

# ELECTRIC MOBILITY FLAGSHIP PROJECTS

Innovative Austrian R&D in the automotive sector –  
Bringing together existing initiatives

# IMPRINT

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# SHAPING THE FUTURE OF MOBILITY TOGETHER



Photo: bmvit / Johannes Zinner

Mobility is the engine that drives our society. Innovation and new technologies have a major role to play in shaping mobility so that it is fit for the future. At the same time, it must help us meet the key challenges posed by climate change, the scarcity of resources and demographic trends. That is why the Federal Ministry for Transport, Innovation and Technology (bmvit) is supporting new and innovative technologies in the fields of mobility and transport.

In addition to transport and technology, electric mobility is also concerned with the areas of environmental protection and the economy. And that is why bmvit is working together with all stakeholders at various levels. Within this context, we are interested in the entire value-added chain, from the initial innovative discovery right through to the market launch of new and integrated transport systems. bmvit's objective is to establish electric mobility firmly within the transport system, within the infrastructure and within Austrian industry. Electric mobility is the key technology for making transport more environmentally and climate friendly. It is also a fundamental building block for creating a joined-up and environmentally friendly transport system.

The "Electric Mobility Flagship Programme" supports the development of new technologies

and helps bring together the expertise of various Austrian players. The great news here is that we now have a whole host of Austrian companies cooperating with one another – ranging from members of the automotive industry and power companies right through to IT start-ups and research facilities. The results confirm that this is the right approach – meaning that we will be able to shape the future of mobility together. This year again, the success story of the "Electric Mobility Flagship Programme" is going to be continued. The present call is for innovative Research & Development (R&D) projects in the sphere of electric mobility, with the focus this year being on reducing production costs and on the electrification of special purpose vehicles. The projects are aimed at one goal in particular: to quickly establish innovative technologies within the market, thus positioning Austria as an international leader in innovation.

In this brochure, we present twelve flagship R&D projects that illustrate how Austria is already well on the way within this area. All twelve projects focus on new concepts and technologies, and have been supported by the Climate and Energy Fund using funds from the Federal Ministry for Transport, Innovation and Technology.

A handwritten signature in blue ink, appearing to read 'Jörg Leichtfried', written in a cursive style.

**Jörg Leichtfried**  
Federal Minister for Transport,  
Innovation and Technology

# INNOVATIONS IN CLIMATE PROTECTION – ELECTRIC MOBILITY FLAGSHIP PROJECTS

On 12 December 2015, an ambitious climate deal was agreed by 195 countries at the 21<sup>st</sup> Climate Change Conference in Paris. The key objective of this agreement is to limit the global increase in temperature to a maximum of 1.5 degrees Celsius. In addition, the parties agreed that the world must achieve greenhouse gas emissions neutrality during the second half of this century.

This climate deal reinforces the climate targets set by the European Union and provides further stimulus for the mobility revolution that Austria has set its sights on achieving. It also increases the significance of those projects that the Climate and Energy Fund has already supported through its electric mobility programmes. This is because transport remains one of the main sources of greenhouse gas emissions within Austria.

The "Electric Mobility Flagship Programme" was initiated by the Climate and Energy Fund in 2009 with a view to supporting innovative and practically oriented projects that could strengthen Austria's position in the growing international market for electric mobility solutions.

While schemes elsewhere have primarily been geared towards technological issues, our programme has always preferred to focus on the

electric mobility system as a whole. And now that the evaluations are in, we can see from the positive results that we were right to concentrate on this unique approach encompassing "User – Vehicle – Infrastructure".

The figures achieved to date are impressive: since 2009, 16 projects have been completed at a total funding cost of almost 41 million euros. Many developments have been successfully taken to the next phase and are now heading for the roll-out and market launch stages. The development efforts have definitely borne fruit, as this brochure so impressively demonstrates. Now it is a question of joining forces so that we can all share in the opportunities for Austria as a key centre of technology!

The START-E open competition that is currently being sponsored by the Climate and Energy Fund is specifically targeted at young companies. The aim here is to get start-ups breathing fresh life into the sector with their ideas for vehicle concepts, infrastructure solutions or usage systems.



Photo: Climate and Energy Fund

**Theresia Vogel**  
Managing Director of the  
Climate and Energy Fund

# ELECTRIC MOBILITY – EUROPEAN AND NATIONAL STRATEGIES



Photos: Climate and Energy Fund / Ringhofer

Mobility is a basic human need. The extent to which our quality of life depends on being fully mobile is revealed, not least, by the increase in traffic volumes that can be seen all over the world, particularly in the main conurbations. However, mobility is also a key factor for our economic system, which now operates on a global scale. The other side of the coin is well known: transport is one of the main causes of climate change. In Austria, transport accounts for approximately 26 % of greenhouse gas emissions. Since 1990, transport emissions have increased by 61 % within the country.

Consequently, if we want our future to be one where we remain mobile – in both our private and business lives – a massive rethink will be required. For this, we will need mobility systems that are not only efficient and comfortable but that also conserve resources and protect the climate at the same time. Electric mobility is one of the key technologies for shaping the mobility system of the future. It offers an opportunity to reduce greenhouse gas emissions from transport significantly, thereby making a substantial contribution to achieving a mobility system that is climate neutral and, in turn, sustainable.

The framework for developing electric mobility in Austria is provided by climate and energy strategies at both a national and an international level. The expansion of electric mobility is an integral part of the targets and packages of measures for shaping future mobility in a sustainable and climate-friendly manner.

## CLEAR STRATEGIC GOALS OF THE EU

With regard to the development of future transport systems, the European Union (EU) is pursuing a set of clear strategic goals. These are being championed by the following Directorate-Generals (departments) of the EU: Energy, Research and Innovation, Mobility and Transport, Environment, and Competition. In particular, the emission targets that have been formulated within this context can only be achieved by using electrically powered vehicles.

## EU climate and energy goals

In 2008, some objectives known as the "20/20/20 targets" were set for the year 2020. Then, in October 2014, these were further tightened and a new deadline of 2030 was set. The following "40/27/27 targets" are the ones that currently apply:

- > 40 % fewer greenhouse gas emissions (compared with 1990)
- > 27 % increase in energy efficiency (compared with the "business as usual" scenario)
- > 27 % of total energy consumption to be supplied by renewable energy sources

## White Paper on Transport

The targets outlined in the White Paper on Transport can – like the others – only be achieved through electric mobility solutions. According to this document, the use of "conventionally fuelled" cars in urban transport is to be halved by 2030. Conventional vehicles are to be completely phased out in cities by 2050. In addition, CO<sub>2</sub>-free city logistics are to be achieved in the major urban centres by 2030.

## Clean Power for Transport

The EU's "Clean Power for Transport" package and Directive "2014/94/EU" outline measures for setting up charging infrastructures for electric vehicles by 2020. The corresponding Austrian implementation plan has to be produced by November 2016.

## Reduction in CO<sub>2</sub> emissions of new passenger cars

The regulation covering average fleet emission limits (443/2009) aims to achieve a gradual reduction in average car fleet emissions. By 2021, average emissions for a new car fleet are to be cut to 95 g CO<sub>2</sub>. This equates to a consumption rate of 4.1 l and 3.6 l per 100 km for petrol and diesel respectively.

### SOURCES

EU climate and energy goals  
[http://europa.eu/rapid/press-release\\_IP-14-54\\_en.htm](http://europa.eu/rapid/press-release_IP-14-54_en.htm)

White Paper on Transport  
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF>

Clean Power for Transport  
[http://ec.europa.eu/transport/themes/urban/cpt/index\\_en.htm](http://ec.europa.eu/transport/themes/urban/cpt/index_en.htm)

Regulation (EC) No 443/2009  
<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32009R0443>



## AUSTRIA'S POSITION REGARDING ELECTRIC MOBILITY

In Austria, there are two basic documents that contain the Federal Government's strategies and measures for expanding electric mobility within the country.

### **E-Mobilität in und aus Österreich (Implementation plan Electromobility in and from Austria)**

In 2012, the Austrian Federal Government produced its national implementation plan entitled "E-Mobilität in und aus Österreich" ("Implementation plan Electromobility in and from Austria – the common path!"). It was here that it first expressed its commitment to a total of 65 concrete measures for introducing electric mobility. The implementation plan, which also forms part of the latest "Regierungsübereinkommen" (a governmental coalition agreement), views the issue primarily as an opportunity to be seized by Austria as a key technology and business location.

The plan regards electric mobility as a clean, cost-effective and environmentally sound form of mobility and places particular emphasis on integrating it into one complete intermodal transport system. This approach also ties in with the need to understand electric mobility in broader terms than merely the replacement of conventionally fuelled vehicles. Instead, electric mobility is to be regarded as the process of systematically integrating all the technical components used in vehicles, communication systems, control electronics and

infrastructures while at the same time also incorporating organisational and user-focused concepts.

### **Gesamtverkehrsplan Österreich (Austrian Overall Transport Plan)**

The Overall Transport Plan produced by the Federal Ministry for Transport, Innovation and Technology (bmvit) lays down the targets and guidelines for transport up until 2025. The overriding principle here is to create a form of mobility that gives people as much freedom and enjoyment as possible while at the same time avoiding the negative consequences normally associated with transport. With this in mind, a major focus is to make electric mobility part of a modern and efficient overall transport system, with an emphasis on the combined use of public and private modes of transport. According to the Austrian Overall Transport Plan, the following targets are to be achieved by 2025: CO<sub>2</sub> emissions to be decreased by 19 %, particulate matter emissions (PM 2.5) to be cut by around 50 % and NO<sub>x</sub> emissions to be reduced by 70 % compared with 2010. None of these targets will be achievable without alternative drive systems, new technologies, but above all, changes in mobility behaviour.

#### SOURCES

Elektrifizierung in und aus Österreich (Electric mobility inside and outside Austria), published by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), the Federal Ministry for Transport, Innovation and Technology (bmvit), the Federal Ministry of Economy, Family and Youth (BWFJ), Vienna 2012

[www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil\\_umsetzung-splan.pdf](http://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil_umsetzung-splan.pdf)

[www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil\\_up\\_fortschrittsbericht201506.pdf](http://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil_up_fortschrittsbericht201506.pdf)

Gesamtverkehrsplan für Österreich (Overall Transport Plan for Austria), published by the Federal Ministry for Transport, Innovation and Technology (bmvit), Vienna 2012  
[www.bmvit.gv.at/verkehr/gesamtverkehr/gvp/downloads/gvp\\_gesamt.pdf](http://www.bmvit.gv.at/verkehr/gesamtverkehr/gvp/downloads/gvp_gesamt.pdf)

Unless there is a significant increase in the proportion of electric vehicles, it will not be possible to achieve the existing goals that have been set at an EU level or the national targets defined by national transport policy. For us at the Federal Ministry for Transport, Innovation and Technology, the crucial factors are to develop a regulatory framework and to support electric mobility in terms of research (as we have been doing successfully for many years as part of the "Electric Mobility Flagship Programme"). The tax reform of 2016 created a major incentive for companies to switch over to electric vehicles because they now stand to benefit from an input tax deduction for zero-emissions vehicles.

We also think it is important to engage in intensive dialogue with the Austrian federal provinces, towns/cities and municipalities. In terms of implementing the EU Directive on the deployment of alternative fuels infrastructure – a process that is being coordinated by bmvit – we are making considerable progress in areas such as the following: adapting the building regulations, simplifying approval procedures and laying the foundations for local incentives. The next few years are going to be dominated by initiatives connected with the purchase of electric vehicles and many other transport decarbonisation measures.

### **HERBERT KASSER**

Secretary General, Federal Ministry for Transport, Innovation and Technology



Photo: bmvit

# RESEARCH AND DEVELOPMENT FOR THE MOBILITY SOLUTIONS OF THE FUTURE

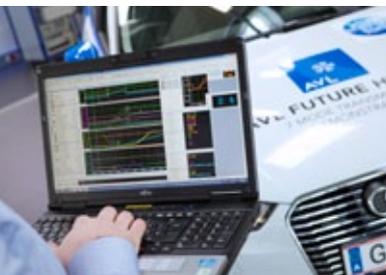


Photo: Climate and Energy Fund / Astrid Bartl

Sustainable mobility concepts rely on having a multimodal transport mix, whereby different forms of mobility (private and public plus motorised and non-motorised) are combined to create one low-emission system. Electric mobility is regarded as a key building block for creating the mobility system of the future. However, the transition to electric mobility is about much more than simply introducing new vehicles. And it does not just affect the automotive industry and its suppliers. Rather, the actual implementation process brings various new players into the market. In the first instance, this naturally means the power industry, whose task it is to provide the power (preferably from renewable sources) and set up the appropriate charging infrastructure. In addition, information and communication technologies (ICT) are coming to play an

increasingly important role. Intelligent concepts are required to enable the networking of users, vehicles, charging stations and power companies. The degree of complexity involved in setting up the necessary data links is considerably greater than has traditionally been the case, all the more so because Austria – in particular – thinks that getting on board with electric mobility is a powerful force for promoting intermodal transport concepts.

Given the many factors and stakeholders involved, a multitude of research fields associated with electric mobility are beginning to emerge. In addition to technological concepts and development activities relating to vehicle and infrastructure components, these also encompass system-related, political, economic and social aspects as well.



Photo: Günther Peroutka/IV

Knowledge, research, development and technical innovation have always been some of Austria's major strengths as a business location. At the same time, these are the very prerequisites for transforming our energy system, which is the core task of the Climate and Energy Fund. Therefore, it is very important – particularly during financially challenging times – to do what makes sense economically while also doing the right thing ecologically. The latest tariff reform has increased the research premium (an Austrian tax refund instrument) from ten to twelve percent and has improved tax benefits for research staff who are relocating from abroad. This is a forward-thinking move that signals how we want to bring Austria back into the fold as an innovation leader.

The recently approved non-profit package is another step in this direction, as it allows more private money to be obtained, in turn, boosting the potential for financing scientific and research endeavours. This is extremely significant, particularly as far as electric mobility is concerned. After all, this forward-looking technology can act as a link between mobility and climate protection, thereby generating added value and growth within Austria.

## GEORG KAPSCH

President of the Federation of Austrian Industries, CEO of Kapsch AG



Photo: Climate and Energy Fund / Astrid Bartl

## AUTOMOTIVE TECHNOLOGY FIELDS

In the area of vehicle technology, one of the main focuses is on developing alternative power trains. Firstly, this is a question of devising "complete system" concepts and operating strategies. Secondly, it entails developing and enhancing various components, such as electric engines, high-performance electronics and control technology. Today's modern vehicles have to respond to external conditions in real time and are expected to optimise all operating parameters continually. For this, they need information from advanced sensor components and high-performance electronics of the same calibre to process this information.

The psychological barriers preventing the spread of electric vehicles remain the same as before, namely the short driving range and the high cost of the batteries. The performance and cost of the rechargeable batteries will be crucial to

the success of electric mobility. Enhancement of the battery technology is mainly concerned with energy density, safety during use, deep-cycle resistance and service life. R&D in this area is heading in several different directions, e.g. how to combine batteries with high-performance capacitors or how to develop batteries with fuel cell range extenders.

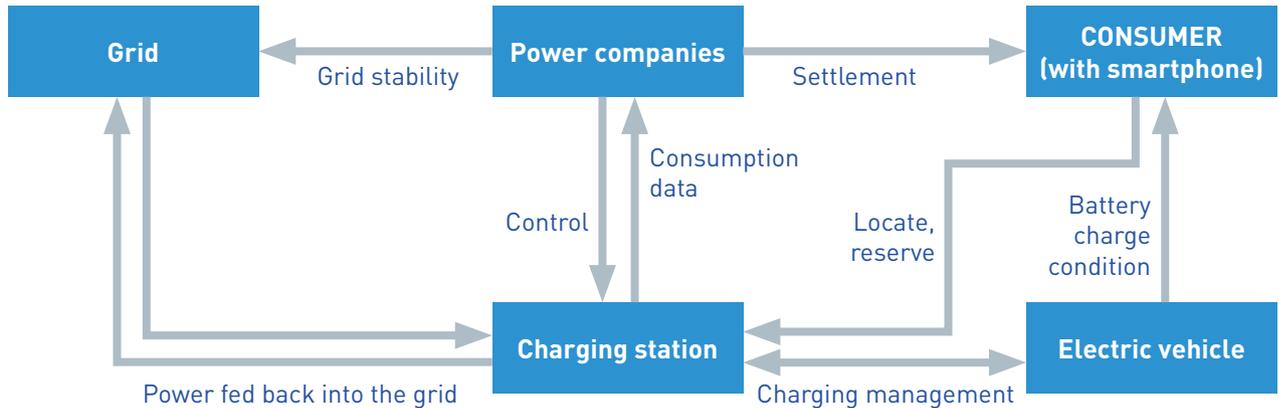
Within this context, life cycle analyses are another important element, i. e. the process of considering the total ecological and economic costs of the battery from the availability of the raw materials right through to recycling.

The integration of energy storage systems into the vehicle is also imposing new requirements in terms of the bodywork. By using new light-weight materials such as carbon fibre reinforced plastics, you can keep the total weight of the vehicle to a minimum, thereby extending the range. >>>



Photo: Climate and Energy Fund / Astrid Bartl

In order to develop a complete system of electric mobility, vehicle manufacturers, power companies and ICT specialists will all have to cooperate with one another



Source: Fraunhofer IAO (institute for work management and organisation), graphic: Waldhör

**ELECTRIC MOBILITY SYSTEM COMPONENTS**

Research and development in the field of electric mobility must be geared towards creating a fully integrated complete system. Vehicle technology, infrastructure, energy supply and intelligent services for users must all link up if the electric mobility system is to work and become accepted.

**TECHNOLOGY FIELDS RELATING TO ENERGY AND INFRASTRUCTURE**

Anyone who relies on a battery-powered vehicle to get around needs the corresponding infrastructure to be in place so that they can charge up their car reliably and conveniently. Along with access to an extensive network of charging stations, user-friendly technologies are also required to enable easy operation.

Without a sustainable energy supply, there is no prospect of creating an environmentally friendly form of mobility that is fit for the future. If the use of electric vehicles leads to increased demand for power from the public grid, solutions will have to be found to facilitate intelligent grid integration and incorporate renewable energies. The key research areas here are: central or decentralised storage management, the power demand associated with an increase in the number of electric cars, charging control and storage management in general. On the other hand, the process of incorporating electric vehicles into the grid introduces new storage capacity because the vehicle batteries can be used as external power storage systems. As part of “vehicle-to-grid” concepts (V2G), intelligent technologies are being developed for controlling charging and discharging processes in the smart grid. The idea is to use the batteries of electric vehicles as small incoming and outgoing feeders that can be connected as required.

**NEW PERSPECTIVES THANKS TO INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)**

The overall system will only function if the users, vehicles, charging station and power companies are all connected to one another in the future via communication technology. Vehicle manufacturers, power companies and ICT firms must work together to develop integrated solutions. Users need to know where they can charge up their car, when their battery is full and how to pay for what they consume. The power companies need the consumption data to ensure the stability of the grid through skilful management of the charging process. The information and communication technologies will form the interface between the users and the operating companies.

If data from public transport operators and other providers of mobility services can be integrated into a single system, this will create some of the most important conditions for "integrated mobility". Users who are able to get around flexibly and conveniently by relying on various interconnected mobility services (public transport, e-car sharing, e-bikes, hire bikes, etc.) will barely miss having their own car. The key to setting up such networks already exists: over a billion smartphones are sold worldwide every year.



