programme

brought together numerous international and Finnish experts to tell about their views on the industry.

The seminar started with presentations and panels on charging networks. Andreas Pfeiffer from Hubject, Jussi Palola from Liikennevirta, and Federico Caleno from Enel presented their views on the development of the electric mobility market in Europe. International interoperability was one of the keywords in discussion. Wide charging networks and easy access were seen as vital components for success. On the other hand higher user rates, and reducing of investment risks and operational costs are needed to secure business. Demos for business models and technology were found essential.

Jens Meyer from RWE, Jonne Jäppinen from Finngrid, and Jani Valtari from Cleen talked about smart grids. The integration of EV with distribution grid was estimated to happen between 2015 and 2017 and V2G i.e. bidirectional integration between 2020 and 2025. In the future the role of EV was seen as a battery with wheels or a distributed battery storage, at least when seen with the eyes of transmission system operator. The conclusion was that smart charging is important not only from the point of view of the sales of EVs, but also of grid operators, energy markets and society in tackling the environmental challenges.

In the afternoon product and service providers were on the stage and continued the discussion. The representatives of Ensto and Kemppi presented their charging solutions. VTT



Virta

Virta, an innovation leader in electric vehicle charging operator business, helps B2B vendors create business from electric vehicle charging services with the comprehensive cloud-based end-to-end IT solutions with open interface.

Virta provides a modular scalable turnkey solution for EV charging networks. It enables roaming between networks and all kinds of business models from crowdsourcing of EV-charging to utility-driven EV infrastructure management. Naturally, Virta supports smart charging and aggregated demand response functionalities. The Virta back-end is V2G ready.

The Virta customers include owners of charging stations and retailers of charging services as well as energy utilities providing services to electric vehicle users.

<http://solutions.virta.fi/en/>

Technical Research Centre of Finland and Helsinki Metropolia University of Applied Sciences introduced their research on high power charging for electric buses. PlugIt Finland in their presentation digged into solving the practical problems of installing charging equipment for the use of consumers and enterprises. Finally Elias Pöyry of Eera regarded EV as a game changer in intelligent traffic systems.

Finland to be the first test platform for Mobility-as-a-Service

In the spring 2014 Tekes organized three workshops on Mobility-as-a-Service (MaaS), where the representatives of cities, Ministry of Transport and Communication, public traffic authorities, transportation and logistics enterprises, and ICT and service design enterprises were looking for solutions to improve quality, and to reduce costs. Moreover, several opportunities to demonstrate MaaS on different areas of transportation were defined. In the spring 2015, as a result of a Tekes call for the MaaS demos, several projects were launched by different consortia. The MaaS concept was found to be one of the main drivers to promote electric and autonomous transportation in the future.

Arctic Research Centre opened in Muonio, Lapland

In Muonio, 150 km above the Arctic Circle, the Arctic Research Centre (ARC) for testing the functionality of EVs and charging systems in Northern harsh conditions was opened in April 2014. Among others the founding partners of the centre are Northern Engineering, Centria University of Applied Sciences, Technical University of Tampere, University of Oulu, Ensto, and Kemppi. The centre was started thanks to the EVGA consortium of the Tekes EVE programme.

Milestones

Jan 2014 – Jun 2014

EVGA Consortium kickoff in Oulu

EVE eMobility Infrastructure seminar

Series of Tekes MaaS workshops started

Electric Traffic consortium seminar

Arctic Research Centre started in Lapland

TIDE - Financing Schemes for EV Charging workshop in Tampere

Electric Traffic Forum by Electric Traffic Branch Group

EVGA at Northern Industry 2014 Grand Fair in Oulu

EV gathering in Turku

Veolia Transport tested Finnish Bus Mule in May in Espoo

The first Combo quick charging station opened

EVE at Tekes stand in ITS Europe Congress in Helsinki

Jul 2014 - Dec 2014

Electric motocross on Elmotion Electric Arena

Electricity as a power source got hailed when a KTM Freeride E electric motorbike was tested by an editor Nettimoto.com on the track of the Electric Arena of Elmotion. The KTM was found powerful, silent (which was regarded as odd but positive), and all in all competitive. Despite the battery limitations the editor questioned why to buy an ICE bike anymore.

