Electric Mobility Europe

Research and Innovation Projects

Co-funded by the Horizon 2020
Framework Programme of the European Union

Dear reader,

Only a decade ago, electric mobility was still in its early stages. Around that time, in 2010, the ERA-NET Plus* initiative Electromobility+, a collaboration of 11 countries and the European Commission focussing on the research and development of products and services in the field of electric mobility was launched. Pressured by the threat of climate change and national and EU policies to counter it, the development of electric mobility has accelerated since.

In 2016 the ERA-NET Cofund** Electric Mobility Europe (EMEurope), a collaboration of 14 countries and regions and the European Commission, had already shifted the focus of the transnational funding to further development and demonstration of innovative products and services. Many of the EMEurope funded innovations and collaborations are now being followed up and rolled out in practice. And meanwhile, electric mobility is going mainstream. Electric mobility has progressed quickly over a decade. That both Electromobility+ and EMEurope may have contributed to it gives a good feeling.

This brochure presents a comprehensive overview of the 13 EMEurope funded projects, their goals and achievements. They involved over 100 organisations from 14 countries actively contributing and optimally exploiting the added value of international collaboration and exchange of know-how, expertise and facilities.

It is admirable how the EMEurope consortium and the funded projects have been able to successfully overcome the challenges of COVID-19. Dealing with the extraordinary circumstances and seeking and finding alternative solutions, has strongly stimulated flexibility, creativity and innovativeness that will also benefit the further roll-out and deployment of electric mobility.

For further inspiration and information we kindly invite you to also watch the EMEurope videos and to visit the EMEurope website.

With warm regards,
Gert Jan Prummel

Rijkswaterstaat -
Ministry of Infrastructure
and Water Management,
The Netherlands

Chair EMEurope

*7th Framework Programme and **Horizon2020 co-fund initiatives

eVolution2G-V2G

Innovative Vehicle to Grid model for electric mobility deployment in Europe

Bidirectional charging system holistic approach analysis

The overall objective of the project eVolution2G-V2G is to contribute to a zero CO_2 emissions future, developing, testing and optimising an integrated vehicle to grid (V2G) solution using a light quadricycle enabling V2G, a bidirectional V2G enabling charging infrastructure and an Energy Management and Control System.

Main results

The experimental activities undertaken were multiple. Some focused on testing the system performance and efficiency, while others investigated the duration and performance of batteries and EVs according to different boundary conditions. Lifelong battery simulations and state of health tests were undertaken, resulting in key findings. More than 800 equivalent cycles based on the Worldwide Harmonised Light Vehicle Testing Procedure (WLTP) were performed at different temperature conditions. Based on the tests, a combined state-of-charge (SOC) and state-of-health (SOH) estimation algorithm was developed capable of compensating for the actual temperature and current level. Errors below 3% for both SOC and SOH estimations were achieved and verified in a realistic Hardware-In-the-Loop setup.

Further, sets of tests were performed using two V2G prototypal charging stations and related EVs. Those tests simulated various actual market conditions to stress the operativity of the system. The system performed well in terms of set-point tracking, showing a significant potential of V2G technologies to stabilise electrical loads and underlining the crucial role that electric vehicles may cover in future smart grids. Imposed market/transmission system operator (TSO) power/energy curves were followed by the vehicle-charger system almost with no deviations.

A detailed framework of the costs related to the installation of prototypal charging stations was presented. The expected reduction of costs due to industrialisation of the production was analysed, and a market scouting exercise indicated a possible reduction of costs of up to 50% compared to project prototype charging solutions. Furthermore, preliminary considerations regarding the potential scale-down of costs and opportunity related to the energy pricing for V2G were outlined. The value chain of V2G, considering different perspectives and analysing the business opportunities for both the aggregator, the car manufacturer and the EV owners, was described using Business Model Canvas.

June 2019 – Jan 2021
Total funding €780,120
Total cost €1,501,916

Website eVolution2G-V2G

V2G has the potential to become a widespread application for sustainable mobility. A standard, easy-to-understand way to participate in the demand-response business (being price arbitrage or energy dispatching market) has probably to be set at EU level before national levels: users, especially on a private level, need to clearly and easily understand the revenues related to V2G models.