Photo: Climate and Energy Fund / Astrid Bartl

Austria is a leading global supplier to the automotive industry. Approximately 175,000 people are employed in this sector and are responsible for creating 38 billion euros of added value. To make sure this role can be maintained in the future and to ensure progress in terms of energy, climate and environmental policy, bmvit has been supporting the development of electric vehicles and the associated components by running specific programmes for more than 15 years.

The flagship projects of the Climate and Energy Fund are an extremely important tool in bmvit's effort as it strives to meet the challenges of industrial policy while also hitting the binding targets of the European Union in the area of climate policy. This is because they close the gap between technology development and commercialisation by relying on system integration and serving as a visible demonstration of Austria's technological expertise. For small countries with a strong supply industry like Austria, cooperation between public and private partners as well as collaboration at an international level are extremely important. That is why, in addition to supporting individual projects, bmvit also supports PPP such as A3PS and is heavily involved in transnational research cooperations as part of the IEA, IPHE and the Fuel Cells and Hydrogen Joint Undertaking.



Photo: bmvit

### EVELINDE GRASSEGGER

Head of Unit, Mobility and Transport Technologies  
Federal Ministry for Transport, Innovation and Technology



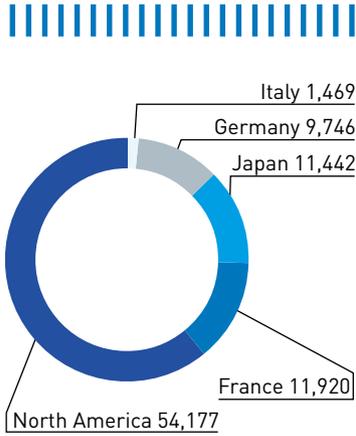
Photo: Climate and Energy Fund / Astrid Bartl

### MORE KNOWLEDGE ABOUT FUTURE USERS

The introduction of electric mobility calls for new transport concepts and a new approach to mobility management. Alongside the economic and ecological aspects, the general political framework also has a role to play in this regard. However, the ability of electric mobility to spread ultimately comes down to whether it is sufficiently accepted by the population. In this sense, it is extremely important to analyse user behaviour, user acceptance and any barriers.

What ranges are required, how reliable do electric vehicles have to be, how much can they cost and under what conditions will users be prepared to change their mobility behaviour? Consequently, demonstrations and test runs involving the new technologies and concepts, and the systematic evaluation of empirical user data obtained from pilot projects will be vital when it comes to the further development of electric mobility.

# GETTING ELECTRIC MOBILITY MOVING – INTERNATIONAL TRENDS



Registration figures for BEV and PHEV, January to June 2015

**SOURCES**  
 E-mobility index – Q3 2015, published by Roland Berger – Automotive Competence Center & Forschungsgesellschaft Kraftfahrwesen mbH, Aachen 2015  
 "Elektromobilität 2024" roadmap, published by Austrian Mobile Power, the e-mobility alliance, Vienna 2014, p.18 [www.austrian-mobile-power.at/amp/user\\_upload/Roadmap\\_AMP\\_2014\\_20141201\\_Upload\\_20141218.pdf](http://www.austrian-mobile-power.at/amp/user_upload/Roadmap_AMP_2014_20141201_Upload_20141218.pdf)  
 Internationaler Vergleich Pkw-Neuzulassungen (International Comparison of New Passenger Car Registrations) (Statistik Austria, 2014), (inMotiv Nederland B.V, 2014), (Opplysningsrådet for Veitrafikken AS, 2014), calculation provided by Austrian Mobile Power.

At an international level, the electrification of vehicles is set to increase even further in the future. Aside from technological improvements and reductions in the cost of purchasing vehicles, growth will also depend on what kind of general framework is put in place, e.g. tax incentives or direct subsidies. In the great automotive nations, the **registration figures** for battery electric vehicles (BEV) and plug-in hybrid vehicles (PHEV) remain fairly insignificant.

The countries that are leading the way in the area of electric mobility are Norway and the Netherlands. By introducing various tax relief

mechanisms, both of these countries have created good conditions for private and business vehicles alike. In Norway, purchasers of electric cars are not only exempt from paying VAT on their purchase (at a rate of 25 %), but also from the registration fees, import and customs duties, and the special car purchase tax that is based on the type of engine and the vehicle's exhaust values. In addition, Norway also believes strongly in indirect incentives. Drivers of electric cars do not pay any road toll charges, can access free electricity at public charging stations, are allowed to use bus lanes and enjoy free parking at a large number of public car parks.

## New electric vehicle registrations as a percentage of total new passenger car registrations annually

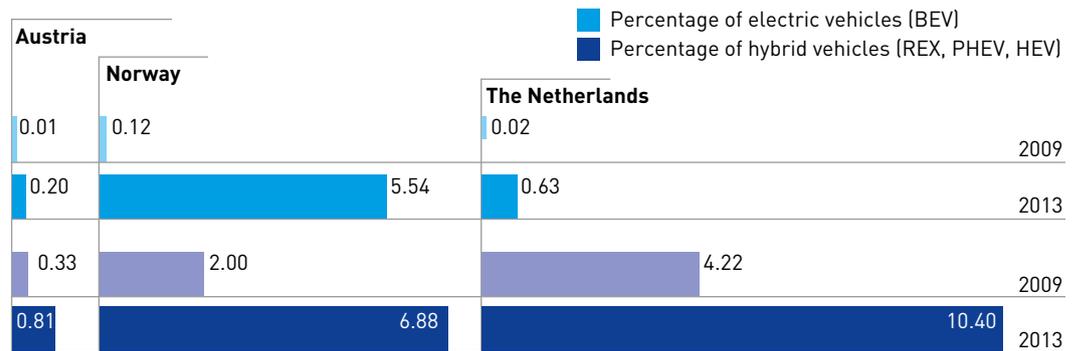


Photo: VERBUND AG

Electric mobility is the key to achieving a sustainable reduction in the energy consumption and CO<sub>2</sub> emission levels associated with private transport. Austria has the best foundations for electric mobility because most of its electricity is already produced from renewable sources. VERBUND, which generates approximately 95 % of its electricity from renewables, has been firmly behind electric mobility for years and is championing projects and e-mobility programmes across Austria and at an international level. Electric mobility is enabling us to realise our vision of pollution-free private transport, which spans everything from quiet, emission-free towns/cities to smart homes, where self-generated electricity can be flexibly stored and fed into the vehicle.

### WOLFGANG ANZENGRUBER

Chairman of the Managing Board of VERBUND AG

Electric mobility is going to play a significant role in the mobility system of the future. This will lead to changes that extend beyond the confines of the conventional automotive sector by opening up all kinds of opportunities for other sectors as well, such as the electrical and electronic industry. That is why new competencies and market positions must be established now to ensure success in the medium to long-term, expand market shares and create extra jobs.

In the area of transport, new concepts will make it possible to boost efficiency, reduce emissions significantly and achieve decarbonisation. The roll-out of new drive technologies has huge potential for possible courses of action and value creation options that will put Austria in a stronger position as a location. With their dedication and commitment, our member companies will help us overcome the challenges of the future. In this sense, the "Electric Mobility Flagship Programme" is a major incentive to support and press ahead with structural change.

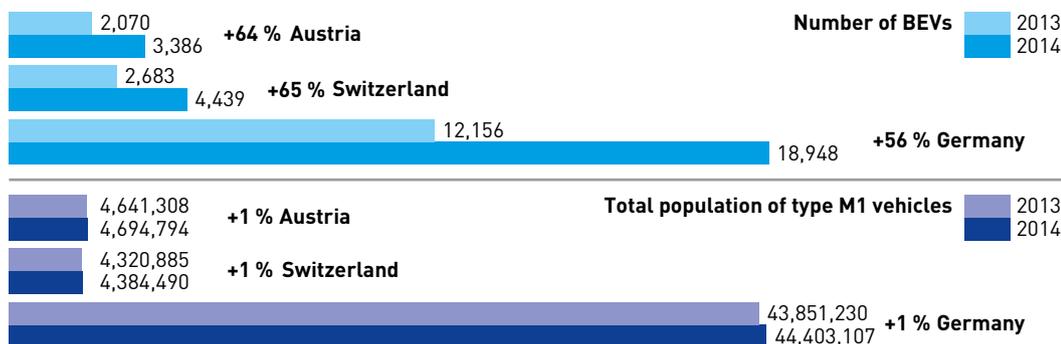
### CHRISTOPH LEITL

President of the Austrian Federal Economic Chamber (WKO)



Photo: WKO

#### A comparison of the existing vehicle population figures for Germany, Austria, Switzerland (2013 and 2014)



#### SOURCES

Elektromobilität 2014, Monitoringbericht (Electric mobility 2014, Monitoring Report), published by AustriaTech – Gesellschaft des Bundes für technologiepolitische Maßnahmen GmbH, Vienna 2015, p.10 [www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil\\_monitoring\\_2014.pdf](http://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil_monitoring_2014.pdf)

Germany: 2013: [http://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/Umwelt/2014\\_b\\_umwelt\\_dus\\_absolut.html?nn=663524](http://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/Umwelt/2014_b_umwelt_dus_absolut.html?nn=663524).

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Austria: [www.statistik.at](http://www.statistik.at)  
Switzerland: STAT-TAB: The interactive statistics database; <http://www.pxweb.bfs.admin.ch/Dialog/Saveshow.asp>

Over the last few years, Germany and the United Kingdom have also started paying more attention to low-emission vehicles when setting vehicle tax rates. In Austria, electric vehicles have become fully input tax deductible as of the 2016 tax reform. Moreover, electric company vehicles are now 100 per cent exempt from the previously applicable regulations governing benefits in kind.

Compared with the rest of the D-A-CH region (Germany, Austria, Switzerland), Austria is certainly holding its own as regards the growth in vehicle numbers. In Switzerland and in Austria, there was a sharp rise in the number of BEVs (more than 60 %) compared with 2013. The percentage rise achieved by Germany was just below this level. In January 2016, Austria saw growth of 139 % in this area.

As they set about implementing EU Directive 2014/94/EU (which covers the deployment of a charging infrastructure for alternative fuels), individual EU countries are creating official registers so that information about the growing number of charging stations can be retrieved more easily in the future. There are already scores of private platforms that provide data about charging points for electric vehicles. Initiatives such as the ChargeMap.com service attempt to provide comparisons of public and semi-public charging stations. According to this platform, the countries with the most charging stations are the Netherlands (more than 5,500), followed by France (just over 3,900), Germany (3,148) and the United Kingdom (just under 1,800). With its 641 charging stations Austria appears ninth in this list.



Photo: Climate and Energy Fund / Ringhofer

# ELECTRIC MOBILITY IN AUSTRIA – OPPORTUNITIES AND OUTLOOK



Photo: Climate and Energy Fund / Ringhofer

## SOURCES

[www.statistik.at/web\\_en/statistics/EnergyEnvironmentInnovationMobility/transport/road/registration\\_of\\_new\\_vehicles/index.html](http://www.statistik.at/web_en/statistics/EnergyEnvironmentInnovationMobility/transport/road/registration_of_new_vehicles/index.html)  
→ pdf for new registrations 2016

[www.statistik.at/web\\_de/statistiken/energie\\_umwelt\\_innovation\\_mobilitaet/verkehr/strasse/kraftfahrzeuge\\_-\\_bestand/index.html](http://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/verkehr/strasse/kraftfahrzeuge_-_bestand/index.html)  
→ pdf for existing registrations 2016

In Austria, the high proportion of renewables within the energy mix provides a solid foundation for creating a sustainable and environmentally sound mobility system. As a key technology, electric mobility holds massive potential for generating high levels of added value and employment in Austria in the long term. Austrian industry and a large number of innovative companies are supplying cutting edge technology for vehicles, infrastructure and smart mobility solutions.

The acceptance of electric mobility has been increasing in Austria for years. Public transport in many of the conurbations is already being enhanced thanks to the introduction of environmentally friendly hybrid and electric buses. E-taxi and e-car sharing concepts are being developed and trialled in various regions. In 2011, more than 30,000 electric bikes were sold, with the figure rising to around 45,000 units in 2012.

## New electric car registrations in Austria

As at: 01/2016



There is also an ever-widening choice of electric cars. Currently, there are more than 15 different types of battery electric vehicle available on the Austrian market. In addition to these, new hybrid and plug-in hybrid vehicles are being introduced all the time, along with range extender vehicles.

Nevertheless, electric vehicles remain a niche product within the private transport sector. In spite of significant growth rates, only around 5,500 electric vehicles and approximately 16,170 hybrid vehicles are currently to be found driving around on Austria's streets (out of a total of roughly 4.75 million). For this reason, research facilities and companies are working on new solutions to break down the psychological barriers that are known to put people off (vehicle range is too short, high purchase costs and inadequate charging infrastructure).

## Existing population of electric cars in Austria

As at: 01/2016

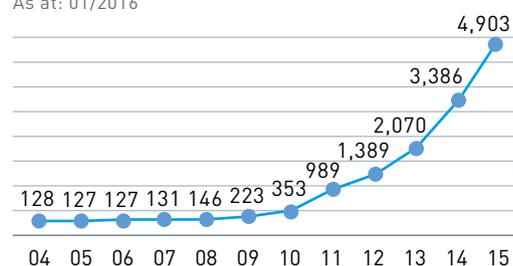


Photo: Fronius International GmbH

In the area of electric mobility, Fronius is focusing on alternative drive technologies for logistics vehicles. New developments, such as the lithium-ion battery, the fuel cell and the hybrid drive, have the potential to become established solutions within intralogistics and to pose a serious challenge to conventional batteries – electric industrial trucks are not only powerful; they also help protect health and the environment.

Fronius has already launched several projects with companies such as the intralogistics provider Linde-MH, DB Schenker (as a user) and the hydrogen supplier OMV – this has been a positive experience and so is a vindication of the innovative concepts involved. However, for us, alternative non-fossil drive solutions are just one part of a bigger picture: comprehensive energy supply based on the use of renewables. The Fronius vision is called "24 hours of sun". Thus, the future aim is for everyone to be able to charge up their electric vehicle at home easily and conveniently – using electricity produced by their very own photovoltaic system.

## ELISABETH STRAUSS-ENGBRECHTSMÜLLER

CEO of Fronius International GmbH

In the area of electric mobility, it is essential to think about and discuss the issues across the various sectors so that holistic solutions may be found. Electric mobility is a complete system (comprising electric vehicles, the charging infrastructure and new service infrastructures) that is based on the achievements of those involved in research & technology development. Currently, the most urgent basic requirement that must be met with regard to electric mobility is interoperability. To ensure that different systems are able to interact without any obstacles, a legal framework must be put in place on the basis of standards and proven development paths and then used to create a clear structure for advanced technologies.

To this end, Austrian Mobile Power's core activities include participation in technical standardisation bodies as well as the advisory and expert groups of the European Commission's Sustainable Transport Forum, of UNECE and of UN-Habitat. What is currently missing in Austria is an intensive and – in particular – a structured model of cooperation between the Federal Government, the federal provinces and towns/cities (on the one hand) and the business world (on the other). After all, one thing is certain: The ability to cooperate on research-related and user-related topics in line with market requirements is a key success factor for ensuring user-friendliness.

### HEIMO AICHMAIER

CEO of Austrian Mobile Power



Photo: Juergen Hammerschmid

## FUTURE MARKET FOR ELECTRIC MOBILITY

As a technology field, electric mobility offers Austrian companies excellent opportunities to position themselves internationally with new developments. The study entitled "Elektromobilität. Chance für die österreichische Wirtschaft" ("Electric mobility. An opportunity for the Austrian economy") (BMWfj, IV, WKÖ 2012) reveals just how much potential electric mobility holds for Austria.

When it comes to the added value and jobs that are linked directly to automotive production in Austria, electric mobility could bring about an increase of more than 70 % by 2020. According to calculations, the direct potential for added value in 2030 stands at around 1.2 billion euros. The highest levels of potential for Austria are thought to lie in the following components: the traction battery, power electronics, electric engine and body.

There is a great deal of potential for the electrical and electronic engineering industry (EEI) as a supplier to the electric mobility sector.

This covers everything from the manufacture of parts and the production of control systems and electric engines right through to the development of new technologies for the entire infrastructure (e.g. control systems for the charging stations, power engineering and ICT solutions for user-friendly mobility services). >>>

SOURCE  
Elektromobilität. Chance für die österreichische Wirtschaft [Electric mobility. An opportunity for the Austrian economy], BMWfj, IV, WKÖ, Vienna 2012

### Number of full-time jobs attributable to electric vehicles

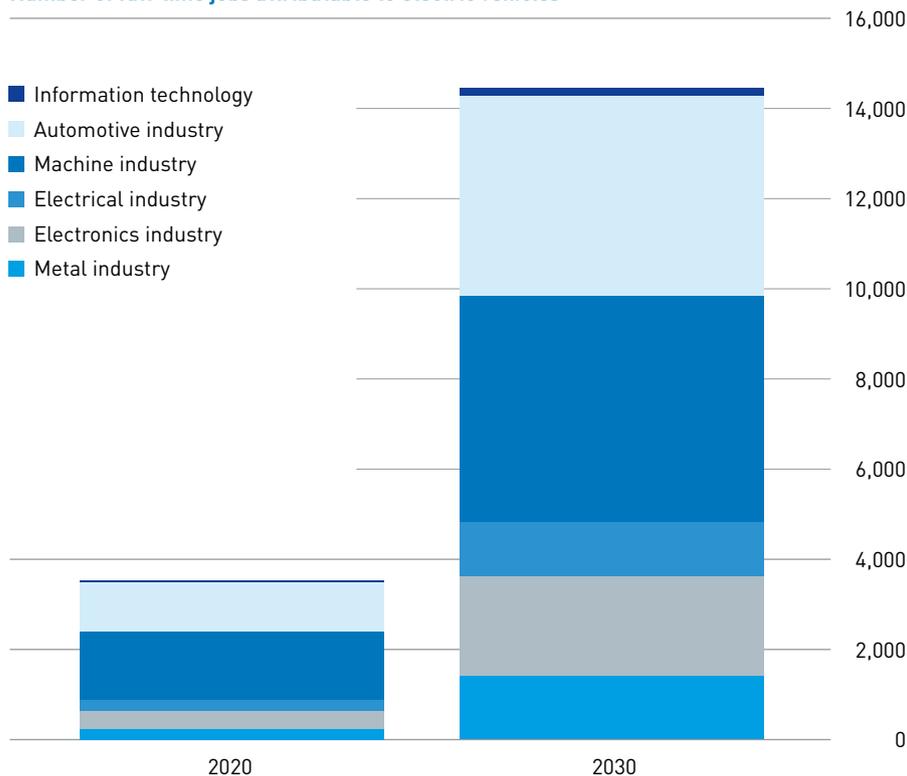




Photo: bmvit

For Austria, innovations within electric mobility are absolutely vital if it is to remain competitive as a key centre of technology. That is why – as the ministry in charge of innovation and technology – we have spent the last seven years supporting further development work and, in particular, visible demonstrations of Austria's expertise in the areas of vehicles, infrastructure, and mobility and energy services.

#### **PETRA BURGHOLZER**

Electric mobility Coordinator  
Federal Ministry for Transport, Innovation and Technology

### SMART INFRASTRUCTURE

On the Austrian market, there are more than 50 different models of charging pillar/wall box available from a variety of manufacturers and for all application areas (private, publicly accessible and public charging infrastructure).

The expansion of the charging structure is being championed by the Austrian power companies. As part of this, the "Bundesverband Elektromobilität Österreich" (the Austrian Federal Association for Electric Mobility, or "BEÖ" for short) is supporting the establishment of an interoperable and comprehensive network of charging stations. The EMPORA flagship project has resulted in the SMATRICES network, a high-performance charging network with more than 380 charging points covering the whole of Austria. The charging pillars are located all along the Austrian motorways at 60 km intervals and also in the main conurbations. 100 % of the electricity comes from hydropower.