The Electric Arena in Kirkkonummi, Finland is a motocross, enduro and trial fleet centre. The fleet of this off-road motorcycle park is completely electric. Electric mopeds are available for children, too. Aside the off-road track the Electric Arena also offers an opportunity to drive electric street motorcycles. Elmotion that produces the services on the arena has been funded by the Tekes EVE programme.

Espoo eBus tests were globally unique

The passengers using the HSL line 11 in Espoo have been participating in the historic public transportation experiment. The eBus project of Veolia Transport Finland is globally unique and has aroused significant international interest.

The project was started in 2012, and ever since five electric buses of different manufactures have been tested on the city line 11. By the midsummer 2014 a Dutch VDL Citea Electric, and a Chinese BYD started their tests on the line, and in December 2013 eBusco designed in Europe and manufactured in China started operation. The first bus tested on the line was Portuguese Caetano EL2500. A Finnish prototype was tested in May 2014.

The Veolia Transport project is even globally unique, because the project tested and compared European and Chinese buses from different manufacturers. Besides buses, the project also compared the batteries and components from several manufacturers. The tests were performed under control and the research data was produced by VTT Technical Research Centre of Finland.



The bus manufacturers that participated in the tests, have been very keen to get the results. The demanding conditions and up to 50-degree-Celsius-temperature variations make Finland a superb laboratory.

EVs for rent in Tapiola and Espoo Centre

Rental of an EV was made easier in 2014 when Ekorent started its EV rental service in the Helsinki region. Ekorent was the second Finnish company to rent EVs, when they opened six service points in October. The first was a rental company Europcar. In the autumn 2015 Ekorent launched crowdfunding scheme with the aim to build two new service points.

Ekorent has a goal to develop a service that is easy to use. The nearest available vehicle can be found and reserved with a mobile app. The service informs simultaneously the kilometres that can be done before recharging the batteries. The Ekorent development project has been funded by the Tekes Witty City programme.

Elmotion

The Elmotion Electric Arena motocross concept meets an identified need in the market to try off-road motorcycling without major investment and extra effort. The customers are the potential Electric Arena concept entrepreneurs as well consumers of all ages and gender. Marketing is directed to both businesses and consumers.

The Electric Arena concept customers receive a proven package of services with back-end systems and support services. Consumer customers will have the opportunity to off-road motorcycling with turnkey services and without big investment and effort. The equipment is completely free of noise and of local emissions and, therefore, it is possible to set up an Electric Arena service close to the customers in a central, easily accessible location.

Elmotion was founded in 2010, and the Electric Arena demo park opened in 2011 in Masala, Kirkkonummi, nearby Helsinki. A second office was opened in Raisio, close to the city of Turku in December 2015. The company employs five and the annual growth of the Electric Arena business has been 70 to 75 per cent.

<http://electricarena.fi/>

Over one-million-euro investment for an eBus start-up Linkker

Linkker, a Finnish electric bus start-up company got a boost to start manufacturing e-buses when the company managed to collect 1.2-million-euro capital from investors in December 2014. Linkker planned to convert diesel buses to electric and to start later the assembly of electric buses of their own design. Fortaco in Sastamala in Southwestern Finland was chosen as the manufacturing partner. Linkker will be responsible for the sales, marketing and product development of the buses.

Linkker was founded in the summer 2014. The company is a spin-off of the eBus research project of VTT Technical Research Centre of Finland and Helsinki Metropolia University of Applied Sciences. In November 2015 the city of Copenhagen chose Linkker as the supplier of two electric buses to be driven on the line 3A. Linkker won the tender with Heliox, the Dutch charging station manufacturer. The delivery is scheduled for June 2016. Linkker will also deliver 12 buses to the Helsinki Region Transport company for its project published in February 2015. The project will widely pilot electric buses.

Milestones Jul 2014 – Dec 2014

- Smart Electric Traffic consortium kick-off
- EV test drive event in Tampere
- ECV national seminar in Espoo
- Tekes launched INKA Innovative Cities programme
- Window to the Future of Transportation seminar by VTT TransSmart
- Charging points opened in Levi, Lapland
- Electricity in Traffic EVGA event with Oulu Energy and Business Oulu
- Linkker and Fortaco agreed on collaboration in e-bus assembly
- German automotive companies showed progress at eCarTec Munich
- EVs in Finland and Elsewhere seminar in Tampere
- Electric Transportation workshop by the city of Tampere
- EVE international seminar



Jan 2015 – Jun 2015

Electric Traffic consortium for increasing the number of low emission vehicles

In January 2015 the Electric Traffic consortium of the EVE network suggested measures to increase the number of zero emission vehicles, to enhance the charging infrastructure, and to modify the taxation of company vehicles.