Together with electric vehicles incentives, support for the charging infrastructure could be crucial for the widespread deployment of V2G.

Partners

- IREN, Italy
- CTC, Germany
- Mecaprom, Italy
- Aalborg University, Denmark

V2G eVolution2Grid

Project Impacts

- Investigation of the bidirectional charging paradigm involving stakeholders such as car manufacturers, end users (corporate fleet and private), Charge Point Operators (CPOs), Electric Mobility Providers (EMPs) and Aggregators.
- The impact of bidirectional charging on the different involved subsystems, electrical grids and energy market development was investigated under all technical points of view.

EUFAL

Electric Urban Freight And Logistics

Information for commercial e-vehicle users

EUFAL supports a knowledge transfer between science and users of electric commercial vehicles to accelerate the market uptake of emission free vehicles in urban logistics. The EUFAL platform informs about available vehicles in the market, charging infrastructure, implementation best practices, demonstrations and new tools for fleet analysis, route optimisation, and total cost of ownership calculation.

Main results

The EUFAL platform presents information on use cases, policies, vehicle technology, costs / total cost of ownership, required charging infrastructure and decision support tools for logisticians. The overall feedback of the users of the platform is positive, with the most essential topics and fields of interest covered. The platform offers a variety of detailed information on e-mobility and the transition from conventional to electric vehicles for fleet managers.

Five tools were developed to support users in their purchasing decisions and the integration of electric vehicles into fleet- and route planning. These tools are described in the EUFAL knowledge platform and deemed relevant according to an assessment. These tools have spiked the interest of potential users of the platform.

Many experiences have been collected by associated partners in Denmark, Poland, and Turkey to demonstrate electric vehicle implementations which are compiled below.

TCO comparison of diesel and battery electric vehicles for urban last-mile distribution of a major e-commerce company in Turkey showed that battery electric vehicles are still a more expensive alternative than diesel options in terms of TCO per km due to higher purchasing prices and lower expected life. A study among urban logistic service providers in İstanbul was conducted, introducing their delivery data in an electric freight vehicle model of choice. As a result, up to 31.7 % of the company's deliveries could already be covered by electric vehicles, which corresponds to 11 % to 26 % CO_2 emission reductions, depending on the trip time scenarios that had been specified. In the framework of a case study focusing on a logistic service provider in Turkey, a fleet optimisation was conducted.

An analysis of the potentials and benefits of unloading bays as charging stations in Poland demonstrated the implementation of two unloading bays in the city centre of Szczecin, Poland. The efficiency of chosen electric vehicles types for daily courier work, including distances and battery capacity, was analysed in deliveries in Szczecin and Stargard in Poland. In cooperation with the Szczecin Municipality, the most strategic locations for charging stations in the city area were identified.

In cooperation with a construction and civil engineering company in Denmark, it was shown that detailed planning of urban service tasks can overcome the shortcomings of battery range. Thereby it results in a greener profile without extra costs for the inclusion of EVs in fleets.

The EUFAL platform is available at www.eufal-project.eu / eufal-platform.

Partners

- German Aerospace Center, Germany
- Austrian Institute of Technology, Austria
- DTU Management Engineering, Denmark
- Copenhagen Electric, Denmark
- Maritime University of Szczecin, Poland
- Borusan, Turkey
- Istanbul Technical University, Turkey

EUFAL
ELECTRIC URBAN FREIGHT AND LOGISTICS

Project Impacts

The EUFAL project:

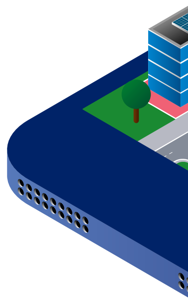
- Established networks between researchers, logistics companies and public authorities.
- Answered the stakeholders' main questions using the developed tools to support the integration of e-mobility in urban logistics.
- Used demonstration activities to enable local experiences and a knowledge transfer from research to practice, which will last beyond the project.