By relying on modern communication technology, intelligent charging stations are able to exchange data with the vehicle. This means, for example, that reservation, payment and roaming functions can be offered via various payment systems and smartphone apps.

As part of the process of implementing EU Directive 2014/94 on the deployment of alternative fuels infrastructure, Austria – like other countries – must set up a standard register to provide information about where the publicly accessible service stations and charging points for alternative fuels are located.

Various electric fuel station locators are already making it easier for people to find charging stations. For instance, the e-connected platform is home to various providers ([www.e-connected.at/content/e-tankstellenfinder](http://www.e-connected.at/content/e-tankstellenfinder)). However, Austria still lacks a comprehensive map that covers all the operators and shows private charging stations in addition to the publicly accessible ones.



Photo: Climate and Energy Fund / Ringhofer

#### SOURCES

"Elektromobilität 2024" roadmap, published by Austrian Mobile Power, the e-mobility alliance, Vienna 2014, p.19  
[www.austrian-mobile-power.at/amp/user\\_upload/Roadmap\\_AMP\\_2014\\_20141201\\_Upload\\_20141218.pdf](http://www.austrian-mobile-power.at/amp/user_upload/Roadmap_AMP_2014_20141201_Upload_20141218.pdf)



Photo: Climate and Energy Fund / Astrid Bartl

## SUSTAINABLE ENERGY SUPPLY

The Austrian power companies are actively involved in the area of electric mobility and are busy developing solutions to create a user-friendly infrastructure. The core tasks are to ensure a secure and sustainable power supply and to integrate electric vehicles into the power networks intelligently. By incorporating electric mobility into our energy system, the power industry is making a major contribution towards reducing CO<sub>2</sub> emissions. Because Austria has such an environmentally friendly electricity mix, a fully electric battery vehicle there produces around 80 per cent fewer CO<sub>2</sub> emissions than a conventionally fuelled passenger car.

The additional electricity consumption generated by electric vehicles poses absolutely no problem at all. Even if there were 100,000 partially or fully electric vehicles, electricity consumption in Austria would increase by less than 0.2 % compared with the current level. And if all passenger cars were to become electrically powered, electricity consumption would rise by around 5 billion kilowatt-hours a year. Given that approximately 71 billion kilowatt-hours of electricity are produced every year, this corresponds to an increase of roughly 7 %.

### SOURCES

"Elektromobilität 2024" roadmap, published by Austrian Mobile Power, the e-mobility alliance, Vienna 2014, p.20 [www.austrian-mobile-power.at/amp/user\\_upload/Roadmap\\_AMP\\_2014\\_20141201\\_Upload\\_20141218.pdf](http://www.austrian-mobile-power.at/amp/user_upload/Roadmap_AMP_2014_20141201_Upload_20141218.pdf)

BEÖ represents the interests of eleven Austrian power companies. One of our biggest tasks is to create an interoperable and comprehensive network of charging stations. The aim is for users of electric mobility to be granted easy and open access to e-mobility offerings. In addition, BEÖ campaigns for future technology such as inductive charging or the operation of hydrogen vehicles.

To achieve a long-lasting impact on the environment, on transport, on energy and on the infrastructure, there must also be broad support for research and development work. Through its research projects, the "Electric Mobility Flagship Programme" is going a long way towards ensuring that Austrian technology can establish itself successfully in the marketplace.

### KATHARINA OLBRICH

Secretary General, Bundesverband Elektromobilität Österreich (BEÖ)



Photo: Kristine Veit Photography

# ELECTRIC MOBILITY FLAGSHIP PROJECTS – AIMS OF THE PROGRAMME



Photo: Climate and Energy Fund / Astrid Bartl

The automotive and automotive supplier industry is one of the most important industrial sectors in Austria. It employs around 175,000 people and has a turnover of approximately 38 billion euros. At the same time (conventionally fuelled) transport is one of the biggest emitters of CO<sub>2</sub> and a major source of climate pollution. This inevitably contributes to man-made climate change, along with all the negative consequences that this entails. The most recent results from research into climate change in Austria have not only revealed that the impact of climate change on the country is twice as high as the global average but also that climate damage is already costing it somewhere in the order of one billion euros a year. Unless something is done, this could rise to around eight billion euros a year by the middle of the century. Consequently, the need for action is not just an ecological but also an economic imperative. In light of this, the Climate and Energy Fund is working hard to bring about a mobility transition. One of the cornerstones of its efforts is the "Electric Mobility Flagship Programme".

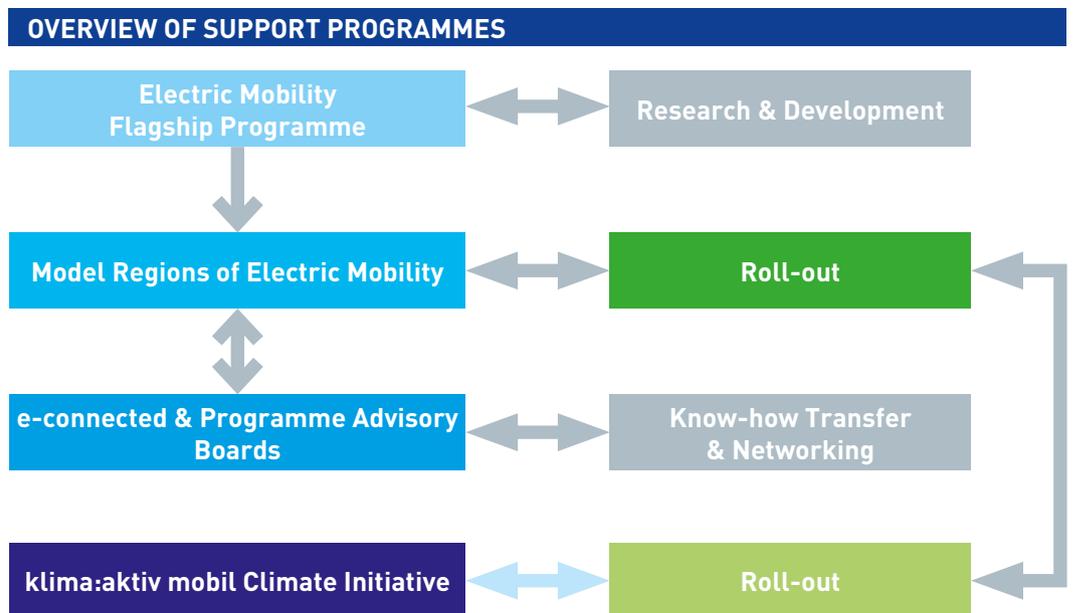
The Climate and Energy Fund has been supporting research activities in the field of electric mobility since 2009. Right from the start, it opted for an approach that is intentionally technology-neutral and holistic. Over time, it has become clear that the approach adopted by the Climate Fund – i. e. viewing electric mobility as the interplay between the vehicles, the infrastructure and the users – was exactly the right one to take. The flagship projects have created an opportunity for stakeholders from all kinds of areas (such as automotive engineering, software development, usability optimisation and even transport planning) to tackle the issue of electric mobility together and in a highly focused manner. Not only has this provided new players in Austria with a chance to become active in the area of electric mobility, but it has also generated clear added value for everyone involved. Thanks to the way the programme has been overseen, both the existing stakeholders and the constant flow of new ones have been brought together in one network, thereby creating a framework for joint projects.

This chart provides an overview of the relationships between the support instruments of the Climate and Energy Fund.

The "Electric Mobility Flagship Programme" is firmly embedded in the overall strategy of the Climate and Energy Fund.

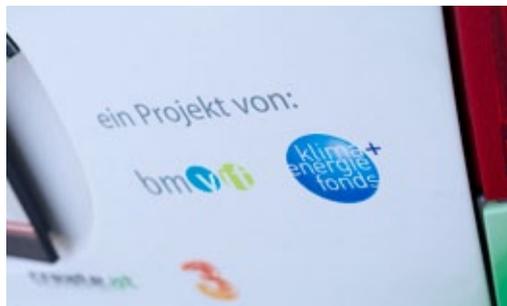
The "Model Regions of Electric Mobility" support the development of new mobility models and are responsible for testing whether electric vehicles are suitable for everyday use in conjunction with renewable energies.

[www.klimafonds.gv.at/our-topics/e-mobility/](http://www.klimafonds.gv.at/our-topics/e-mobility/)  
[www.e-connected.at](http://www.e-connected.at)  
[www.smartcities.at/home-en-us/](http://www.smartcities.at/home-en-us/)  
[www.klimaaktiv.at/english.html](http://www.klimaaktiv.at/english.html)





Photos: Climate and Energy Fund / Astrid Bartl



Electric mobility is/could be so much more than simply swapping conventional vehicles for electric ones. Rather, it is a question of rethinking the entire (electric) mobility system and maximising the opportunities afforded by new technologies (whether in terms of the power train or other relevant fields of technology) so that we can offer users alternative forms of mobility that are sustainable, energy-efficient and climate-friendly.

In view of this, the Climate and Energy Fund has consistently aligned its "Electric Mobility Flagship Programme" with the guiding principles of technology neutrality, having a clear mission and viewing electric mobility in holistic terms. This brochure demonstrates how this has been instrumental in helping Austrian companies to position themselves in the area of electric mobility and, in turn, has helped make a substantial contribution towards the mobility transition both within Austria and beyond.

### GERNOT WÖRTHNER

Project Manager and Controller, Climate and Energy Fund



Photo: Climate and Energy Fund

The past few years have also revealed just how quickly and dynamically this area is evolving. When the support programme was first launched, many technical questions were still unanswered and the first electric cars had a long way to go before they would be ready for the mass market. In recent years, huge progress has been made in this regard. For instance, the flagship projects have also allowed substantial progress to be made concerning the degree of maturity of the technology, that is, the extent to which it is ready for the market. A few examples worth mentioning here are the flywheel that was developed as part of the CMO flagship project; Europe's first ever indoor hydrogen fuelling system, which formed part of the E-LOG-Biofleet project; and the demonstration vehicles that arose from the EMPORA and VECEPT flagship projects.

The various schemes supported through the "Flagship Programme" reveal the sheer scope and breadth of the issue. The projects have been used to develop solutions for individual electric vehicle components (such as the flywheel and the battery cooling unit) by relying on a highly focused approach. However, they have also looked at the question of how to enable optimum connection to a future charging infrastructure and how to achieve the most energy-efficient forms of routing and fleet management. In addition,

they have considered the question of how to link electric mobility solutions to the transport system as a whole. In each of these areas, they have managed to develop forward-thinking approaches with a view to strengthening the ability of Austrian companies to compete.

Despite the fact that considerable successes have been achieved in the area of electric mobility over recent years, there is still a great deal more to do. In the next few years, some very exciting questions will emerge as researchers attempt to address a whole host of research areas. To name but a few, these include: how to reduce the cost of the battery while at the same time increasing its storage capacity, how to mass-produce electric vehicles in a cost-effective manner, how to reduce the weight of the vehicle by using lightweight components, how to merge information and vehicle technology, how to achieve smart integration into multimodal mobility solutions and how to recycle the constantly growing number of electric cars.

That is why the Climate and Energy Fund will continue to actively support these areas in the future and will help ensure that Austrian technology and Austrian companies are responsible for driving the transformation that will ultimately lead to a climate-friendly transport system.

# SUCSESSES AND FUTURE OUTLOOK – EVALUATION OF THE PROGRAMME



Photo: Climate and Energy Fund / Astrid Bartl

The Climate and Energy Fund launched its research and technology programme called "Electric Mobility Flagship Programme" in 2009. Following the 3rd call, the mid-term results of the support programme were evaluated on behalf of the Climate and Energy Fund. The analysis, which was carried out by the Prognos, ProgTrans and TÜV Rheinland consortium, confirmed that the programme has exactly the right kind of purposeful approach and that it truly stands out on the (inter)national research landscape.

The programme brings together a wide range of partners from along the entire length of the electric mobility value-added chain, from the research stage right through to market launch. As a result, important stakeholders are involved in key projects, from SMEs through to large corporations from all kinds of sectors. The programme's system-focused approach (i. e. its focus on electric mobility as part of an integrated transport system) makes it completely unique at an international level.

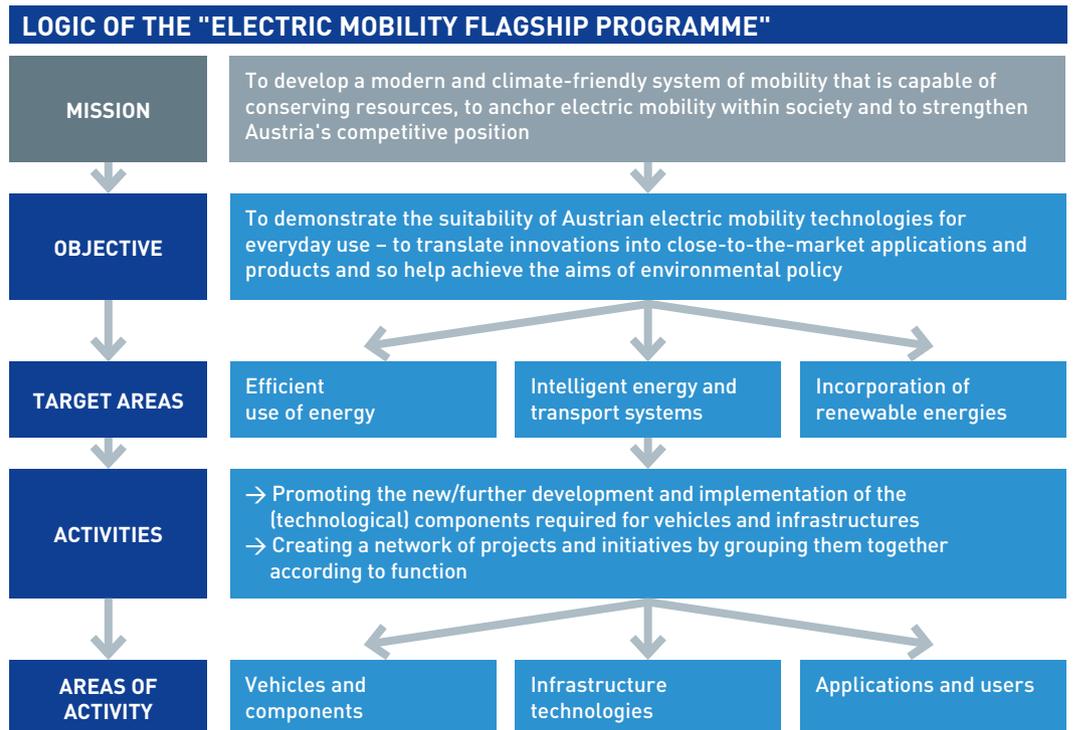
When it comes to integrating electric vehicles into complete systems, Austrian companies and research facilities have a major contribution to make on the international markets. Up until now, this kind of system-focused perspective has only really been seen to a partial extent (mobility: France; energy: USA, Japan) and yet it is crucial if the "electrically mobile" future is to become a reality.

### Motivation of the programme participants

The majority of companies participating in the programme are primarily motivated by the fact that it gives them an opportunity to form new cooperative partnerships and allows them to open up market access for their technologies/focal areas. Another powerful motivator that encourages companies to take part in the programme is the prospect of increasing their knowledge and expertise in the area of electric mobility. Almost 90 % of the companies surveyed confessed that they would not have been able to carry out their activities within the pro-

**SOURCES**  
Mid-term evaluation of the research and technology programme "Electric Mobility Flagship Programme" with an emphasis on calls 1 to 3, carried out on behalf of the Climate and Energy Fund by Prognos AG, ProgTrans AG, TÜV Rheinland Consulting GmbH, Berlin 2013

All diagrams on pages 20/21 sourced from: Prognos/ProgTrans/TÜV Rheinland 2013



ject, or would not have been able to carry them out to the planned extent, without the support that they have received. The main obstacles cited were the lack of opportunities for cooperation and the high investment costs.

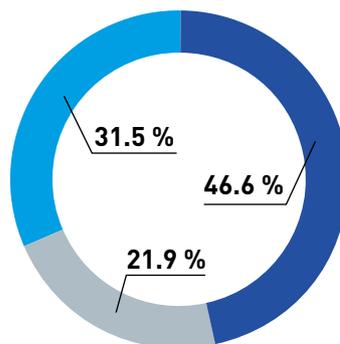
**Programme objectives are being achieved**

The projects accommodate all the objectives of the programme. According to 85 % of the project participants, the primary objective is to create a sustainable, affordable and intelligent energy/transport system that incorporates electric mobility.

**Necessary future steps**

Back in 2014, some adjustments were made to the support programme with a view to defining clear expectations for transport and technology policy and enabling long-term planning certainty for those receiving the support. The system-focused perspective still lies at the heart of the research programme – rather than seeking to develop individual components, supported flagship projects should keep their eyes set on the system integration of the technologies they develop.

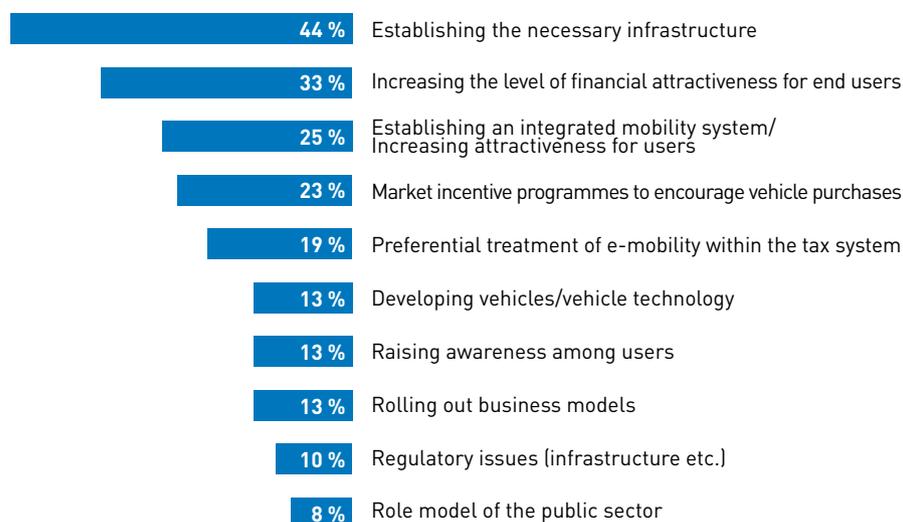
The aim here is to demonstrate Austria's technological expertise and show how it is innovatively devising an electric mobility system by drawing on the know-how of complementary partners. The content of the programme has been defined for the years up to and including 2017. The future direction of the programme and its ongoing adaptation are to be determined as part of a strategy process.



**What technology/topic is the primary focus of your activities as part of the project?**

- Vehicle technology (including energy storage)
- Infrastructure technologies (intelligent charging stations, grid integration etc.)
- Applications and users (integration into the transport system etc.)

During the mid-term evaluation of the programme, the participants and experts were asked to say what factors they thought were critical for implementing electric mobility in Austria. They identified the following issues:



Over recent years, SIEMENS has participated in a number of ground-breaking flagship projects in the area of electric mobility and has undertaken a huge amount of research, built up considerable know-how and developed a broad technological portfolio. As far as we are concerned, electric mobility is about much more than simply replacing the type of energy that powers the vehicles. Rather, electric mobility calls for completely new mobility concepts. There are implications for the vehicles, the entire transport system and the electrical infrastructure because, ultimately, electric cars are also active participants in the grid.