The consortium targeted with the four-point programme in

1. the deployment of zero emission vehicles by reducing the automobile tax and vehicle tax of zero emission vehicles to 0 per cent,
2. applying a Dutch type company vehicle taxation model for extremely low emission vehicles,
3. building a sufficient distribution infrastructure for alternative transportation fuels in 20 biggest cities in Finland by 2017, and alongside main roads by 2020,
4. enhancing transportation and energy investments that reduce the consumption of crude oil.

Investments in development of electric public transport by Helsinki Region Transport

HSL, the Helsinki Region Transport company published its plans to invest 5 to 6 million euros in the electric bus system. HSL announced that at the first stage they will purchase 12

electric buses from Linkker, a spin-off of the eBus project of the Tekes EVE programme. The purchase is part of the ePELI project which promotes the deployment of new transportation technologies within HSL.

The charging infrastructure is planned to be financed by Helsinki and its neighbouring cities Espoo and Vantaa. The first quick charger for buses was opened in Espoo.

TankTwo combined mobile technology with EV battery

In the spring 2015 Tanktwo, an energy storage start-up company launched an innovation to replace battery pack of an EV with thousands of small, intelligent string cells. The cells are swapped in less than three minutes by sucking them out of the tank of the vehicle and filling the tank with charged ones. According to TankTwo the cells utilize the technologies used in wireless network, internet and mobile phone hardware.

According to TankTwo, their solution can parallel or exceed the energy density of conventional battery packs thanks to the ellipsoid shape of the string cells. The cell container can be air-cooled, and the weight remains also lighter than that of the traditional systems. Also the price per kWh of the TankTwo battery is said to be lower than that of a conventional one.

TankTwo offers one solution to solve the problem with charging times that tend to limit the use of EVs mostly to short distances.

Milestones

Jan 2015 – Jun 2015

Toroidion super car introduced in Monaco

Toroidion introduced a 1,000 kW-electric vehicle in the Top Marques Monaco 2015 fair. The vehicle was unveiled by Prince Albert II. This super car has the electric drivetrain containing several patented Toroidion inventions. The application was said to be fully scalable and applicable to all kinds of vehicles from one wheelers to aeroplanes. The technology was not revealed in detail due to the unfinished patent process. The vehicle itself is four wheel driven with four electric motors. The performance figures have turned out to be phenomenal.

Combined effort of Nordic enterprises at EVS28 in Korea

The Electric Vehicle Symposium (EVS), organized in turns in Europe, North America and Asia took place in Kintex, Korea in May 2015. The 2015 event was the 28th symposium. Out of the 180 exhibitors, five were from Denmark, 14 from Finland and two from Sweden. The companies from the Nordic countries were presenting their solutions at the Nordic stand. The programme for the Nordic delegation was generated by Innovation Denmark from the Danish Embassy, and assisted by Finpro. The participation was supported by the funding from Nordic Energy Research, Tekes, and Swedish Energy Agency. Insero from Denmark took care of the practical arrangements.

The location of the Nordic stand was excellent, and the stand had lots of visitors. Several seminars with Korean companies and authorities were arranged either in the event venue or at the premises of the hosting companies. The Nordic organisations had meetings with the representatives of Korean Electric Power Corporation (KEPCO), Jeju Island, Korean Environment Corporation (KECO), and Hyundai Group, among others.

Thanks to the Nordic participation several Korean delegations have visited the Nordic countries after EVS28, and business connections have been created between Korean and Nordic enterprises.

Linkker

Linkker provides solutions for emission free public transport. The company is a spin-off of the ECV consortium eBus project. Linkker has developed an electric powertrain, lightweight chassis and electric bus system optimized for intensive public transport in cities. In addition, Linkker electric buses provide an enhanced travel experience for passengers and drivers. The key characteristics of the solutions are zero local emission, low noise, high energy efficiency, long lifespan, and smooth and comfortable user experience.