Jan 2018 – Oct 2020
Total funding € 1,358,264
Total cost € 1,755,507

Website EUFAL

ELECTRIC TRAVELLING

Platform to support the implementation of electromobility in Smart Cities based on ICT applications



Lifting e-mobility to the transport mainstream

ELECTRIC TRAVELLING provides Information and Communications Technology (ICT) tools to identify smart mobility solutions adapted to urban and suburban areas and ease the introduction of electric vehicles and required charging stations in the existing transport infrastructure, improving people's awareness and participation in solving mobility environmental impacts.

Main results

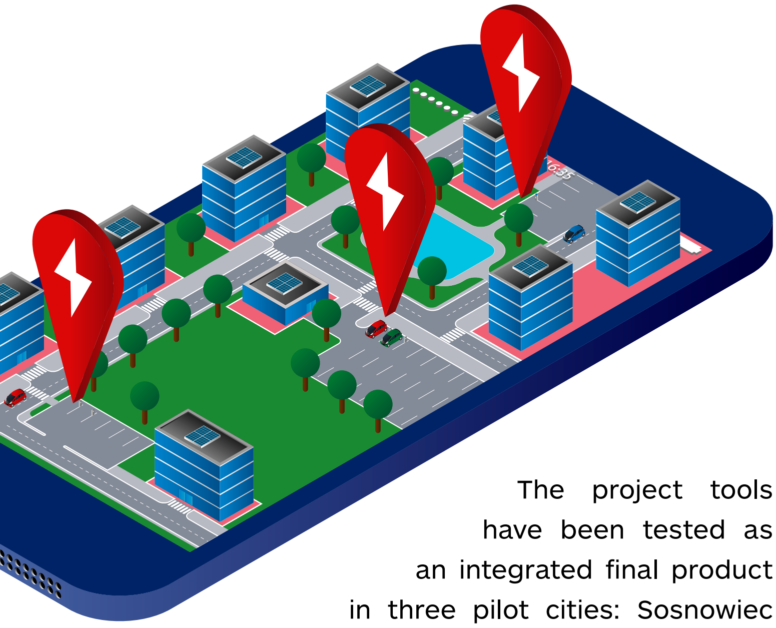
ELECTRIC TRAVELLING produced a set of combined tools (ETSys) to facilitate the integration of electric vehicles in urban and suburban mobility. The ETSys tool includes four modules:

ETPlanner is a door-to-door travel planner with a routing optimiser ready for EVs and directed to promote the use of EVs. As an innovation, it includes greener criteria to minimise environmental impact.

ETCharge is a module that supports charging infrastructure planning in cities by estimating the current demand of charging stations and forecasting future demands. The innovation comes from including an optimal multi-criteria allocation algorithm of charging stations.

ETSim is a multi-agent simulation module that allows the simulation of travelling people in selected areas. It reproduces EV users' behaviour on their route choice based on the battery range estimations and charging options. Simulation results include charging points' location, trip simulation and environmental impact quantification. These results are compared for different scenarios considering several incentives and their contribution to the mobility scheme.

ETReport is a reporting module addressed to local authorities. It presents the results of the simulations in a way that easily serves as a guide suggesting how to develop the transport system to achieve faster steps in the introduction of EVs in cities or increase their number.



The project tools have been tested as an integrated final product in three pilot cities: Sosnowiec (Poland), The Hague (The Netherlands) and Budapest (Hungary).

ELECTRIC TRAVELLING is a step forward in the state of the art because it extends current routing algorithms and travel planning tools focusing on e-mobility. It makes it possible to prioritise urban areas adapted to electric vehicles using a heuristic approach and develops a daily activity chain optimisation algorithm that includes chargers and implementation of Big Data to understand daily travel patterns and day-to-day fluctuations. The tools are open to independent Information Transport Systems inputs, are interactive and can be used EU-wide. An optimal allocation of charging stations is achieved. The final tool includes EVs Life Cycle Assessment.

Mar 2018 – Aug 2020
Total funding € 1,383,470
Total cost € 1,744,470

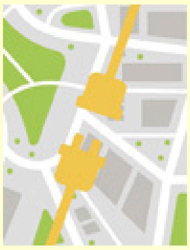
Website ELECTRIC TRAVELLING

The methodology followed integrates several impact assessment sources into a single easy-to-use tool. It is helpful to evaluate the impact of travels and contrast different vehicle types using Multi-agent Simulation and Scenario Comparison that includes charging points' location, trip simulation and environmental impact quantification.