The SIEMENS portfolio encompasses technologies from all along the value-added chain – including everything from efficient electric engines plus power electronics for vehicles and inductive charging technologies right through to the infrastructure that will be required for the grids of the future. Aside from the issues of technical development and market positioning, another important question that must undoubtedly be faced is how to leverage the situation for the purpose of protecting the climate. In particular, if the electricity we use to power our cars can be drawn from renewable sources and generated efficiently, the benefits of electric mobility will also be fully extended to the climate as well. Thanks to technology from SIEMENS, the perfect conditions for achieving this are to be found in Austria.

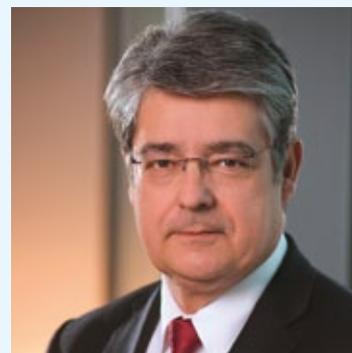


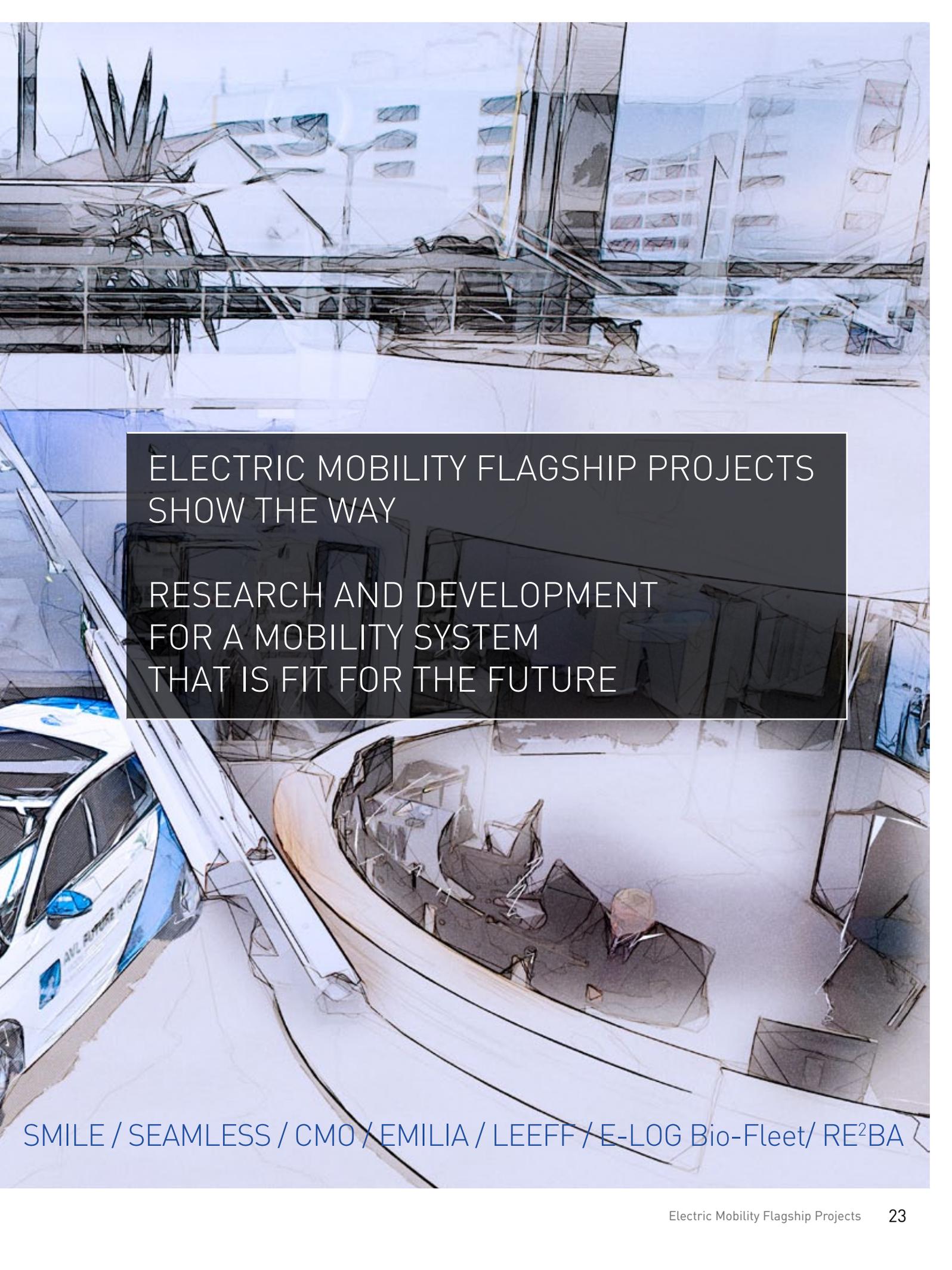
Photo: SIEMENS AG

**WOLFGANG HESOUN**

CEO of SIEMENS AG Austria



EMPORA / CROSSING BORDERS / VECEPT / eMPROVE / eMORAIL /



ELECTRIC MOBILITY FLAGSHIP PROJECTS  
SHOW THE WAY

RESEARCH AND DEVELOPMENT  
FOR A MOBILITY SYSTEM  
THAT IS FIT FOR THE FUTURE

SMILE / SEAMLESS / CMO / EMILIA / LEEFF / E-LOG Bio-Fleet/ RE<sup>2</sup>BA

# EMPORA 1 & 2

## E-MOBILE POWER AUSTRIA

EMPORA is Austria's largest cooperative R&D project in the area of electric mobility. 22 leading firms from the automotive, power, infrastructure and research sectors have spent several years working on integrated technical and organisational solutions to facilitate the large-scale deployment of electric mobility across Austria. This extensive project is laying the foundations for reducing emissions and improving energy efficiency in the area of transport and is revealing how the energy turnaround in mobility can be achieved in concrete terms.

## EMPORA

E-MOBILE POWER AUSTRIA

### CONTACT

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### PROJECT PARTNERS

A1 Telekom Austria AG / AVL List GmbH / BEKO Engineering & Informatik AG / DiTest Fahrzeugdiagnose GmbH / EVN AG / Fluidtime Data Services GmbH / Ecotech / Infineon Technologies Austria AG / LINZ STROM GmbH / MAGNA E-Car Systems GmbH & Co OG / Österreichisches Forschungs- und Prüfzentrum Arsenal GmbH (AIT) / Raiffeisen Leasing GmbH / REWE International AG / Salzburg AG für Energie, Verkehr und Telekommunikation / Siemens AG Österreich / The Mobility House GmbH / UBIMET GmbH / VERBUND AG, Wien Energie GmbH / Wiener Linien GmbH & Co KG

The new forward-thinking concepts and solutions for electric mobility in Austria cover everything from the vehicle technology, the infrastructure and the integration of renewables right through to mobility offerings and services for end customers. Examples include powertrain/charging/storage components in the car itself, intelligent charging pillars that are able to communicate with both vehicles and users, smart grids, tools for energy-efficient routing and concepts for new business models. The EMPORA 1 and 2 projects have unified the diverse approaches and brought together know-how from all the relevant economic sectors and research areas.

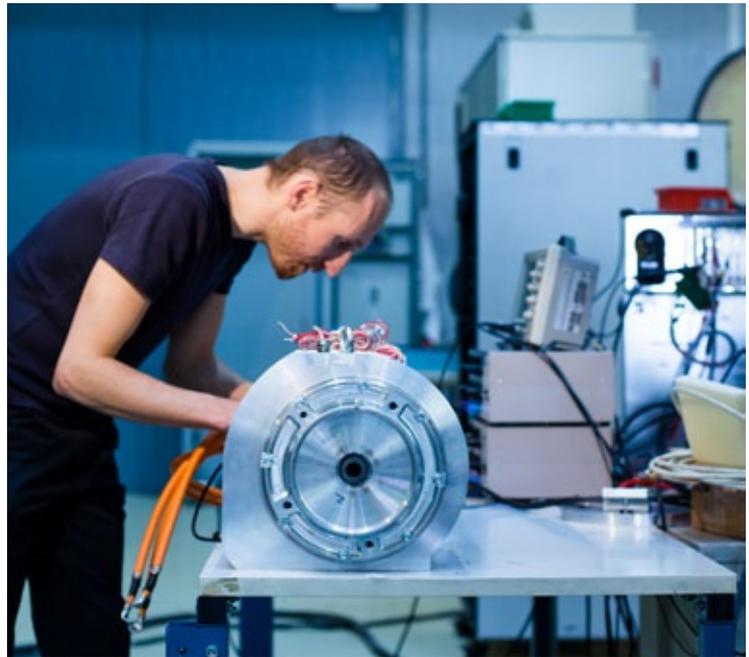
The new technologies and concepts are to be implemented within the context of a jointly developed system architecture. With this in mind, the first part of the project involved defining the roles, tasks and interfaces for the various players involved. The main requirement is to ensure that the needs of customers are met. The desire is to create incentives for using environmentally friendly electric vehicles by offering attractive and convenient solutions. EMPORA 2 focused mainly on infrastructure solutions, roaming concepts and how to embed electric mobility in multimodal mobility systems. All the results of the project were demonstrated in practice by allowing test users to try out the infrastructure technologies and service offerings in real-life situations.



All photos: Climate and Energy Fund / Astrid Bartl



Photo: VERBUND AG



AIT engine test bench, photo: Climate and Energy Fund / Astrid Bartl

### High-tech solutions for electric vehicles

MAGNA E-Car Systems, AVL and Infineon developed new power train solutions as well as new vehicle charging and storage technologies with a view to making electric cars more suitable for everyday use and more cost-effective in the future. The components and software solutions were installed in a demonstration vehicle featuring a range extender (a two-cylinder piston engine) and with a total driving range of 400 km (175 km of which could be covered by the electric engine alone).

The researchers managed to optimise the electric power train and other EV system components in terms of their cost, weight, efficiency, safety and suitability for series production. The on-board AC/DC converter (charger) was similarly improved with regard to space requirements, weight and cost, and a highly efficient modular

system was developed for the 3.3 kW to 10 kW power range. As far as the batteries are concerned, new installation concepts were devised to enable better mechanical, electrical and thermal integration into the vehicle. This took account of how much storage space is normally provided in vehicles as standard and how much storage space customers want.

### Smart infrastructure

In the area of infrastructure and energy (coordinated by SIEMENS AG Österreich, VERBUND AG and Wien Energie), concrete solutions were implemented for the charging infrastructure and energy supply. The infrastructure encompasses the hardware for charging the vehicle, management systems for the charging stations, data management in the grid, the provision of renewable energy and the software for supporting the customers. >>>



Photo: VERBUND AG

*"EMPORA has set itself the goal of covering the entire e-mobility value-added chain and devising solutions accordingly: Getting partners from different sectors to cooperate has been the key to describing a complete system of electric mobility and using this as a basis for devising solutions that range from technological developments within the vehicle and the provision of energy from renewable sources right through to the testing of e-mobility services in conjunction with customers. This has clearly demonstrated that e-mobility can go a long way towards creating an ecologically sound transport sector."*

### Eva Maria Plunger

Project Leader, EMPORA & CROSSING BORDERS  
VERBUND AG



Photo: Climate and Energy Fund / Astrid Bartl

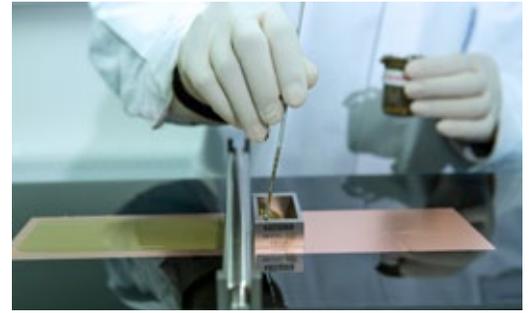


Photo: Climate and Energy Fund / Astrid Bartl

As part of the demonstration phase EMPORA charging stations were installed in Vienna and Graz. These were then accessed by the test users and have remained in operation ever since. With the launch of the follow-on project, which is called CROSSING BORDERS, the charging infrastructure is now being expanded to cover the entire country. In 2014, VERBUND and SIEMENS (two of the partners involved in the EMPORA project) founded a company called SMATRICES to take care of the operational running of the charging infrastructure.

#### **Electricity from renewable energy sources**

One of the core elements of the project involved looking at how energy from renewable sources could be made available for electric mobility. An analysis was carried out on the basis of simulations to examine what requirements would be placed on the energy supply and grid infrastructure in the future, and a system was devised for supplying green electricity in a traceable and transparent manner. With a view to enabling a higher level of market penetration by electric mobility, a concept was drawn up for the integrated management and control of electric vehicles (e.g. as flexible consumers) in the event of fluctuations in the supply of energy from renewable sources (wind, solar).

#### **Intelligent services for e-mobility**

Given the limited range of electric vehicles, it is particularly important that they be integrated into the transport system as a whole. To this end, AIT and its partners came up with concrete offerings and support services, such as energy-dependent routing solutions. Dynamic routing takes account of how much energy would be consumed on the various routes and also the current availability of the charging points. It is even possible to integrate up-to-date traffic data and options for reserving charging stations. During EMPORA 2, the partners built on this by developing a form of multimodal routing (i. e. one that incorporates multiple modes of transport).

#### **Demonstration phase involving test users**

During the test phase, which lasted one year, 25 customers from Vienna, Graz and Salzburg tried out the new technologies and services in practice. An electric vehicle was leased to each customer and they were provided with a comprehensive mobility offering. The testers were free to choose between various models (passenger cars and vans) and drive technologies (battery electric and plug-in hybrid vehicles). The mobility package included the home charging infrastructure (wall box), a card for accessing the public charging infrastructure and additional services such as membership of an automobile association and special car sharing and car hire offers.



Photo: Climate and Energy Fund / Astrid Bartl

#### **HIGHLIGHTS ▼**

- R&D along the entire electric mobility value-added chain
- Joint system architecture developed
- Interfaces between the relevant players defined
- Capabilities of Austrian companies increased within the e-mobility segment
- Experience swapped with international R&D projects and initiatives

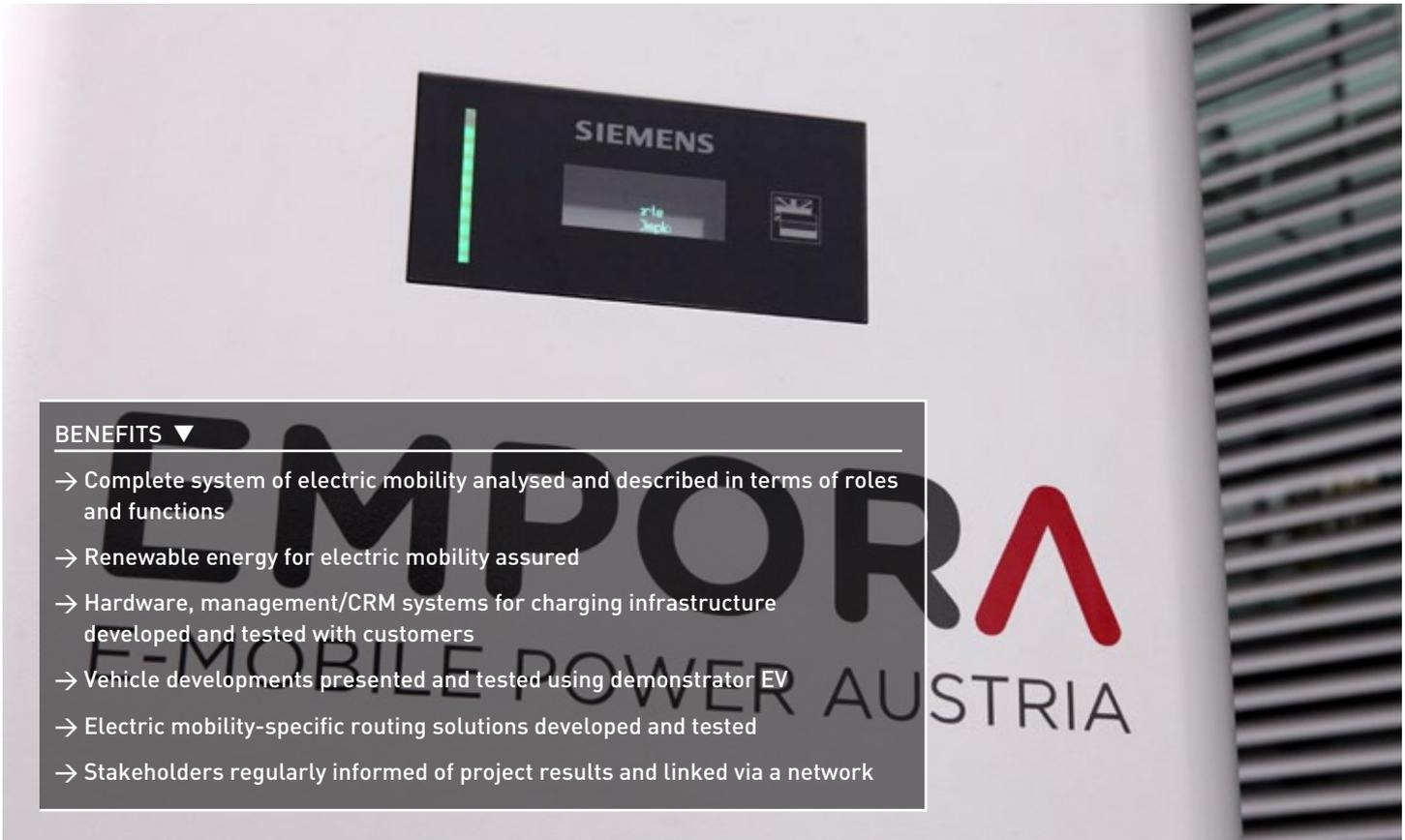


Photo: VERBUND AG

**BENEFITS ▼**

- Complete system of electric mobility analysed and described in terms of roles and functions
- Renewable energy for electric mobility assured
- Hardware, management/CRM systems for charging infrastructure developed and tested with customers
- Vehicle developments presented and tested using demonstrator EV
- Electric mobility-specific routing solutions developed and tested
- Stakeholders regularly informed of project results and linked via a network

**Follow-on projects**

The results of the EMPORA project are serving as a basis for the CROSSING BORDERS flagship project and the international CEGC (Central European Green Corridors) project, which is being funded by the trans-European transport networks (TEN-T).

Within this context, VERBUND is working with its international partners at a European level to implement a cross-border network of rapid charging stations along with cross-border roaming services (see page 28).

*"The EMPORA project involved partners from all along the value-added chain. This made it possible to obtain feedback on new components for the innovative area of electric mobility at an early stage and, in turn, this led to better decisions in relation to further development work. The results from EMPORA have helped to transform semiconductor switches for BEVs and PHEVs into a major area of business for Infineon."*

**Herbert Pairitsch**  
INFINEON TECHNOLOGIES AUSTRIA AG  
EMPORA project partner



Photo: VERBUND AG

 **LINK**  
[www.empora.eu](http://www.empora.eu)



**Project videos**  
<https://youtu.be/MC4Xk8Eihpk>  
and <https://youtu.be/XxysF8kW2os>

# CROSSING BORDERS

## CROSS-BORDER E-MOBILITY SERVICES

Through the CROSSING BORDERS project, VERBUND and its partners from Germany, Austria and Slovakia are achieving new milestones to enable the rapid implementation of electric mobility. 30 rapid charging stations in the regional western corridor running through the three participating countries, intelligent access and billing systems, and an intermodal routing concept are opening up convenient and energy-efficient electric mobility solutions that can be accessed across national borders.