The Linkker solutions are the Linkker 12 and Linkker 13 electric buses, the LinkDrive drivetrain and the LinkLight chassis.

www.linkkerbus.fi

Electric Transport seminar by Electric Traffic consortium

Virta launched its charging services

ECV seminar on eStorage project results

Centria opened quick charging station

EVE Business Breakfast meetings on growth and internationalisation

More than 1,000 registered EVs in Finland

Smart Electric Transportation and Business Development event of ECV

ECV seminar on eCharge project results

Combined effort by Nordic enterprises in EVS28 in Korea

Tesla opened first superchargers in Finland

Breakthrough for Electric Vehicles seminar in Oslo

EVGA consortium in Automotive Testing Expo in Stuttgart

Jul 2015 - Dec 2015

EVGA enterprise projects leading to business openings

Several projects implemented within the EVGA consortium of the Tekes EVE programme were informed to collaborate in commercialisation of the research results. The joint appearance at the Stuttgart Automotive Testing Expo lead to several new customer contacts.

The plans presented by Northern Engineering to develop a new testing area, Lapland Proving Ground have led to concrete business actions. In addition Finnish Meteorological Institute, Technical University of Tampere and University of Oulu are preparing a project to create testing environment in Lapland for smart transportation, autonomous driving, and robotics in collaboration with Finnish Transport Agency and local authorities.

The digital 3D presentation solution of Satavision and Brand Factory is planned to be introduced to European automotive industry during the project. In the Stuttgart Expo Kemppi launched its plans of mobile 20 kW Move & Charge quick charger with Chademo and CCS standards.

Niinivirta started transportation with electric truck

Niinivirta European Cargo, an international logistics service company was the first in the Nordic countries to purchase a heavy 16-ton-electric truck. The truck was constructed in Holland on the DAF LF55 platform. The vehicle is in operation in Tampere as a delivery truck of Enset, a supplier for Niinivirta. According to the company the high price of the vehicle – almost triple to the price of the respective DAF ICE model – can be justified, since Niinivirta wants to stay in the front line in the

development of smart and environmentally acceptable transportation. Also, electricity is substantially cheaper as a power source.

The vehicle has been equipped with data collection system, the data can be used for analysing the driving behaviour and vehicle movements, that helps in improving the cost efficiency of the truck. The data collection system has been developed and implemented by Tampere University of Applied Sciences.

Tampere ordered eBuses from Poland

Solaris Bus & Coach, a Polish company won the tender for an electric bus system for the city of Tampere. The delivery consists of four buses, a quick charging station and four depot charging stations. The buses will be purchased with five-year-leasing contract, and they will start operation at the end of 2016.

The buses will be driving on the line 2 in Tampere. All of them are charged at the depot and state of charge is maintained with end stop charging. The line will operate simultaneously as an innovation platform for smart transportation. In November 2015 the city of Tampere also launched a competition for electric mobility ideas.



IGL Technologies

IGL Technologies has specialised in developing electric vehicle charging solutions as well as smart block heating poles for public and private parking facilities. Above all the company focuses on the internet-of-things and the development of software. Their customer base includes big companies and parking area managers of cities, airports, railway stations, housing cooperatives, property management agencies, and enterprises.

The IGL eTolppa ("ePole") represents a new generation of remote-controlled heating pole and electric vehicle charging point with cloud services for billing and parking place rental. The traditional heating poles can be easily and cost-effectively upgraded to smart heating poles or mode 3 type 2 charging points equipped with sockets. Thus the investment needed remains on a reasonable level. The new charging points are also quickly available. By the end of 2015 about 3,000 eTolppa solutions had been installed, out of which about 70 are EV charging points from 3,6 kW to 22 kW.

IGL Technologies was founded six years ago, and its premises are located in Tampere.

www.eTolppa.fi

First fast charging solution for electric shuttle and straddle carriers to be introduced by Kalmar

Kalmar, a Cargotec company, announced in December 2015 that it will introduce the first fast charging solution for electric powered shuttle and straddle carriers for the industry. The solution called Kalmar FastCharge, utilizes fast charge battery technology, already used in large capacity electric buses. It can be applied in autonomous and manual operation. The benefits include local zero emissions, less noise, reduced maintenance and up to 50 per cent increased energy efficiency compared to diesel/electric drive. The solution is planned to be launched in the market during 2016.