Partners

- SAITEC, S.A., Spain
- Factor, Spain
- Silesian University of Technology, Poland
- BME, Hungary
- TU Delft, The Netherlands
- Over Morgen, The Netherlands
- DeustoTech, Spain

Project Impacts

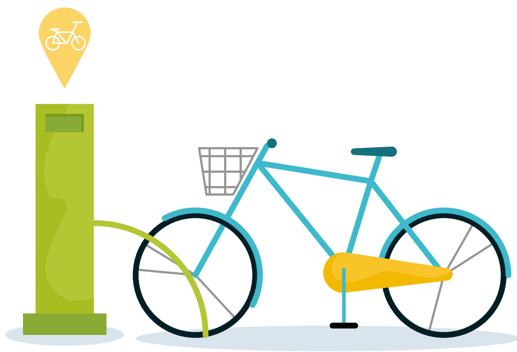


The ETSys tool:

- Tackles barriers related to people's perceptions of e-mobility.
- Simplifies decision-making by using tools for proper location of charging stations.
- Increases the number of people with more profound knowledge about the environmental impacts of transport.
- Shows the results of changing travel behaviour towards more pro-ecological solutions, improving acceptance of e-mobility.

Standard interfaces – an essential requirement for adapting eMaaS

eMaaS combines innovative technology and new business models to create the conditions for the large-scale adoption of EVs. EV sharing services are connected to other eco-friendly mobility modes, optimising the total mobility chain. Standardised interfaces for eMaaS platforms are essential to exploit mobility data as a valuable service for operators and cities.



Main Results

eMaaS proposition for electric Mobility as a Service (eMaaS) is the combination of MaaS with Electric Mobility Systems and Shared Electric Mobility Services. eMaaS refers to the integration of multiple forms of (electric) transportation modes, including public transport and shared electric mobility services, into a single mobility service that allows travellers to plan and go from A to B (and / or from B to C and / or vice versa) in an eco-friendly and seamless way. The service is offered through a single user-centred interface, and it also involves the prearrangement of electric mobility technologies and infrastructure (e.g. charging stations, energy contracts).

Through an extensive market assessment, it was concluded that current efforts in the market neither emphasise sustainable (and thus electric) mobility enough, nor do they have exclusive integrated offers of these types of mobility. This is somewhat surprising, as sustainability is one of the critical pillars of the integrated mobility offer in MaaS. Electric and sustainable mobility can also be a huge motivator that propels the transition towards less ownership-based mobility.

eMaaS analysed several potential business models against the eMaaS project goals. Two models stood out: First, the use of vehicles of any operator, also known as “roaming”, from the App and environment of a single operator. Second, to use the data in the eMaaS eco-system in a value-adding manner, without comprising end-user rights issues such as General Data Protection Regulation (GDPR). The use cases were split into two sub-categories: roaming and data sharing.

Roaming addresses the technical challenges of national roaming (Use Case 1) and the perhaps more organisational challenges that occur for international roaming (Use Case 2). The focus for data sharing is divided between supporting the businesses in the eMaaS eco-system by handling user data (Use Case 3) and utilising data to monitor and steer towards societal goals (Use Case 4).

In order to establish an appropriate foundation for technical developments, various architecture representations have been created. A critical development for an open eMaaS eco-system supported by this project was the creation of the Transport Operator to Mobility Provider-Application Programming Interface (TOMP-API). This API has the goal of connecting Transport Operators with MaaS Providers in a standardised manner. The open nature of the standard supports an open eco-system. Further results of this project include a data connection between partners' systems, resulting in a data dashboard showing key eMaaS data.