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### PROJECT PARTNERS

AIT Austrian Institute of Technology GmbH / E.ON Technologies GmbH / SMATRICES GmbH & Co KG / Ecotech e.U. / Fluidtime Data Services GmbH / IFSTTAR/ ENTPE / OVOS Media GmbH / Siemens CVC Convergence Creators GmbH / PDTS GmbH / Ubimet GmbH / VERBUND Solutions GmbH / TRAFFIX / ZSE Západo slovenská energetika

CROSSING BORDERS connects the four e-mobility regions of Bratislava, Vienna, Salzburg and Munich. To this end, a transnational e-mobility corridor has been developed and the entire infrastructure has been set up all the way along it. 13 companies are participating in this process of creating an international and interoperable electric mobility network.

The establishment of the rapid charging corridor is based on a network plan that was itself developed as part of the CROSSING BORDERS project. This plan was drawn up using a mixture of socio-economic and transport planning input data. In this way, it is possible to identify the ideal locations for users. The assumptions made by the project in relation to location attractiveness are analysed using an internally developed work package. SMATRICES (a company founded by the EMPORA partners VERBUND and SIEMENS) is responsible for the operational running of the charging infrastructure.

Customer convenience is a stated aim of all the project partners involved. The rapid charging stations along the route are connected to an intelligent cross-border roaming and billing system. This means that users can use a variety of providers to charge up their vehicles without any problem. In addition, an intermodal route planner is being developed for use in all three countries, thereby providing different mobility offerings for the regions concerned. On the basis of this information, customers will be able to select exactly the right set of environmentally friendly mobility services at each point of the route.

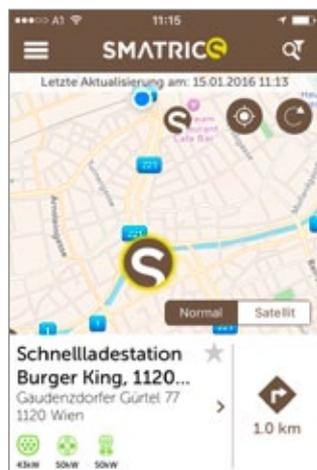


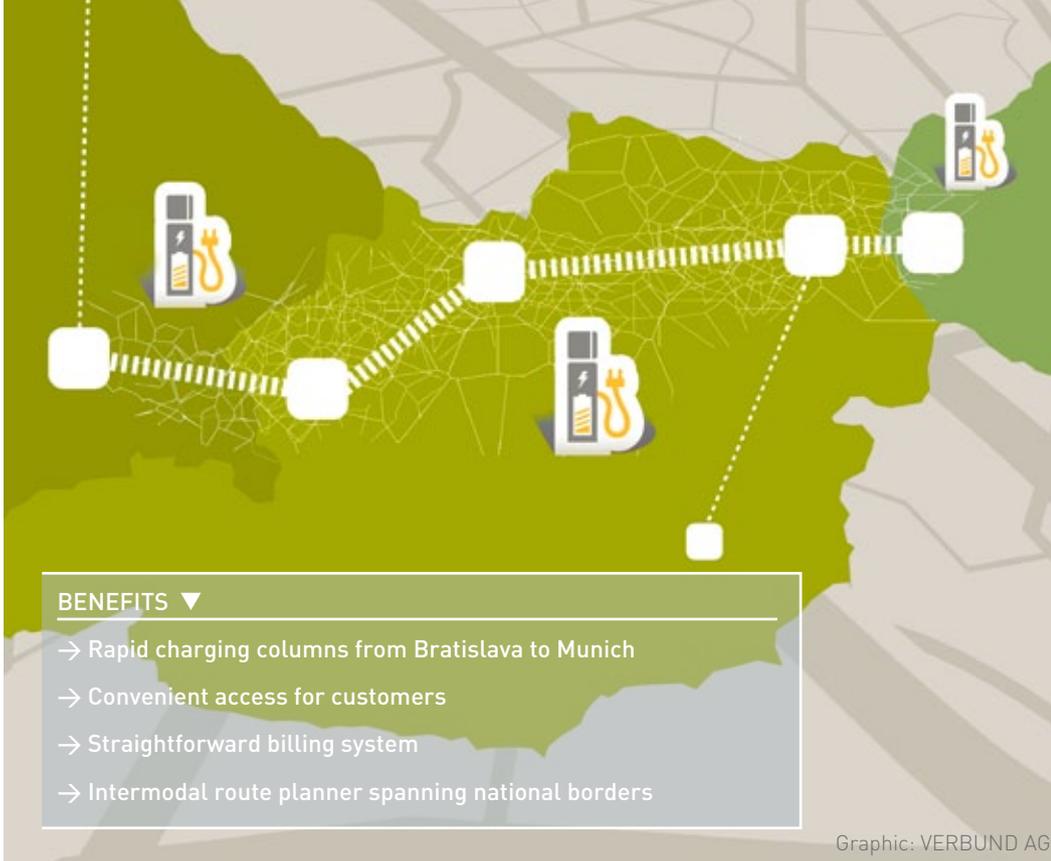
Photo: VERBUND AG

### HIGHLIGHTS ▼

- Implementation of intelligent, cross-border systems for electric mobility
- Creation of an e-mobility corridor along the axis formed by Slovakia / Austria / Germany
- Transnational roaming and billing systems
- Chance for Austrian companies and research partners to cooperate in international follow-on projects



[www.crossingborders.cc/en/project](http://www.crossingborders.cc/en/project)



**BENEFITS** ▼

- Rapid charging columns from Bratislava to Munich
- Convenient access for customers
- Straightforward billing system
- Intermodal route planner spanning national borders

Graphic: VERBUND AG



**International network**

Following on from the CROSSING BORDERS project, Austrian companies and research facilities are currently involved in the international CEGC (Central European Green Corridors) project, which is being funded by the trans-European transport networks (TEN-T). The aim of this cooperation is to create a pan-European e-mobility network and establish transnational infrastructures.

The EMPORA and CROSSING BORDERS flagship projects have put Austrian know-how on the map internationally. The CEGC project is now enabling Austria to collaborate with four vehicle manufacturers at a European level (BMW, Nissan, Renault and Volkswagen).



Photo: VERBUND AG



Photos: Climate and Energy Fund / Astrid Bartl



Photo: ZSE

*"Thanks to the roaming concept that has been developed and implemented as part of the CROSSING BORDERS project, it is now really easy for drivers of electric vehicles to cross the border into Slovakia and charge up their vehicles at ZSE charging stations. For example, there is the rapid charging station that was recently opened at the 'Bory Mall' shopping centre close to the Czech/Austrian border. As roaming partners, ZSE and SMATRICES manage the transaction in the background without bothering the customers."*

**Radoslav Markus**

ZSE Západo slovenská energetika  
CROSSING BORDERS project partner



Project video

[https://youtu.be/VfAVIE\\_PxoA](https://youtu.be/VfAVIE_PxoA)

# VECEPT

## VEHICLE WITH COST-EFFICIENT POWER TRAIN

The VECEPT flagship project is concerned with the development and testing of a cost-effective plug-in hybrid vehicle (PHEV) that is suitable for everyday use. This is to take the form of a volume model for the global market with an electric range of approximately 50 km. Key factors for achieving the objectives are the development of a comprehensive thermal and energy management system and a battery that is optimised from both a weight and energy perspective. In addition, a professional management tool for mixed vehicle fleets is being developed and the project is looking into the behaviour of various user groups in relation to the charging infrastructure.



### CONTACT

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### PROJECT PARTNERS

AVL List GmbH / AIT Austrian Institute of Technology GmbH / ecoplus. Niederösterreichs Wirtschaftsagentur GmbH / Fluidtime Data Services GmbH / IESTA – Institute for advanced Energy Systems & Transport Applications / Infineon Technologies AG / IVD Prof. Hohenberg GmbH / MAGNA E-Car Systems GmbH & Co OG / University of Vienna / Samariterbund Wien Rettung und Soziale Dienste gemeinnützige GmbH / VERBUND AG / VIF – Kompetenzzentrum Das virtuelle Fahrzeug Forschungsgesellschaft mbH (Graz)

### The VECEPT solutions:

> Virtual vehicle manufacturer (OEM): Given that there is no relevant OEM in Austria, the members of the consortium created a virtual OEM for VECEPT (that could also be used beyond the confines of the project) that had all the competencies and expertise required to produce a complete vehicle.

> Management of mixed fleets so that a large pool of users can be built up quickly: VECEPT concentrates on the use of PHEVs (Plug-in-Hybrid Electric Vehicles) and BEVs (Battery Electric Vehicles) within larger conventional fleets with the aim of encouraging the roll-out of electric mobility, providing fleet operators with security and flexibility, and overcoming anxieties about the driving range. Further down the line, it will become possible to target private users as well.

> Powerful and easy-to-use infrastructure for PHEVs and BEVs: The charging infrastructure has a key role to play in the use of electric mobility, for example, as a means of reducing anxieties about the driving range. As well as considering the issue of installation, VECEPT is also analysing possible differences between the requirements of various user groups in relation to PHEVs and BEVs and working out how to balance these. This is the first ever study of its kind. Ultimately, the aim is to make users feel just as "at home" with the new technology as they do with conventional fuelling solutions.

### Fully developed and tested PHEV demonstration vehicle with cost-effective power train

As far as the demonstrator vehicle was concerned, the top priorities were efficiency, weight, performance, comfort, range and cost, i. e. all the parameters required to boost consumer acceptance of the innovative vehicle concepts. These key criteria were used as a basis for drawing up an innovative concept for the passenger car power train. New components were developed and optimised on test benches and in test vehicles with a view to achieving the power, torque, fuel consumption, emission and noise behaviour targets.

On the basis of these tests, the VECEPT plug-in hybrid vehicle was then built using a volume model as a platform. This made it possible to carry out intensive tests on the new components within the vehicle in order to optimise the system and power train configurations of the BEVs/PHEVs. In addition, the thermal management system of the vehicle and the HVAC (heating, ventilation and air conditioning) system were optimised to achieve the maximum possible efficiency while still keeping the costs reasonable. >>>



Photo: Climate and Energy Fund / Astrid Bartl



Photo: Climate and Energy Fund / Astrid Bartl

Photos on left: AVL List GmbH

Photo: Climate and Energy Fund / Astrid Bartl



*"The development and rapid market launch of cost-effective plug-in hybrid vehicles have a major role to play in reducing CO<sub>2</sub> emissions. In contrast to purely electric vehicles, these vehicles are also the key to overcoming the anxieties that users have about the driving range and can have a wide-reaching impact – not least on the environment."*

**Theodor Sams**  
Project Leader, VECEPT  
AVL List GmbH



The demo vehicle was unveiled in December 2015 at the 14th International CTI Symposium in Berlin – the leading convention for gearbox systems, and HEV and EV drives. The integrated systems are now being improved so that the vehicle is ready for release as a prototype and can be used for further demonstration and benchmarking activities.

**The VECEPT battery – High energy density and lower costs**

Samsung SDI Battery Systems GmbH (formerly: Magna Steyr Battery Systems GmbH & Co OG) were responsible for developing the battery system, which they had to optimise from an energy and cost perspective while also taking reduced CO<sub>2</sub> emissions and safety into account.

The aims were primarily achieved by using an alternative cell technology within the prototype battery on the plug-in hybrid vehicle (PHEV). This offers better capacity values and lower internal resistance without having to increase the size. Consequently, the performance of the PHEV battery has been improved and less heat is generated during charging/discharging. In turn, this improves the life of the temperature-sensitive cells.

The overall result is a higher energy density coupled with a lower weight. Both of these characteristics have a positive impact on the electric range of the vehicles. Compared with a conventional battery, the prototype battery has managed to extend the electric range by more than 20 % with a corresponding reduction in carbon dioxide emissions. What's more, by introducing new lighter-weight concepts and reducing the battery components, the manufacturing process can also be optimised.

**Strategic planning software framework for managing mixed fleets**

With the new fleet management tool that has been developed, optimised strategies can be drawn up for gradually introducing PHEVs and BEVs into existing (conventional) vehicle fleets. This tool uses the basic data for the existing vehicle fleet and the daily mobility requirements of users to generate solutions that are optimised from the perspective of costs and CO<sub>2</sub> emissions.

**HIGHLIGHTS ▼**

- New power train: Highly integrated approach (combustion engine/electric engine/gearbox/operating system) minimises ineffective operation of the combustion engine
- New battery concept: Higher energy density coupled with lower costs
- New software tool for fleet management: Optimises strategies for gradually introducing PHEVs and BEVs
- New infrastructure: Expansion of rapid charging stations in the Vienna – Graz corridor



All photos: Climate and Energy Fund / Astrid Bartl



#### BENEFITS ▼

- Development of cost-effective solutions that are suitable for everyday use
- Broad base of users (business, private and public)
- Users made to feel just as "at home" with the charging technology as they do with conventional fuelling solutions
- Potential to overcome anxieties about driving range
- Security and flexibility for fleet operators
- Further encourages the roll-out of electric mobility

Photo: Climate and Energy Fund / Astrid Bartl

A variety of scenarios can be run to simulate future developments such as demand and energy/fuel costs etc. as well as what effect the number of charging stations will have. In this way, the requirements for the charging infrastructure can be determined.

This optimisation calculation results in a suggested mix of conventional, electric and plug-in hybrid vehicles for the fleet. Detailed vehicle purchase and sale decisions are outlined for each solution within a specific time frame.

#### Infrastructure

Four rapid charging stations have been set up between Vienna and Graz (Dobl-Kaiserwald service station, Wiener Neustadt, Schottwien service station, Sebersdorf service station). The associated trials are now complete and day-to-day charging data is being collected for the purpose of scrutinising and evaluating user behaviour patterns.

 **LINK**  
[www.vecept.at](http://www.vecept.at)



 **Project video**  
[https://youtu.be/e7kehsek\\_s0](https://youtu.be/e7kehsek_s0)

# EMPROVE

## INNOVATIVE SOLUTIONS FOR THE INDUSTRIALISATION OF ELECTRIFIED VEHICLES

The aim of the eMPROVE flagship project, which was launched in October 2015 and is due to run until 2018, is to industrialise the innovative components and electrified vehicle concepts that have been developed as part of the VECEPT flagship project. Another major focus of the project is to further improve energy and cost efficiency while paying particular attention to the possibilities of future mass production on an industrial scale.

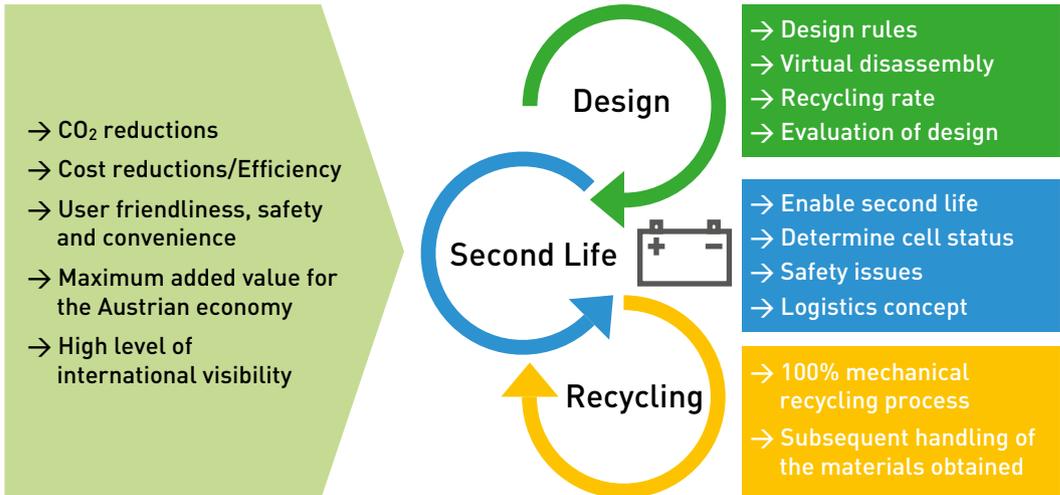


**CONTACT**

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**PROJECT PARTNERS**

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The eMPROVE project involves analysing, improving and evaluating electrical vehicle gearboxes, the combustion engine, and storage and energy systems from the perspective of industrialisation. These activities are supplemented by the following: innovative approaches (cross-system methods, processes and materials for energy systems plus intelligent control concepts for energy systems and gearboxes), the improvement of existing series-produced technology (battery analytics and modularisation, heating and cooling of the storage and energy systems) and the related system development work to enable subsequent integration into the vehicle.

In future, the issue of how to manufacture electrified vehicles cost-effectively will be addressed by designing flexible PHEV drive systems and modular HV battery systems that are easier to integrate into more vehicle classes.

Recycled and second-life electrochemical storage systems are opening up new possibilities in terms of costs and cost-cutting measures in the area of series production and beyond.

As a result, product design and near-series production of electric vehicles may undergo substantial changes, leading to expanded business models, business scenarios and lower prices for end customers. In addition, there are likely to be clear benefits for the environment.

Two integrated demonstrators (a complete PHEV vehicle and a modular battery system) will be used to demonstrate concrete results and the functionality of the technical solutions devised during eMPROVE. As volume models for the global market, these will play a key part in the market entry planned for 2019/2020.



**BENEFITS ▼**

- Innovative solutions for the industrialisation of electrified vehicles
- Longer range for electrically powered vehicles
- Cheaper and innovative components for lower vehicle prices
- Reduced impact on the environment – less energy consumed over the entire life cycle and optimum use of resources
- Novel recycling/second life approaches for electrochemical storage systems

All photos: Climate and Energy Fund / Astrid Bartl



**HIGHLIGHTS ▼**

- Recycling of environmentally critical components
- Design of an intelligent concept for the battery housing
- Information for reusing batteries/giving batteries a second life
- Demo models for a PHEV vehicle and for a modular battery system

Photo: Virtual Vehicle / W.Wachmann



*"A more cost-effective method of manufacturing electrified vehicles will be ensured in the future by designing PHEV drive systems and modular HV battery systems that are flexible. In the future, these measures will enable the components to be integrated more easily into a larger number of vehicle classes and will ensure cost-effective recyclability and second life use."*

**Michael Nöst**

Project Leader, eMPROVE

IESTA – Institut für innovative Energie- & Stoffaustauschsysteme  
(Institute for Innovative Energy and Material Exchange Systems)



LINK

[www.eMPROVE.at](http://www.eMPROVE.at)

# EMORAIL

## INTEGRATED EMOBILITY SERVICE FOR PUBLIC TRANSPORT

The thought of having to walk the "first and last mile" from the station to your final destination and then back again often acts as a psychological barrier to using public transport. eMORAIL is a forward-thinking, environmentally friendly and cost-effective mobility service for commuters that systematically links up public transport and electric mobility solutions. This intelligent complete concept has already been successfully piloted by test users from rural regions (Bucklige Welt in Lower Austria and Leibnitz in Styria) over a period of 16 months. The next step is to develop it further and get it ready for deployment across the whole of Austria.