The Kalmar FastCharge solution is based on similar opportunity charging technology used in electric buses. The station for opportunity charging will be located on the working route of the machines in the terminal. When the machine has stopped to wait for the container, it can be charged. Typical charging time is between 30 to 180 seconds. Maximum charging power of 600 kW gives full charge in a few minutes.

The Kalmar FastCharge solution consists of electric powered carriers and fast charging stations. Testing and verifying of the solution continues at the Tampere Technology and Competence Centre in Finland.

Milestones Jul 2015 – Jan 2016

Nordic Electric Bus Initiatives seminar in Gothenburg

PopUp Electric Vehicle Day broke records in Helsinki

Number of EVs exceeds one million worldwide in September

EVE Business Breakfast meetings on EU Programme participation

ECV national seminar in Lappeenranta

Emphasis in infrastructure in eCarTec Munich

City of Tampere launched competition for electric mobility ideas

Electrification in Ports and Vessels – Benefits and New Business Opportunities seminar by Tekes

Nordic Smart Electric Transport conference - 20-year-celebration of Norwegian EV Association

Linkker to deliver electric buses to Copenhagen

EVE closing seminar: Let's talk EVE

5

Versatile research in technology and business

Some of the research projects of the EVE – Electric Vehicle Systems programme are introduced in this chapter. Numerous others, including doctoral and master theses, were finished within the consortia, but due to the limited space all cannot be presented here. Also, the introductions below give only limited description of the contents and results of the research projects. For more thorough information the readers are kindly advised to utilize the contact information given.

EV-Acte, Acting Effectively in Emerging Ecosystems

The research project of the Department of Industrial Engineering and Management at Aalto University has been following the formation of electric mobility industry in Finland, Singapore and USA between 2012 and 2015. The focus of the project has been the birth of business ecosystems and strategizing in emerging industries.

In emerging ecosystems shared value creation brings challenges: the development of business and technology is

uncertain and selection of potential partners can be challenging. The research project has generated new knowledge about the role of assumptions, formation of understanding, and interaction in the emergence of business ecosystems.

Utilizing the extensive material collected, this research project has advanced our understanding of the birth of business ecosystems and strategic activities by firms and ecosystem facilitators in emerging industries. In particular, the research project has produced new insights about the role and the use of the so-called soft strategy, focusing on emotions and narratives. The empirical findings expose how companies can use emotional influence strategically for the creation of co-operation and facilitating business ecosystem development. Further, the results show how narratives help companies strategically affect their legitimacy, and how industry disruption is understood. The findings have been presented in top management conferences, and currently several articles are in the making to be published in leading management journals. During the project three master theses have



been finished. Two doctoral theses based on data collected materials are underway.

The research group has been headed by assistant professors Robin Gustafsson and Timo Vuori from the Department of Industrial Engineering and Management at Aalto University. Other principal researchers have been Christopher Rowell and Eero Aalto.

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eSini and eCoSini emphasize socio-technical change

eSINI project (2012 – 2013) and its follow-up eCoSini (2014 – 2016) project are part of the Aalto University electric transportation research. eSini was implemented in the Electric Traffic consortium, eCoSini, in turn, is a parallel public research project of the Smart Electric Traffic project.

The primary objective of the both projects has been to promote the Finnish electric transportation, and in particular, business in this field. The Finnish networked ecosystem has been analysed and advanced through socio-technical change. The projects have contributed to the business of the Finnish charging operator model and businesses arisen around it. Simultaneously concrete, effective electric mobility promotion proposals have been presented to various reference groups, especially the state, cities and enterprises of the electric traffic.

The projects also examined relevant technical factors related to electric transportation in Finland. Among others these factors include winter resistant battery cells and below zero temperature charging. In addition, the impact of electric vehicle charging on power grid was analysed. At the same time the utilization rate of the charging network was simulated. When this information is combined with known traffic flows, the structure of electricity grid and charging station cost data, the location of charging points can be optimized. Department of Design at Aalto University studied

the brand for electric transport, its communication and visual appearance. During the project, the city of Helsinki made a public charging network plan. Finland also joined to the open Norwegian electric vehicle charging point database.