Partners

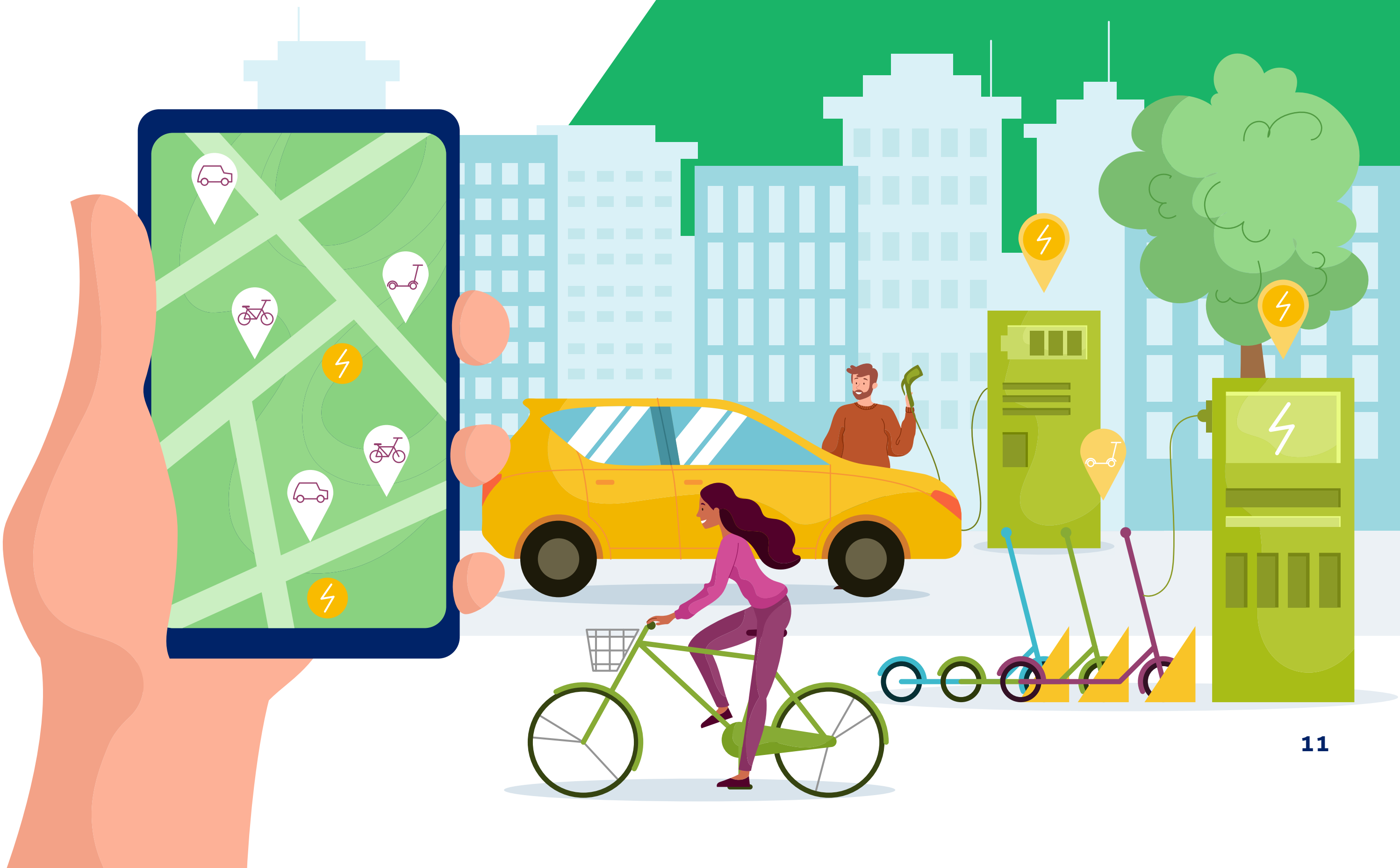
- [ui!] Urban Software Institute GmbH, Germany
- GoodMoovs, The Netherlands
- Move About Sweden, Sweden
- [ui!] The Urban Institute Hungary Zrt., Hungary
- ZET Austria GmbH (formerly Move About Austria), Austria
- University of Twente, The Netherlands

Project Impacts

- The implementation of the TOMP-API showed that standardised communication holds technical and organisational challenges.
- Public authorities can support the large-scale adoption of the TOMP-API by setting its use as a requirement in tenders or concessions.
- Demonstrating the business value of visualisations could receive a considerable boost if coupled with standardised data sharing methods.