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### PROJECT PARTNERS

tbw research GesmbH /  
 create – mediadesign GmbH  
 / QUINTESSENZ Organisationsberatung GmbH / HERRY Consult GmbH / P.L.O.T. EDV-Planungs- und Handelsgesellschaft mbH / iC consulenten Ziviltechniker GmbH / DB Rent GmbH / EBE Mobility & Green Energy GmbH / NTT DATA Österreich GmbH / Rail Equipment GmbH / ÖBB-Personenverkehr Aktiengesellschaft / Verkehrsverbund Ost-Region (VOR) GmbH

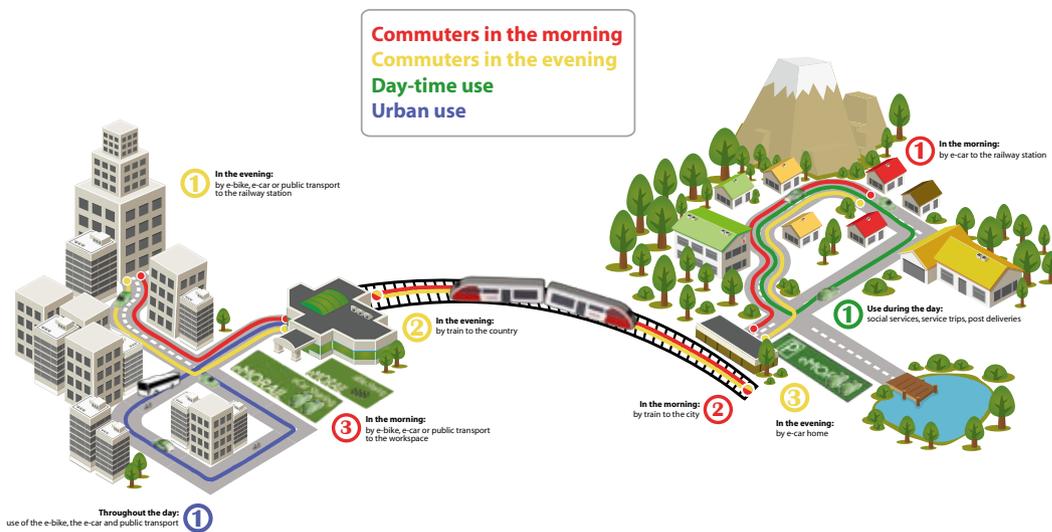


Photo: create – mediadesign GmbH

To build a solid network of electric vehicles as one component of environmentally friendly, intermodal mobility offerings – this is the idea behind eMORAIL, an innovative service concept that has been developed and trialed by the Austrian Federal Railways (ÖBB) in cooperation with ten partner companies. The eMORAIL sharing package for commuters combines an ÖBB rail ticket with the use of an electric vehicle for the journey from home to the station. Once commuters arrive at their destination station (Vienna or Graz), they can continue their journey to work by bus or underground/overground train, or by borrowing a car sharing vehicle. The service package includes a travel card for the public transport network at the destination and access to an e-car sharing service provided

by EMIL and Flinkster (in October 2016, they will be joined by another cooperation partner: ÖBB-Carpool). When commuters arrive at their home station, the eMORAIL car is already there waiting for them: fully charged, clean and ready for use.

The complete charging management system was developed as part of the project and charging stations were set up at the railway stations and at the homes of the test users. The project has its very own photovoltaic power plant, which generates the same amount of energy as consumed by the electric cars. To maximise utilisation, the electric cars are used for commercial purposes during the day by business users such as the postal service and local firms.



Photo: create – mediadesign GmbH



Photo: create – mediadesign GmbH



Photo: create – mediadesign GmbH

Outside of business hours, the vehicles are available to the users for personal journeys. All services are planned and controlled using the eMORAIL smartphone app. This can be used to access information about availability, the current battery status and range of the electric car, real-time timetable information, vehicle reservations,

and so on. Users pay a monthly all-inclusive mobility fee that covers the commuter ticket, the use of the electric vehicle and all the other services. >>>



**JASMIN THOMANN  
FROM EVERTO,  
A PHOTOVOLTAICS COMPANY  
BASED IN LEIBNITZ AND AN  
EMORAIL BUSINESS USER**

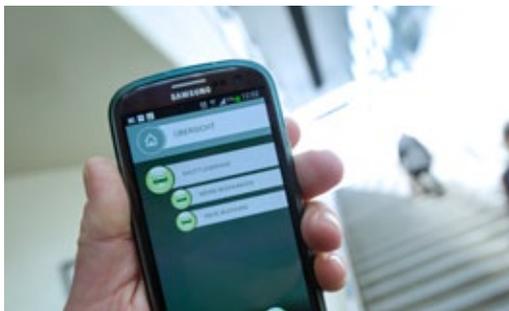
"As daily users, we rely on the vehicle for lots of different things. It allows us to travel to our installation sites and fetch materials, and we cover an average distance of around 50 km a day. The vehicle has a long range and so does the job perfectly without having to be charged up partway through. It has really proven its worth with commuters, who are able to use the car outside of work. Communication is very good. In other words, we can find out about any scheduling changes by telephone – but by and large, everything runs according to the agreed schedule."



**HIGHLIGHTS ▼**

- Intelligent linking of public transport and electric vehicles
- Design and technical development of an integrated e-mobility solution
- Development and implementation of the eMORAIL smartphone app
- Design of an open, interoperable charging management system and a charging station
- Structural measures at the sites (including photovoltaic power plants, charging facilities at the homes of commuters)
- Successful implementation of test phase
- Public transport improved in rural areas by offering new supplementary mobility services

All photos: Climate and Energy Fund  
/ Astrid Bartl



**JOHANN HOFMANN,  
FROM LEIBNITZ,  
AN EMORAIL SHUTTLE USER**

"I am extremely happy with the eMORAIL shuttle service, although I only use it weekly – not every day. The process of booking with the system and with the partner company works perfectly and I am always picked up punctually. I am a huge fan of electric mobility. It would still be too expensive for me to get a vehicle of my own, but I like the combination of the shuttle service plus train, which caters for the general public very well."



## EMORAIL ADVANCED – NEW SERVICES FOR ENVIRONMENTALLY SOUND MOBILITY

Work is currently under way to roll out the scheme across the whole of Austria and to enhance the concept. The first aim is to improve the technology even further (e.g. the functionality for accessing the vehicle via a smartphone or for automated billing and settlement). The second aim is to increase the pool of potential users significantly. To this end, mobility experts, regional stakeholders and corporate partners are busy devising new solutions so that environmentally friendly mobility services for the onward journey can be integrated into the public transport system, e.g. shuttle services, synchronised pick-up times or the offer of a lift to ensure multiple occupancy of the electric vehicles. A test is currently being carried out to see how feasible it is to use eMORAIL vehicles as a passenger and to book a lift using the smartphone app as and when required. In this way, the offer is also being geared towards people who work part-time or who do not have a driving licence. In addition, an e-shuttle service concept has been developed to provide commuters with a local transport option for getting between home and the station. This is fully synchronised with the train arrival and departure times.

Austria's first ever electric vehicle shuttle service is currently being tested in Leibnitz (Styria). In November 2015, the town of Leibnitz launched its own distinctive and cost-effective mobility service called "*LeibnitzMobi!*" based on the eMORAIL model. The electrically powered

vehicle has been provided through a cooperation between ÖBB and Graz (a Model Region of Electric mobility) and links the various districts – even travelling to areas not covered by public transport. It takes commuters to the railway station and is also available for personal journeys during the day (so that people can go shopping, get to the doctor's or get to appointments with the authorities). There are 41 collection points within the municipal area. You can board the shuttle at any of these at your chosen travel time and then get dropped off at another one. Routes are tailored in accordance with when people want to travel. The fare charged is similar to the cost of public transport.

Another new development is the pooling tool for business customers. This module allows employees who work for the same company to travel the final mile between the station and their place of work by sharing an electric car. This reduces costs. The concept even allows for vehicles from the pool to be used across different companies.

Another new idea for a service is the eMORAIL station storage box, which is aimed at eMORAIL commuters who do not drive. The associated app allows them to order goods from local retailers (e.g. groceries) and have them delivered to their storage box in the course of the day so that they are ready to collect on the way home from work. A prototype has been developed as part of the eMORAIL advanced research project. This meets all the technical requirements and is ready to be implemented in cooperation with local suppliers.

**BENEFITS ▼**

- Smart e-mobility solution for commuters in rural regions
- Flexible mobility that relies on the use of an electric car and public transport as an alternative to owning your own car
- Intelligent service package from a single source
- Smartphone app offers a convenient booking and control method
- Regionally tailored shuttle and car sharing models



Photo: Climate and Energy Fund / Astrid Bartl



Photo: private

*"As a result of the growing trend towards electric mobility, new aspects of contemporary mobility solutions are emerging. The 'eMORAIL' intermodal mobility concept of the Austrian Federal Railways is making it possible to integrate a car sharing model in a sensible way so that it becomes a well networked component of one overall transport concept. As part of the research project, commuter models (such as the local shuttle and lift services or collection points for day-to-day purchases) are being trialled so that they can be rolled out to locations across all the federal provinces in the future. The aim here is to make the journey to work as easy as possible for commuters by providing them with an optimum service offering that offers a cost-effective solution."*

**Helmut Wolf**  
Project Leader, eMORAIL  
ÖBB-Personenverkehr



**LINK**

[www.emorail.at](http://www.emorail.at)



Project videos

<https://youtu.be/gtjfsfdCTKhc>

and <https://youtu.be/fXZxmvjQ7Xo>

# SMILE – SIMPLY MOBILE

## SMART MOBILITY INFO & TICKETING SYSTEM

In the future, the way we get around is going to change fundamentally, particularly in the main conurbations. Integrated mobility concepts are counting on a change in the way we choose and combine private and public modes of transport, with our decisions becoming more needs-based, varied and spontaneous. The SMILE flagship project involved developing a prototype for a multimodal mobility platform for use all across Austria. SMILE links public transport (PT) with electric mobility and brings together different elements in one unified system, namely information, booking and payment processes, and the benefits of various transport types.

**smi)e einfach mobil**

### CONTACT

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### PROJECT PARTNERS

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ÖBB and Wiener Linien, the two biggest mobility providers, joined forces with numerous partner companies to develop the smart mobility solution. The SMILE mobility platform integrates all kinds of transport types (conventional public transport as well as e-car sharing, e-bikes, hire cars, rental bikes, taxis etc.) and combines them with routing information and user data to create tailored mobility offerings.

The SMILE app can be installed on a smartphone and lets users know what travel options are available for getting from A to B. Combined journey suggestions are created from the individual services on offer. Customers can select the route and mode of transport, book their journeys and obtain a ticket to cover all the mobility services they have selected. They can also pay for these in a single step.

### Key technology for integrated mobility

A standard interface (SMILE Connector) allows the various mobility providers to connect their technical systems via specific adaptors and to make all relevant data available in real time. Even ticket sales can be completed via the system. The same principle is used to connect routing services to the mobility platform: the Austrian transport information service, the AIT router that has been specifically developed for electric cars and e-bikes, and the toursprung routing engine for bikes.

All the data goes to the application server of the mobility platform, where the relevant data items are selected and combined on the basis of the user request. These are then used to produce the individually applicable journey suggestions along with the associated price information. Customers can book and pay for all the services directly without having to switch to the respective systems of the providers. Clearing with the payment service provider runs in the background.

### HIGHLIGHTS ▼

- Key technology for integrated mobility
- Easy-to-use open-access mobility platform
- System designed from the perspective of the user
- Standard guidance and integrated control system despite it being an open system
- Connection of hardware and infrastructure (e.g. charging stations, vehicles, car parks)



Project video

<https://youtu.be/ZWTZOS-d1DM>



LINKS

[smile-einfachmobil.at](https://smile-einfachmobil.at)



Photo: Nick Waldhör

**BENEFITS ▼**

- SMILE offers tailored mobility solutions from a single source
- Smart linking of different modes of transport (public transport, e-bikes, e-car sharing, rental bikes, hire cars, taxis)
- User-friendly smartphone app
- Intelligent information, route planning, electronic booking and payment in one unified system



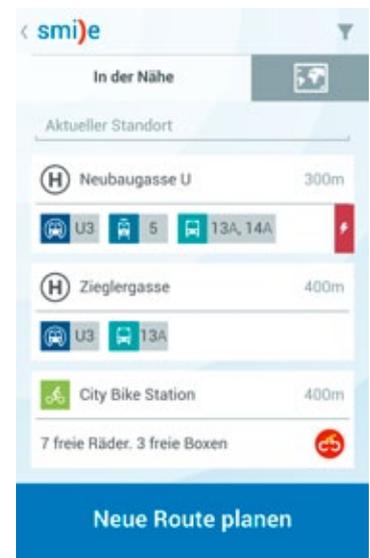
**The SMILE pilot phase**

In order to test the SMILE platform, a multi-stage practical trial was carried out over the course of one year with more than 1000 participants. 6 % of those surveyed said they used the SMILE app every day during the pilot phase, with another 30 % using it several times a week. They primarily used the services for running personal errands (64 %), leisure trips (59 %) and for accessing routes not covered by the usual transport companies (45 %).

When the pilot phase was evaluated, the results revealed that the mobility platform can be used to increase the use of sharing and electric mobility services while reducing the number of journeys made by private car. A total of 48 % of the SMILE testers surveyed said that they had started using public transport more often. 10 % were accessing bike sharing schemes more often and 4 % were making more frequent use of e-car sharing services. Another 4 % were using their e-bike/pedelec more often. 21 % of the pilot users surveyed said they were using their private car less frequently.

More than two thirds of those surveyed admitted to trying out new ways of getting from A to B thanks to the routes suggested by SMILE. In most cases, this consisted of using alternative means of transport (47 %) or different combinations of transport (24 %). This demonstrates that smart mobility solutions can play a significant role in helping people to break established patterns of mobility behaviour and try out alternatives.

The project partners have taken the results from the SMILE flagship project and are now developing them further on a variety of levels. Neue Urbane Mobilität Wien GmbH, a wholly owned subsidiary of Wiener Stadtwerke, is responsible for coordinating research and innovation within the e-mobility sector and is continuing the work on multimodal end customer services. Meanwhile, a start-up called iMobility (a joint venture between ÖBB and Speedinvest) is working on the further development of digital trip planning solutions; for this purpose, it is able to build on the experience gained from the SMILE project.



Photos: Wiener Stadtwerke Holding AG

Photo: Wiener Stadtwerke Holding AG



*"To enable the use of electric mobility across the board, it is essential to have efficient access to information about charging station, e-mobility routing, range/journey time, state of charge etc. as well as opportunities for using it (e-car sharing, reservation of charging stations, activation of charging process, and so on). The SMILE research project was the first time that all this had been trialled by incorporating it into the public transport system as a whole. In the course of the project, it became clear that – in spite of numerous technical obstacles – the offering enjoyed a high level of acceptance among those users who were already committed to electric mobility. The project helped to highlight current user hurdles, to confirm that it does make sense to incorporate everything into one comprehensive mobility offering and to pave the way for further implementation projects within this area."*

**Reinhard Birke**  
Project Leader, SMILE  
Neue Urbane Mobilität Wien GmbH

# SEAMLESS

## SUSTAINABLE, EFFICIENT AUSTRIAN MOBILITY WITH LOW-EMISSION SHARED SYSTEMS

Electric mobility is rarely used in commercial environments, because company vehicles usually have to satisfy lots of different requirements. Company cars are used for long journeys as well as shorter ones, they are generally assigned to individuals and they are available for business and personal journeys alike. 2016 marks the launch of the SEAMLESS flagship project, which focuses on innovative concepts for business e-fleets. The aim is for new technologies and mobility solutions in the areas of car sharing and car pooling to make the commercial use of electric vehicles more attractive.

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### PROJECT PARTNERS

AIT Austrian Institute of Technology (lead) / Österreichische Post AG / HERRY Consult GmbH / tbw research GesmbH / SPECTRA TODAY GmbH / im-plan-tat Raumplanungs GmbH & Co KG / iC consulenten Ziviltechniker GesmbH / ETA Umweltmanagement GmbH / T-Systems Austria GesmbH / ENIO GmbH / Fronius International GmbH / Kalomiris Consulting e.U. / ecoplus. Niederösterreichs Wirtschaftsagentur GmbH / Greenride GmbH

The forms of financial relief for electric cars that are to take effect following the 2016 tax reform (company vehicles no longer classed as benefits in kind, input tax deduction) are an opportunity to establish electric mobility more firmly within the commercial environment. Innovative mobility concepts plus new business and operator models are required so that companies are able to switch their fleets over to electrically powered vehicles.

Under the leadership of the AIT (Austrian Institute of Technology), project partners from a large number of Austrian companies are in the process of devising various e-fleet concepts. This means analysing and testing internal company car fleets as well as cooperative car pooling models that involve the use of vehicles across different companies. The issue of how to connect car sharing to multimodal mobility solutions is another major focus of the project.

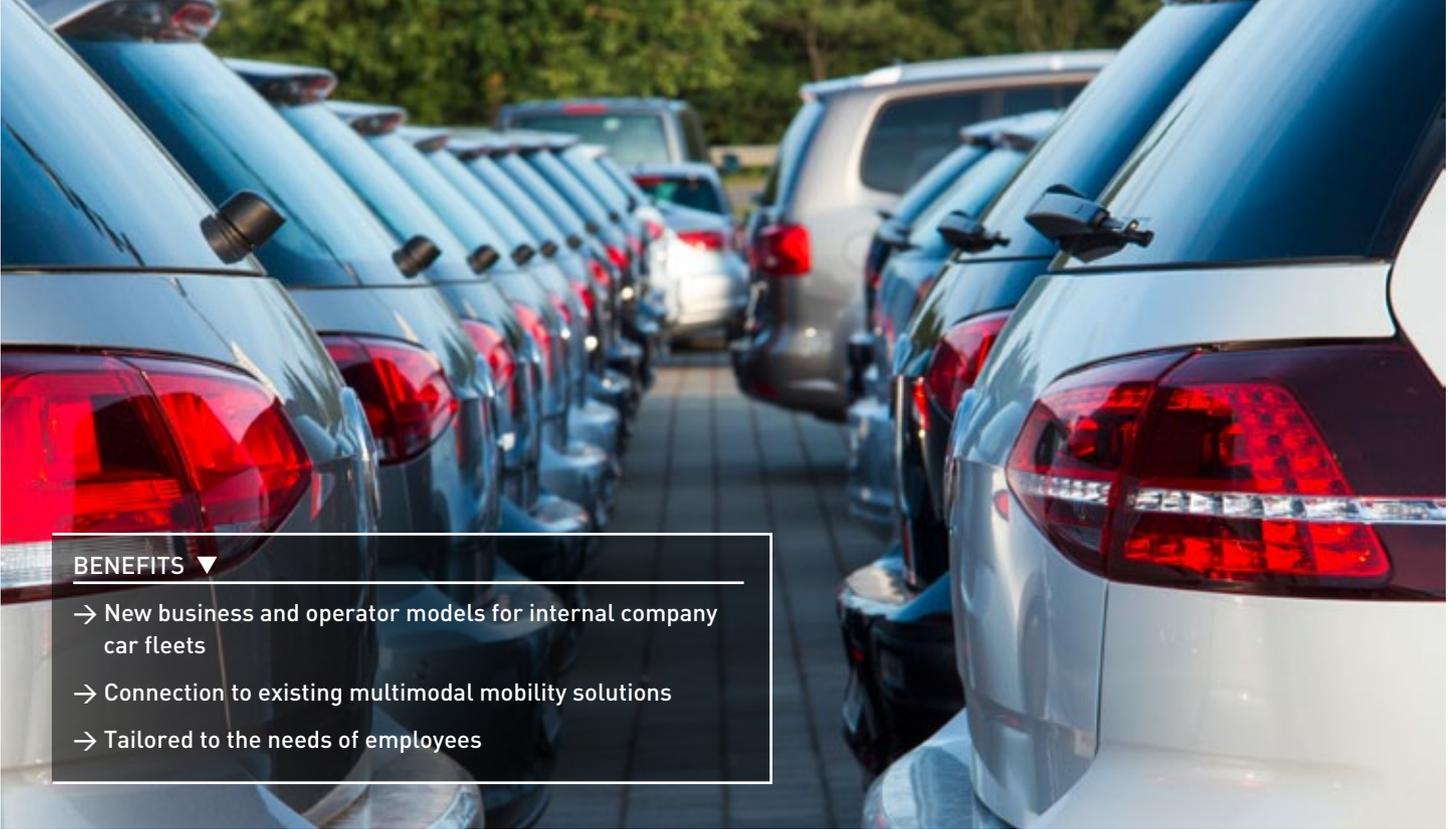


Photo: kasto / fotolia.de

It is extremely important to get vehicle users involved. Employee motivation and acceptance are vital to ensuring that the new solutions are introduced successfully.