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User experiences of and views on electric mobility

The objective of the research conducted at the Consumer Society Research Centre at the University of Helsinki was to study and assess the potential of electric mobility to rise to a significant and everyday form of transport in Finland. Based on interviews and questionnaires, and utilizing the approach of socio-technical change, Finnish experiences of and views on electric mobility and its impacts on the everyday practices of its users were studied.

The conducted studies provided information on how Finns rate the opportunities and challenges of electric vehicles (electric automobiles and light electric vehicles) in everyday life. Electric vehicles were perceived as interesting, and users were rather satisfied with them. Overall, electric vehicles were seen as enablers of the mobility of the future. The results increase our understanding of the factors that motivate people to purchase electric vehicles and to utilize shared electric transport solutions instead of traditional transport modes. Also, barriers to the introduction and acceptance of electric vehicles were identified. The results further show how electric vehicles and their market as well as the mobility and transport infrastructure should be developed, in order to make electric mobility more commonplace in the future.

For developers, the results achieved in the research projects provide information about desired electric mobility solutions and services, based on the user-experiences and views. The results also assist in an evaluation of business opportunities relating to electric mobility.

Research group members were Kaarina Hyvönen, Petteri Repo, Minna Lammi, Mika Pantzar, Mika Saastamoinen, and Saana Tikkanen.

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Tubridi, hybrid plug-in working machine of the future

The hybrid plug-in working machine of the future called Tubridi, focuses on the research and development of tomorrow's hybrid electrical non-road working machinery. The main outcomes of the project were a simulation environment including a hardware in loop realisation for the design, optimisation and virtual validation of a hybrid powertrain and an experimental platform build on a mine loader for full scale testing. Further, to understand the current status and to envisage what is to come, a technology road map for the hybrid electrical powertrain has been prepared.

Contacts

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eStorage, experimental work on batteries

Batteries are the enabling but also one of the most challenging components of various electric vehicles. Poor battery pack design and/or poor battery cell choices in respect to application requirements can ruin the safety, performance, and lifetime of a battery system.

eStorage has focused solely on battery technology by experimental work on different type of batteries and by literature work on emerging technologies. The performance of various battery cell chemistries has been studied in detail. Lifetime testing has been conducted with different operating profiles and modelling tools have been developed for

simulating battery performance accurately and for battery thermal management design purposes. A database of battery experimental data enables easy examination of suitable battery technologies for given applications.

The design tools are to help engineering. The complete battery research facilities can be used to further develop and validate the technology. It is expected that this research work on batteries will lead to highly energy efficient and low emission products and services in commercial vehicle sector and grid-connected applications. After all, a battery is the enabling technology for many applications.

Contact

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eBus, testing of electric buses in Nordic conditions

Electric city buses, eBuses, as a part of transportation system in Helsinki Metropolitan area were evaluated by operating and testing six different buses in and out of season in Nordic climate. The energy efficiency in comparison to diesel buses was extensively measured in laboratory to reveal all the differences. One of the six buses was a prototype bus designed and built in the project to serve as a testbed for Finnish electric powertrain components and research environment to study and develop electric commercial vehicles.

Based on the prototype, company called Linkker was founded to commercialise the state of the art electric bus. The original will continue as part of a development environment in national Living Lab Bus project demonstrating intelligent services, user experience and technologies. The Finnish testing environment of commercial electric buses will have continuation by attending the international Horizon 2020 project EBSF_2 to demonstrate driver aid system guiding bus drivers towards even more energy efficient driving in eBuses.

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Steering group feedback

The members of the steering group of the EVE – Electric Vehicle Systems programme represented widely electric mobility business and its fields, such as automotive and mobile machine industry, charging solutions, telecommunication, batteries, energy, electronics, software, transportation and logistics. The group had also the representatives from Tekes and the Electric Mobility Branch Group of the Federation of Finnish Technology Industries. Dr. Jussi Palola, who became CEO at Liikennevirta in 2014 acted as the chairman of the steering group. Liikennevirta is one of the start-ups established in the EVE network. In their over 20 meetings during the four-year period the steering group members consulted the programme manager and coordinators to best benefit the development of the electric mobility network, business and internationalisation of the companies, and start-ups. The steering group wishes to end its work by focusing on the measures that help to continue the positive development in technology and business.

EVE launched electric mobility in Finland

The final impact of the EVE programme remains to be evaluated after an appropriate period of time, the real influence will be seen later, in five to ten years. The electric mobility sector is growing slowly but a few effects can be noted already.