### HIGHLIGHTS ▼

- Electric mobility solutions within corporate fleets
- Carpooling and car sharing models
- Innovative technical implementation
- Demonstration involving five vehicle fleets



**BENEFITS ▼**

- New business and operator models for internal company car fleets
- Connection to existing multimodal mobility solutions
- Tailored to the needs of employees

**Technical implementation and test phase**

Alongside the organisational and commercial aspects, technical implementation also has a crucial role to play. As part of the project, a car sharing technology was developed so that electric cars could be used within fleets in an uncomplicated and convenient manner. This technology includes a straightforward booking and billing system, route and trip planning, optimised vehicle allocation and charging, and the intelligent use of back-up batteries and energy management systems.

During the demonstration phase, the solutions are to be tested within five company fleets (POST AG, iC consulenten, ETA Umweltmanagement, t-systems/t-mobile Austria and SPECTRA TODAY) containing a total of just under 100 vehicles (55 of which are electric). Particular importance is being attached to user acceptance, cost effectiveness and positive environmental impact. The aim is to achieve a 40 % reduction in greenhouse gas emissions coupled with financially viable operation of the solutions within the demonstration fleets.



Photo: ellisia / fotolia.de

*"SEAMLESS aims to smooth the way as we move away from the idea of company cars as status symbols and towards the concept of mobility as a service provided by employers. This will call for a permanent transformation/paradigm shift in the thinking of company car users and employers alike. In turn, this will encourage greater use of electric vehicles within company fleets and the incorporation of alternative modes of transport (such as public transport) into everyday working life and the private sphere. At the same time, SEAMLESS will also allow technical components that are usually developed and tested independently of one another to be brought together into one cohesive whole so that it is easier for companies to switch over to a future-oriented mobility solution."*



Photo: AIT

**Matthias Prandtstetter**  
Project Leader, SEAMLESS  
AIT Austrian Institute of Technology

# CMO

## CLEAN MOTION OFFENSIVE

In this project coordinated by the automotive cluster of Upper Austria (Automobil-Cluster Oberösterreich), twelve project partners (business and research companies) worked together on the "Clean Motion Offensive" with a view to developing powerful electric mobility technologies that are perfectly in line with the needs of the market. The main barriers preventing the spread of electric mobility are the high costs of the battery, the short range of the vehicles and the lack of a proper infrastructure. Moreover, as the number of electrically powered vehicles increases, extensive demands are placed on the grid operators. To address all the relevant issues, forward-looking concepts and solutions were devised as part of the CMO project.



### CONTACT

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### PROJECT PARTNERS

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KEBA AG / Lagermax Lagerhaus  
und Speditionen AG / Lightweight  
Energy GmbH / LINZ Strom  
GmbH / reload multimedia /  
Smart E-Mobility / STEYR  
MOTORS GmbH / Technology  
& Innovation Center TIC Steyr  
GmbH / Graz University of  
Technology

The team involved in this Upper Austrian initiative consisted of engine builders, industrial automation companies, a power company and two research institutions. The Clean Motion Offensive involved working through the entire chain, from the vehicle technology and the establishment of an intelligent infrastructure right through to new business models. The key focus was on finding solutions to make electric vehicles suitable for everyday use as part of fleets. All the vehicle technologies were installed in a test vehicle and then put to the test in practice in the "Model Region" of Steyr.

### Vehicle technology

To extend the range of the vehicle, STEYR MOTORS developed a two-cylinder range extender as part of the Clean Motion Offensive. This runs on biodiesel and extends the range of electric vehicles by 150 to 200 km. At Graz University of Technology, a prototype flywheel energy storage system was built. Acting as a

highly efficient energy buffer, the "flywheel" utilises the braking energy from starts and stops, takes the strain off the battery system and helps reduce energy consumption within the electric vehicle.

A new battery concept was used on the test vehicle. This combined a cost-effective lead storage battery with high-performance lithium batteries. The HESSPC (High Energy Storage System Power Controller) hybrid controller developed by Lightweight Energy allows several different energy sources to be combined in the same traction system. With the help of this intelligent energy controller, it was possible to integrate the range extender and the flywheel energy storage system into the vehicle. The vehicle development work resulted in a fully equipped test carrier (a converted Skoda Roomster) with three interchangeable modules ("Energy Cubes") that made it possible to test various energy storage systems and range extenders.

The SEM box collects vehicle and battery data and then evaluates this for various applications.  
Photo: Automobil-Cluster



Prototype flywheel energy storage system  
Photo: Graz University of Technology



Photo: Automobil-Cluster

The test carrier vehicle was used to try out the developments on various routes and with different operational profiles. This provided insights into their degree of suitability for daily use, the savings potential, the driving range and the dimensioning of the energy sources. The HESSPC controls the function of the various "Energy Cubes" (range extender, additional battery, flywheel) and integrates them into the drive system. The SEM box performs a monitoring role and supplies online data from the test runs. Inductive charging has been integrated into the operational concept and tested for its user friendliness.

### ICT solutions

The interaction between the combustion and electric engines was controlled by software from Smart E-Mobility. The SEM box that was designed as part of the project enables the collection and evaluation of battery and vehicle data. The data is transmitted via a data line or GSM and is collected and processed in a central processor. Many automotive manufacturers lease the electric vehicle batteries to their customers. The SEM box is easy to integrate into the vehicle and provides the data that leasing companies and other players (power companies, municipalities, vehicle manufacturers, traffic management systems) need as a basis for their various services and billing processes.

### Charging infrastructure & management

KEBA AG, Linz AG and the Wels campus of the University of Applied Sciences of Upper Austria worked together as project partners to develop a cost-effective and user-friendly charging infrastructure along with some highly automated charging management systems. This resulted in an intelligently controlled base station that distributes the energy to numerous satellite stations.

They also investigated how electric vehicles could be integrated into the grid as a controllable load. Linz AG was responsible for implementing a powerful piece of software to enable intelligent load management with grid monitoring included. >>>

*"Electric mobility increases the demand for power and so the CMO flagship project analysed the environmental factors, framework conditions and methods that are involved in regulating this through reliance on automated load and charging management within an existing grid. It proved possible to overcome these challenges by using intelligent technologies on the grid side, such as smart meters or smart grids. This resulted in an intelligent load management system that included grid monitoring, the data from which was transmitted to an automatic charging management system at the e-charging station. In future, this means that it will be possible to control the charging current demand of electric vehicles in accordance with grid availability."*

**Norbert Breitschopf**  
Linz AG  
CMO project partner



Photo: Linz AG



**BENEFITS ▼**

- Biodiesel range extender that is ready for series production
- Load management – infrastructure solutions for using electric vehicles as part of fleets
- Cross-company fleet management



Photo: Automobil-Cluster

*"The development of new, cost-saving components is extremely significant for suppliers based in Upper Austria. By getting ahead of the pack in those areas that have tended to be neglected by car manufacturers and power companies in the past, our firms can become international winners. New and highly lucrative spheres of activity are also emerging for the electrical and electronics sector. This is where most of the innovations for the car industry are currently being generated. In Austria, you can find companies whose technologies are extremely advanced. Generally, these are niche technologies but they have the potential to become internationally marketable products. One of the automotive cluster's tasks is to put these companies (which are sometimes quite small) in touch with companies and research facilities at an international level. Through initiatives such as CMO or the current ICM scheme, we are creating the ideal conditions for this."*

**Wolfgang Komatz**  
Manager of Automobil-Cluster



KEBA wall box,  
photos: KEBA AG

The data obtained from the grid is transmitted to the e-charging station and used there for load management purposes. In this way, the charging current demand can be controlled in accordance with the level of grid availability.

#### Successful enhancements

The CMO project has led to several other projects by cluster partners that are concerned with enhancing electric mobility components. The results from the Clean Motion Offensive were also used as part of the Emilia flagship project (see page 48).

As regards vehicle technology, the insights gained helped STEYR MOTORS to develop the "Energy Cube", which has now been added to its product range. In the course of further development work focusing on engine-generator

applications, it was possible to build on the design know-how gained from the CMO project in relation to range extenders.

KEBA AG also benefited from the project results when coming up with new developments for the charging infrastructure. Its high-power wall boxes for private and public use are currently being marketed around the world under the KeContact brand label.

[www.kecontact.com/de/news/](http://www.kecontact.com/de/news/)

The Clean Motion Offensive gave rise to the "Initiative Connected Mobility" (ICM). The ICM is an advanced platform that has been set up by the automotive cluster to promote new technologies for vehicles of the future.

[www.connected-mobility.at](http://www.connected-mobility.at)

#### HIGHLIGHTS ▼

- Initial results obtained from on-road tests with the flywheel energy storage system
- HESSPC (Hybrid Energy Storage System Power Controller)
- SEM box for collecting vehicle and battery data
- Central evaluation of data

#### LINKS

- [www.cleanmotion.at](http://www.cleanmotion.at)
- [www.automobil-cluster.at](http://www.automobil-cluster.at)
- [www.connected-mobility.at](http://www.connected-mobility.at)



#### Project videos

<https://youtu.be/Bn9lvVHS90>  
and <https://youtu.be/ROFQ9g53Fol>

# EMILIA

## ELECTRIC MOBILITY FOR INNOVATIVE FREIGHT LOGISTICS IN AUSTRIA

The aim of the EMILIA flagship project is to make freight logistics in urban areas more efficient and environmentally friendly in the future. 15 Austrian companies are currently working together on this project under the leadership of the Austrian Institute of Technology (AIT). They are developing innovative freight logistics concepts for towns and cities as well as small electrically powered transport vehicles for what is known as "last-mile distribution".



### CONTACT

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 Cluster Clusterland Oberöster-  
 reich GmbH / Bitter GmbH /  
 DPD Direct Parcel Distribution  
 Austria GmbH / ECONSULT  
 Betriebsberatungsges.m.b.H /  
 Gebrüder Weiss GmbH / gleam  
 technologies GmbH / OVH  
 Design / HET Hochleistungs-  
 Eisenbahn- und Transport-  
 technik Entwicklungs-GmbH /  
 isn – innovation service network  
 GmbH / Magna Steyr AG & Co  
 KG / Miba Sinter Group / Rewe  
 International AG / Schachinger  
 Logistik Holding GmbH /  
 SIGNON Österreich GmbH

Due to the rising population figures in urban areas, the issue of urban freight logistics is becoming increasingly important. Around 20 % of the traffic in European towns and cities is attributable to transport and the delivery of goods. The market for courier and parcel services has been growing constantly for years. The high number of individual deliveries made to end customers means that miles and miles are being clocked up in city centres.

The negative consequences of this are noise, emissions and environmental pollution, which – in turn – reduce quality of life. According to EU targets (White Paper on Transport/2011), logistics in urban centres are to become CO<sub>2</sub> neutral by 2030. The lack of space and the access restrictions in towns/cities call for special solutions. How can goods be delivered in a flexible, efficient and environmentally manner in the future when areas are becoming more and more densely populated? That is where the EMILIA project comes in.

### Vehicle technology

Electrically powered vehicles offer forward-thinking alternatives for transport and delivery services within urban areas. Three innovative electric vehicles are currently being enhanced and tested for this very purpose. The aim here is to optimise an electric delivery tricycle, a light utility vehicle and a brand new type of road transport train from the point of view of their range and production costs.

An innovative power train has been developed for the tricycle, which was produced by a start-up called gleam technologies GmbH. This combines human pedal power with the power of an electric motor, thereby giving the vehicle a long range. The final versions of the optimised motor and converter are to be produced and integrated into the vehicle by the summer of 2016.

A light utility vehicle (Skoda Roomster) is being converted into an electric light utility vehicle.



Photo: gleam technologies / OVH Design



Photos: HET Verkehrstechnik

This involves installing a new high-efficiency engine that is both lightweight and low-cost. For this, the project team is drawing on the developments that emerged from the Upper Austrian CMO project (see page 44).

The enhancement work that is being carried out on the EMF Citylog (an innovative road transport train from HET) is a question of redesigning the lightweight frame. The aim of the new design is to reduce the weight even further. At the same time, it will ensure better protection for the sensitive components of the vehicle (fuel cell, hydrogen tank and battery). The all-wheel steering is being optimised to improve the manoeuvrability of the vehicle in narrow alleys or warehouses. >>>

#### HIGHLIGHTS ▼

- Strong consortium comprising start-ups, SMEs, large corporations, research organisations, plus consulting and service companies
- Components for innovative, electrically powered transport vehicles that have a long range and are low-cost
- New freight logistics concepts based on electric mobility
- Accompanying open innovation process
- Demonstration of research results



LINKS

[www.emilia-project.at](http://www.emilia-project.at)



Project video

<https://youtu.be/8ejoeirSEJA>





Photo: Martin Rumersdorfer

"At Schachinger, our ambition is to develop sustainable logistics solutions that are fit for the future. Alternatively powered transport vehicles are the next logical step in the journey towards environmentally friendly and efficient freight logistics. Thanks to the EMILIA project, we are moving one step closer to the aim of achieving CO<sub>2</sub>-free major urban centres by 2030."

**MAX SCHACHINGER**  
**MD SCHACHINGER LOGISTIK**  
**HOLDING GMBH**

**Logistics concepts**

New logistics concepts are required if the alternative modes of transport are to be deployed intelligently. Having a network of electric vehicles available for use in areas such as the delivery of parcels, medicines and food products could bring both ecological and economic benefits. Currently, the foundations are being laid so that suitable software solutions can be created for specific concepts. The requirements of the software architecture have already been fleshed out and some initial versions of mobile apps for future use by the drivers have been produced. The requirements arising from transport logistics must be closely coordinated with the adaptation of the vehicles.



Photo: Martin Rumersdorfer

**Open innovation and demonstration**

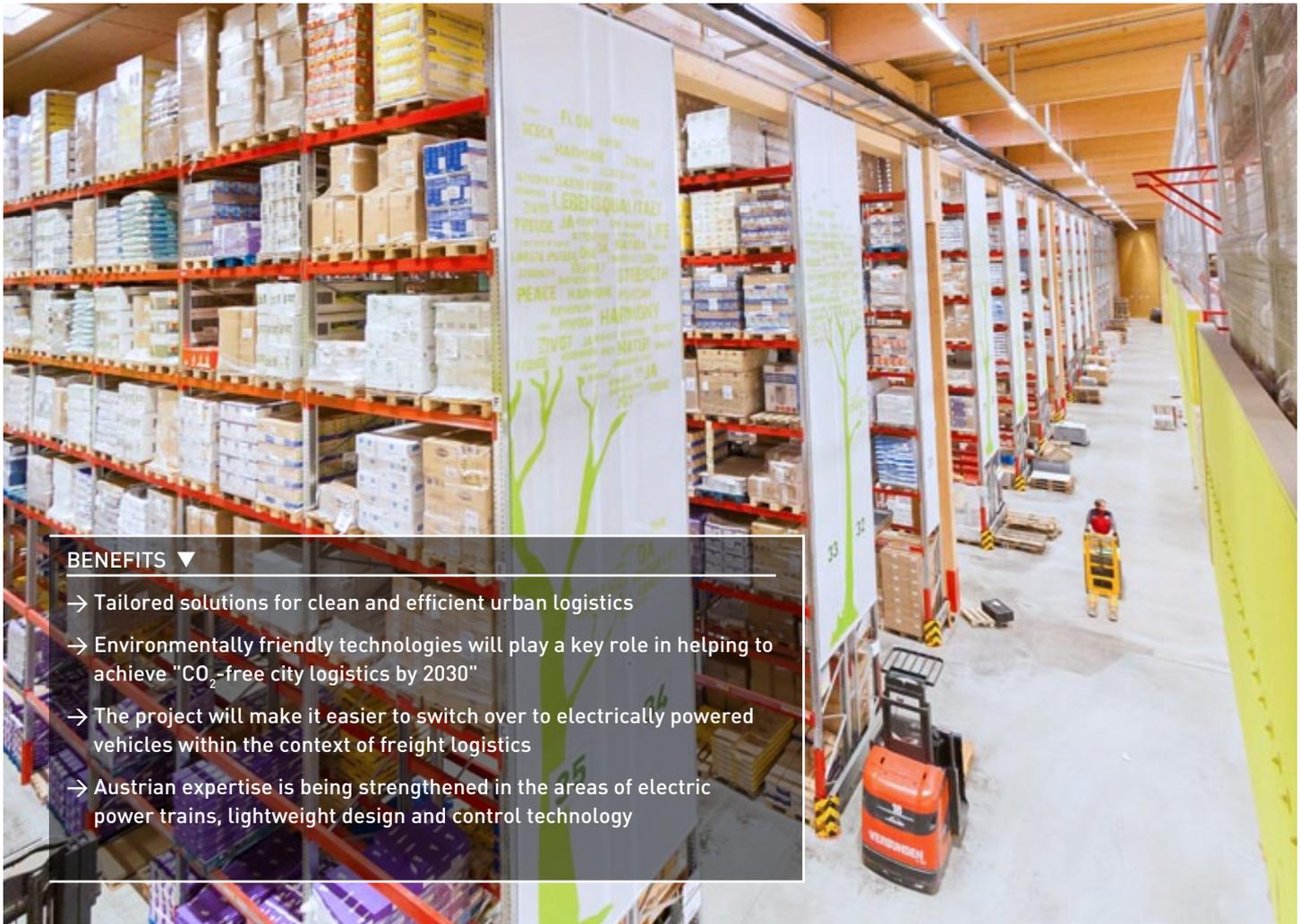
As many stakeholders as possible were included in the flagship project right from the start. These include logistics companies and delivery services as well as urban and transport planners, researchers, and representatives from politics and administration.

EMILIA is accompanied by an open innovation process. An online open ideas platform was used to get the general public involved and to find out more about the needs of users. The idea of this is to encourage acceptance of the new solutions. The project, which is due to run until 2017, will end with a demonstration phase and this is when the concrete results and developments will be unveiled.



Photo: Martin Rumersdorfer

Photo: Martin Rumersdorfer



**BENEFITS ▼**

- Tailored solutions for clean and efficient urban logistics
- Environmentally friendly technologies will play a key role in helping to achieve "CO<sub>2</sub>-free city logistics by 2030"
- The project will make it easier to switch over to electrically powered vehicles within the context of freight logistics
- Austrian expertise is being strengthened in the areas of electric power trains, lightweight design and control technology

*"In the long-term, electric mobility is the future – and that goes for the field of freight logistics too. However, there is still a lot of work to do before the technologies and concepts are able to compete technically and commercially with those that are already well established – and before they can, in turn, truly conquer the market. In this regard, EMILIA has an important role to play in closing the gap between the current state of affairs and the requirements of the future. The newly developed technologies also have the potential to strengthen Austrian and European added value in electric mobility, an area that is going to be extremely important in the future.*

*A good example of this is the electric engine that has been developed for use in a light utility vehicle. Unlike many other designs, this one does not rely on the use of rare earth elements, which is important from a European perspective because no mining of rare earth elements takes place on the continent. The other components, such as the highly efficient compact converters and the lightweight frame for a road transport train, also demonstrate the expertise of Austrian companies and will help them with their long-term positioning in the markets of the future."*

**Boschidar Ganev**  
Project Leader, EMILIA  
AIT Austrian Institute of Technology GmbH

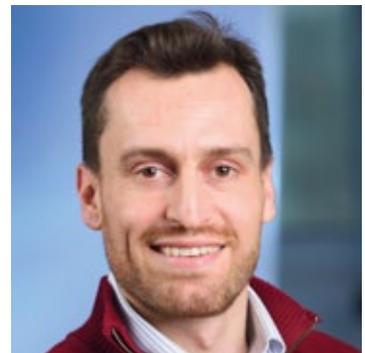


Photo: AIT/Johannes Zinner

# LEEFF

## LOW EMISSION ELECTRIC FREIGHT FLEETS

Road freight transport is responsible for a large proportion of the world's greenhouse gas emissions. If electrically powered vehicles were to be used in the transport industry, the environmental impact of the transport sector could be reduced significantly. The LEEFF flagship project is seeking to develop new electric mobility solutions for freight transport along with appropriate planning and communication tools for electric fleets.

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### PROJECT PARTNERS

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SPAR Österreichische  
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Logistik Holding GmbH /  
Quehenberger Logistics GmbH  
/ Greenway E-Mobility GmbH  
/ Energie Ingenieure GmbH /  
Consistix GmbH / University  
of Natural Resources and  
Life Sciences, Council für  
nachhaltige Logistik CNL /  
Satiama GmbH / University  
of Vienna, Institut für  
Betriebswirtschaftslehre /  
University of Applied Sciences  
of Upper Austria – Hagenberg  
campus

The project, which was launched in 2016, covers the full range of vehicle technology, the charging infrastructure and also new business models for using electrically powered vehicles in freight fleets. Under the leadership of i-LOG Integrated Logistics GmbH, the project team is not only looking at technical aspects but also at organisational and socio-economic issues.

As part of the project, an electric van with an adapted battery system is being developed along with an intelligent charging station that is suitable for commercial use at logistics centres. A further aim is to come up with an innovative business model for fleet operators along with tailored planning tools (in the form of a prototype) and to test these out during a demonstration phase.

### Vehicle technology

By developing an electric transporter van that is ready for series production, the hope is that new discoveries will be generated in the area of electrically powered light commercial vehicles (LCVs). The advanced e-van is to feature a 120 kW rear wheel electric drive and a range of 200 to 300 km. It will be equipped with an on-board charger that supports rapid charging.

A single-stage gearbox for electric vehicles is being specially developed and this will be suitable for speeds of up to 12,000 rpm. It will also have a parking lock and a connection for a tachograph.

Most of the costs associated with electric vehicles are attributable to the energy storage system. The key technologies here are the battery and charging equipment. That is why research work is so focused on finding the right layout for a powerful and cost-effective battery/charging technology.

*"As far as Tesla boss Elon Musk is concerned, there can be no doubt that the future of mobility is electric. It is high time that this started applying to urban delivery logistics as well. Electric stacker trucks are already used as standard in intralogistics. In view of the constantly increasing volume of e-commerce parcels, delivery vehicles such as those used for courier, express and parcel services should – ideally – also play their part in minimising noise and emissions in the main conurbations. Particularly in the case of major cities that are growing strongly, such as Vienna, this is becoming an important part of the smart city concept. Together with our top project partners, we want to make a major contribution in this regard."*

**Bartosz Piekarz**  
Project Leader, LEEFF  
i-LOG Integrated Logistics GmbH



Photo: i-Log GmbH

Photo: arsdigital / fotolia.de



Photo: SMATRICES

## HIGHLIGHTS ▼

- Enhancement of electric vehicles for use in freight fleets
- Solutions for creating an intelligent charging infrastructure
- New fleet concepts
- Optimisation of mixed fleets
- Innovative operating and business models
- New logistics, scheduling and routing solutions
- Integration of user needs



Photo: Satiamo

Lithium-ion battery packs are being optimised so that a higher energy density (4.1 kg/kWh and 1.95 dm<sup>3</sup>/kWh) can be achieved for various applications with a low-weight solution that is more compact. The development work also encompasses the thermal management of the batteries plus optional use of the batteries for active vehicle heating and cooling. Several charging strategies (from high-performance charging through to battery changes) are being investigated as part of the project.

### Optimisation of charging management and planning tools

As far as the charging infrastructure is concerned, ICT-based solutions are being devised to enable charging control and energy management within a commercial fleet setting. The process

of integrating these technically into existing fleet management systems is being analysed and tested. The project also involves developing prototypes for a new fleet management tool and a mobile application that will actively support drivers. Intelligent routing and planning tools are the key to implementing electric mobility successfully within a route planning context.

The new technologies are being combined with suitable business models with a view to creating something that is both cost-effective and highly convenient for users. The plan is for the developments to be demonstrated from 2017 onwards. This will rely on a relatively large demonstration fleet at the logistics facilities of the Schachinger Logistik Group in Hörsching as well as at SPAR and Quehenberger Logistics.



Photo: Greenway



Photo: Kreisel



LINKS

[www.leeff.at](http://www.leeff.at)

# E-LOG-BIOFLEET

## FUEL CELL TECHNOLOGY FOR INDUSTRIAL TRUCKS

Battery powered industrial trucks are a significant international market for electric drives. However, the short ranges of these vehicles and the long outage periods caused by charging reduce productivity, particularly in the case of multi-shift operation. One new technology for optimising vehicle operation consists of fuel cells with hydrogen storage that can be used as range extenders.

### CONTACT

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### PROJECT PARTNERS

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JOANNEUM RESEARCH  
Forschungsgesellschaft mbH  
/ Linde Fördertechnik GmbH  
/ OMV Refining & Marketing  
GmbH / Schenker & Co AG

In the course of the E-LOG-Biofleet project, it proved possible to develop and implement this innovative concept for a logistics application, and to test it in a real-life industrial environment at DB Schenker in Hörsching (Upper Austria). This was the first time in Austria that battery powered industrial trucks had ever been converted to allow hybrid operation with fuel cell range extenders and lithium-ion rechargeable batteries.

This involved using a Power Package developed by Fronius International in conjunction with a fuel cell, a hydrogen storage system, lithium-ion rechargeable batteries and control electronics. This system was certified and installed in twelve industrial trucks (Linde T20AP) instead of the original lead storage battery.

In addition to producing the components for the drive, storage system and vehicle as a whole, the necessary infrastructure was also created. The hydrogen is supplied using a CO<sub>2</sub> neutral technique. Hydrogen is produced from biomethane in a decentralised system located at the site. A fuelling system was installed inside a hall (the first time this has ever been done in Europe).

Everyday operation in a challenging multi-shift logistics facility has demonstrated that the new vehicles and the infrastructure reliably meet all the requirements in practice. The fuel cell drive system is even capable of withstanding the extreme demands of a logistics environment and has so far exhibited very good durability.



Photo: Fronius International GmbH

*"By the end of 2015, the industrial truck fleet at Schenker had already clocked up 40,000 successful operating hours, thereby proving that it is able to compete in terms of performance and availability. The main challenge now is to create an initial market that is large enough for the manufacturing costs of the fuel cell to become competitive as well. In other regions of the world (e. g. the USA), markets are being created by means of appropriate incentive programmes. Therefore, rapid action is required to ensure that Austria and Europe also become a source of the technology and don't just end up importing it."*

### Ewald Wahlmüller

Project Leader, E-LOG-Biofleet  
Fronius International GmbH



Photo: Fronius International GmbH

Photo: HyCentA Research GmbH



**BENEFITS ▼**

- Reliably available H<sub>2</sub> industrial trucks with a longer range than conventional battery sets
- Not having to change the battery makes work easier and saves money
- It only takes a few minutes to refuel the H<sub>2</sub> vehicle

**HIGHLIGHTS ▼**

- Strengthening of Austria as a technology leader in the area of range extenders for logistics applications
- Implementation of the entire value-added chain
- Development and production of all components for the new industrial trucks
- Establishment of the infrastructure: Biomethane generating plant and fuelling system
- Maintenance and servicing solutions
- Successfully tested with regard to efficiency and service life

A high level of efficiency is being achieved thanks to the hybrid operating strategy and braking energy recovery technology. The fast refuelling time (< 3 minutes) means that the vehicles are constantly available. This enables greater flexibility but with the same level of performance.

Fleet data (as at end of 2015 / rounded):

- > Operating hours: 40,000 h
- > Fuel cell operating hours: 21,000 h
- > Number of start/stop cycles: 47,000
- > Driving cycle efficiency (tank-to-plug): 53 %
- > Refuelling operations: 5700

The demonstration phase is to continue with the aim of making further important discoveries about the service life and the maintenance/ servicing requirements under real-life conditions and as the system ages. Acceptance among users is also being tested. In this way, the project is creating the right conditions for an efficient and competitive market entry.



Photo: Severin Wurnig

"The E-LOG-Biofleet project demonstrates that hydrogen and fuel cell equipment is a drive technology of the future that is already functioning in practice. In this way, we are backing up our claim to be the most innovative logistics company within the industry."

**THOMAS ZIEGLER**  
**MANAGER OF THE LINZ**  
**BRANCH OFFICE OF**  
**SCHENKER & CO AG**

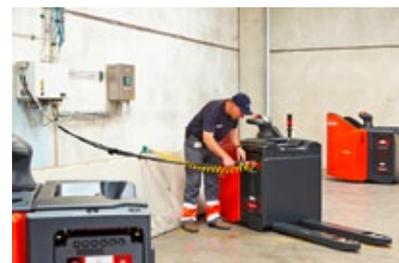


Photo: HyCentA Research GmbH



**Project videos**  
<https://youtu.be/Ox98Psy6D04>  
and <https://youtu.be/RF8hu1pYHZY>

# RE<sup>2</sup>BA

## RECYCLING AND REUSE OF LITHIUM-ION BATTERIES

A new concept for recycling battery systems from electric mobility products should help to optimise the costs and, in turn, make electric mobility more cost-effective as a whole. This is the first time ever within the German-speaking world that the technical suitability of these batteries for storing electricity from renewable sources has been tested. This is known as "peak shaving" (i. e. storing energy for use during peak demand periods).

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(University of Leoben) /  
Smart Power GmbH & Co KG

In the RE<sup>2</sup>BA project, partners from industry and research are investigating the recyclability and reusability of high-voltage battery systems from electric mobility products. To this end, they are testing a recycling process that has already been developed for used industrial batteries to find out how flexible it is with regard to different chemical structures.

The first step was to evaluate the state of the art and to draw up a catalogue of requirements for the recycling and reuse of these batteries. One of the key factors is determining the technical and legal status of end-of-life batteries (i. e. the waste characteristic). For this purpose, a suitable control tool (decision making tree) was defined. The way the batteries are handled subsequently is heavily dependent on the stipulations of waste legislation and the technical transport requirements. A knowledge of their chemical composition is vital for assessing the cost-effectiveness of a reprocessing plant. With a view to optimising recyclability as early as possible, some optimum design factors were defined.

The flexibility of the recycling process is currently being tested in practice at pilot plants based at the project partner sites in Graz and Leoben. These are equipped with all the relevant

plant components (shredder, air separator, sifter, conveyor belts etc.).

In order to meet the stringent safety requirements, the team is also devising optimised collection, logistics and storage concepts for the used battery systems. These are to serve as a decision-making basis for manufacturers and disposal firms as well as for public authorities.

A long-term test is being carried out at Smart Power GmbH & Co KG (one of the project partners) in Garching near Munich to analyse the reusability of the batteries on the basis of a used electric mobility battery system. Here, they are testing whether these battery systems (which generally still have 80 % of their capacity) are suitable for use as storage media. Tests are being carried out with a number of sample households that have photovoltaic systems installed to determine whether the batteries are suitable for increasing self-consumption of the PV electricity generated. The initial results are extremely promising. A battery system from an electric motorbike would, for example, be sufficient to act as a storage system for a standard home PV system with an installed power of approximately 5 kWp.

*"Electric mobility can only make a significant contribution toward the conservation of resources if the electricity used is truly green and if the necessary batteries can be recycled in an environmentally friendly manner."*

**Alexander Curtis**  
Project Leader, RE<sup>2</sup>BA  
Saubermacher Dienstleistungs AG



Photo: Dr Gernot Kreindl



RE<sup>2</sup>BA pilot plant for recycling batteries at Saubermacher, all photos: Climate and Energy Fund / Astrid Bartl



HIGHLIGHTS ▼

- Catalogue of requirements for reusing and recycling batteries from electric vehicles
- Decision making tree for determining end-of-life status
- Collection, logistics and storage concepts
- Initial practical tests for utilising used batteries as a storage system for PV generated electricity
- Enhancement of the LIBRES recycling process



Photo: Smart Power GmbH & Co. KG

# REVIEW OF THE PROGRAMME

## ELECTRIC MOBILITY FLAGSHIP PROJECTS



Photo: Climate and Energy Fund / Astrid Bartl

Ever since it was founded, the Climate and Energy Fund has been deeply committed to mobility because of this area's huge potential for reducing CO<sub>2</sub> emissions in Austria. Within the area of transport, electric mobility represents an important building block for creating a future mobility system that is both sustainable and climate friendly.

In light of this, electric mobility has been and continues to be seen as much more than simply replacing the drive technology used on vehicles. Rather, it is a question of delivering an intelligent solution that forms one part of an overall mobility system. For this reason, electric mobility has increasingly come to be viewed holistically – i. e. as an interaction between the vehicles, the users and the infrastructure. This idea is reflected in the concept that lies behind the "Electric Mobility Flagship Programme".

By adopting this perspective, which considers electric mobility as a complete system, the Climate and Energy Fund has managed to reach

all kinds of players – from automotive suppliers, power companies and IT service providers right through to transport planners – through its calls to participate and has succeeded in integrating them into joint research projects. As the mid-term evaluation of the programme has revealed, this is a unique benefit of the programme when compared to what else is happening internationally. This has led to a framework that allows a wide variety of players to grapple intensively with the issue by working together across conventional value and cooperation chains so that they can develop ground-breaking solutions together. Not only has this contributed towards a much deeper understanding of the matter among the institutions involved, but it has also brought the results to international attention.

Through its commitment to this area, the Climate and Energy Fund has thus helped Austrian companies and research facilities to become competitive at an international level and to operate on a level playing field as far as electric mobility is concerned.



Photo: Reinhard Reidinger

Technological developments in the area of electric mobility have come a long way. All the elements that are required for electric mobility to make a breakthrough are now in place and even the ranges of the electric vehicles will cease to be an issue within the foreseeable future. There are two things that are still lacking: firstly, we need the individual components to be linked up so that they form a complete system and, secondly, we need to win the acceptance and trust of users in relation to this new technology.

The eMORAIL and eMORAIL advanced flagship projects show how completely new services – but more importantly, services that are tailored to the needs of the market – can be created by linking electric mobility to public transport, and that people are also willing to accept these services. The new SEAMLESS project is another example of solution development work that includes studies of user acceptance as one of its core elements. As far as I am concerned, the most urgent research issue that needs to be addressed over the next few years is how to incorporate a highly diverse set of demands into technological developments.

### ANGELIKA RAUCH

Member of the BiEM (Bundesinitiative eMobility Austria) Managing Board

"I've really enjoyed being a juror for the Austrian 'Electric Mobility Flagship Programme'. Just a couple of years ago, the proposed projects were all focused on technology development. Some were concerned with vehicle technologies while others concentrated on the infrastructure or on technology for end users. Over the years, the programme has evolved so that there is now a strong focus on implementation. The projects have changed from technology-oriented R&D projects into projects that bring together all aspects of e-mobility. One example of this is the integration of electric mobility into public transport systems.

This is an important step for finding business models in which electric vehicles generate real added value and so can, in future, be used without the need for additional support. In other countries, such as the Netherlands, the approach is different. There, financial support has helped increase the number of electric vehicles very quickly over recent years. The system solutions that have been developed in the course of the Austrian 'Electric Mobility Flagship Programme' have the potential to strengthen the market for electric vehicles and for Austrian technologies, and they have a key role to play in facilitating strong growth in the area of electric mobility in the near future."

### PETRA DE BOER

Member of the "Electric Mobility Flagship Projects" Jury  
Head of Section New Energy Technologies at DNV GL



Photo: DNV GL



Photos: Climate and Energy Fund / Astrid Bartl



Furthermore, key stakeholders have been brought together in Austria and the visibility of electric mobility has been boosted significantly both inside and outside of the country.

The area of electric mobility has developed very rapidly over recent years, with the "Electric Mobility Flagship Programme" naturally following suit. In the first few years, a multitude of technological issues had to be addressed. Huge progress has been made in this regard, as demonstrated by the degree of technological maturity that has been achieved by various components. In addition to this, there has recently been an increase in research focusing on socio-economic issues (such as user requirements) and specific application areas (such as urban logistics).

Even though the market already offers a wide range of electric vehicles that are fully suitable for daily use, a whole host of technology-related and system-related questions are yet to be answered. That is why the Climate and Energy Fund is going to remain committed to this area over the coming years while staying true to the guiding principles that have proven so successful in the past – technology neutrality, having a clear mission and viewing electric mobility in holistic terms.

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# LIST OF ABBREVIATIONS

AMP	Austrian Mobile Power
BEV	Battery Electric Vehicle
BEÖ	Bundesverband Elektromobilität Österreich (Austrian Federal Association for Electric Mobility)
BieM	Bundesinitiative eMobility Austria (federal initiative for e-mobility in Austria)
BMLFUW	Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry of Agriculture, Forestry, Environment and Water Management)
BMWFJ	Bundesministerium für Wirtschaft, Familie und Jugend (Federal Ministry of Economy, Family and Youth)
BMVIT	Bundesministerium für Verkehr, Innovation und Technologie (Federal Ministry for Transport, Innovation and Technology)
CEGC	Central European Green Corridors
CO <sub>2</sub>	Carbon dioxide
D-A-CH	Deutschland-Österreich-Schweiz (Germany-Austria-Switzerland)
EEL	Electrical and Electronics Industry
EV	Electric Vehicle
GSM	Global System for Mobile Communications
HEV	Hybrid Electric Vehicle
HVAC	Heating, Ventilation and Air Conditioning
IAO	Fraunhofer-Institut für Arbeitswirtschaft und Organisation (Fraunhofer institute for work management and organisation)
ICM	Initiative Connected Mobility
IEA	International Energy Agency
IPHE	International Partnership for Hydrogen and Fuel Cells in Economy
ICT	Information and Communication Technologies
km/h	Kilometres per hour
SMEs	Small and Medium-sized Enterprises
kW	Kilowatts
kWh	Kilowatt hour
kWp	Kilowatt peak
bn	Billion
MW	Megawatts
NO <sub>x</sub>	Nitrogen oxide
NOVA	Normverbrauchsabgabe (standard consumption tax)
ÖBB	Österreichische Bundesbahnen (Austrian Federal Railways)
OEM	Original Equipment Manufacturer
ÖPNV	Öffentlicher Personennahverkehr (local public transport)
PT	Public Transport
PHEV	Plug-in Hybrid Electric Vehicle
PKW	Personenkraftwagen (passenger car)
PPP	Public-Private Partnership
PV	Personenverkehr (passenger transportation)
REEV	Range Extended Electric Vehicle
REX	Range Extender
TEN-T	Trans-European transport networks
TÜV	Technischer Überwachungsverein (technical inspection service provider)
V2G	Vehicle-to-Grid
WKO	Wirtschaftskammer Österreich (Austrian Federal Economic Chamber)
ZSE	Západo slovenská energetika

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