The EVE programme has been an effective starting point for EV transformation in Finland. The earlier a country is able to participate in this big system transformation, the more its national economy benefits in the long-run. The EVE programme has increased the speed of transformation in several large and smaller companies by enabling the introduction of new products and service businesses. There is also potential for significant volumes in the future. New companies have arisen and will arise, but at the same time some companies will be trampled underfoot by these new businesses. Hence, the overall

effect should also be taken into account and not just the creation of new businesses. A good indicator of the real success of the programme is the number of new electric mobility companies which have been able to grow internationally.

The programme has already contributed decisively to founding of a handful of businesses with international orientation. Good examples are Liikennevirta and Linkker. The future will show whether these will be successful. In addition, there has been effect on the development and direction of businesses of existing young companies. However, the existing export businesses, more specifically the heavy duty machinery manufacturers have an impact on the national economy. Their ability to improve their competitiveness and to show willingness to reduce the dependence of Finnish road transportation on imported energy is decisive. Machinery manufacturers are likely to have a key role in achieving the effects faster. In the future, the results of the EVE programme will help to accelerate the ability of mobility-as-a-service operators in reducing the variable costs of their services by electric transportation.

The EVE programme was insightfully scheduled to be implemented in the beginning of electric traffic growth. The programme has also provided information on the global business perspectives and linked Finnish industry into the major trend and technology transition. The EVE programme has launched electrification of transport in Finland.

Emphasis on business development

The stakes must be put solely and exclusively in promoting and supporting the development of international business. Basic competence and research capabilities have been well created in the programme. From this point of view the first and foremost challenge is their exploitation and the development

of business. The role of public research is bound to be reduced which emphasizes the need to move to the development of products, services and businesses. Also, the mere export of components or know-how is not necessarily always the right direction, on the contrary more end products manufactured in Finland are needed. The emphasis has to be moved from basic research to the creation of actual new business. Internationalisation can be promoted by utilizing partnerships.

Preferably research and business proceed side by side towards electric and autonomous traffic by creating new business models, and challenging procurements of cities and governments. When electric robot cars are developed and launched in the market, the variable costs will be close to the zero, enabling the mobility-as-service concept to become profitable also in sparsely populated areas.

Electric traffic business will change existing structures by replacing traffic based on fossil fuels for energy-efficient and emission-free traffic. In this transformation, success requires perseverance. The change will be global and offers specialized professionals a wide market. Tekes has an important role in supporting technological development. The fact is that companies need support when the situation is most demanding.

Bold public procurement promotes innovation

Tekes has allocated resources in the right way, they are able to support when the situation is most difficult – hopefully they can continue the operation in the same way also in the future. Trends are clear, the markets are growing, the benefits of electrification are there, and applications exist. Support for SMEs is the right choice. Also failures must be allowed, one the roles of Tekes is to share the risk. Even a small stake and risk-bearing is extremely valuable.

Tekes has also the role of mental pioneer, an awakener. The global opportunity of electric mobility has to be clearly communicated.

It is the government that has to choose when to step into the EV transformation; the sooner, the better. New indications from the Minister of Transport and Communications suggest that this development is going to right direction. However, more speed is needed to catch up other European countries. And supporting the acquisition of an electric car is not the only possibility. The new mobility-as-a-service demos have to be able to make use of electric intelligent vehicles in the enabling of the services. Currently the only reason to object electric mobility seems to be defending of oil based transportation and business. Finland needs to see beyond that: transportation will be electrified with increasing speed.

Public procurement should be more innovative and enable the introduction of new ideas. Procurement procedures should also enable the selection of new domestic innovations. A lot has been invested in electric traffic, the national and municipal procurement strategy should also support this.

Electric transport enables energy savings and emission reductions. It also offers new beginnings for new businesses. No matter how good the ideas are, they can not be transformed into reality without effort. Also the universities and research institutes should strive that competencies and services developed in the projects of the programme could be commercialized by companies. Best policy in electric transport are investments and acquisitions that concretely move the traditional solutions of the past. The advantages of electric traffic can be enjoyed only by utilizing electricity in mobility. Now is the right time for businesses to develop the capacity, and to take a share in the globally growing electric vehicle market.

On behalf of the steering group
Dr. Jussi Palola
Chairman

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