Jan 2018 – June 2020
Total funding € 1,128,956
Total cost € 1,741,852

Website eMaaS



EMWF

Electric Mobility Without Frontiers

Sector coupling via high-level data integration

EMWF improves the EV user experience by increasing data interoperability. Focus is given to charging point availability data, and deployment of improved parking sensor technology to predict usage. Information on electrical grid communication is included, and Public Key Infrastructure (PKI) for a plug-and-charge infrastructure is analysed and extensively demonstrated.

Main Results

EMWF designed, implemented and showcased the importance of data interoperability in several ways. The value of high-quality data true potential can be unlocked only through high availability, interoperability and security. EMWF succeeded in demonstrating the feasibility of enhanced data exchange in the following ways:

Currently, most charging points can communicate the availability of their plug, and this data can be made available to the user in a wide range of front ends. By focusing on adding the availability data for the parking spots from external sources like parking sensors, the actual availability can be determined. By enhancing the charging points information on static power rating with grid availability, the user can be informed of any shortages and frustration about longer than usual charging pre-empted.

Building a high-quality and efficient charging network is a crucial enabler for e-mobility rollout. The EMWF project succeeded in providing additional tools for operators of charging points both in the planning and operational stage of their deployment: agent-based simulation to predict charging behaviour was improved with additional data via the project; automated report generation of parking spot usage allows operators to monitor and counteract unwanted blocking behaviour by non-charging customers; and, prediction of power usage and two-way communication with energy grid providers allows for more efficient integration into the power grid, lowering cost and making more locations available for charging infrastructure

In addition to the tools above, EMWF contributed to define open standards that will help shape the future of electric mobility in Europe. By working under open source licenses in the Open Clearing House Protocol (OCHP) and the Distributed Energy Exchange Protocol (DEEP), the results are readily available for public access to ensure maximum market adoption.

The most efficient charging optimisation requires seamless communication from the vehicle to all relevant stakeholders running the connected

Jan 2018 – Oct 2020
Total funding €1,595,422
Total cost €2,403,849

Website EMWF

systems. A reliable PKI is a cornerstone on which to build these critical systems to secure this deeply integrated communication. In EMWF, the implementation of the public key infrastructure and how to improve it to become more open and flexible, while retaining the same level of security was analysed.

The result is a thorough report and several live and online demonstrations for an interoperable system that ensures a discrimination-free PKI to secure communication and future proof critical infrastructure.

Project Impacts

- Improved information flow on charging spots by including parking spot detection and power grid information in datasets.
- Demonstrated an interoperable, open and non-monolithic PKI to enable seamless Plug-and-Charge.
- Enhanced simulations of charging behaviour to allow for better planning of charging infrastructure.
- Demonstrated reliable sensor technology in several locations, improved user interfaces.

Partners

- Smartlab GmbH, Germany
- Stadtwerke Aachen AG, Germany
- SoNah UG, Germany
- ElaadNL, The Netherlands
- Eindhoven University of Technology, The Netherlands
- Electromaps S.L., Spain
- Parking Energy Ltd, Finland

OSCD

Orchestrated Smart Charging in mass Deployment

Knowledge and products supporting multi-actors in smart charging

OSCD enables mass EV deployment in an economical way while sustaining grid services and utilising renewable energy by orchestrating smart charging. Distribution System Operators (DSO) and site owners have access to services through which they can improve and influence the charging process to reduce grid expansion costs satisfying different flexibility requesters.

Main results

OSCD has performed a thorough study of the impact of EVs on the Low Voltage (LV) grids. For the scenario definition, previous projects have been analysed and the main findings have been implemented. Existing simulation tools have been evaluated, scenarios were chosen, and additional features implemented as required.

Extensive evaluations of different state-of-the-art smart charging strategies have been carried out to identify the most important aspects of each. Detailed reports on the impact of massive uncontrolled EV charging were developed.

Finally, an algorithm consisting of several functions was built to minimise node electricity cost, maximise renewable energy usage and node self-sufficiency, reduce grid congestion, and provide frequency-regulation service.

Variable-capacity contracts were considered as the best method to give the DSO the possibility to manage congestion when necessary. Based on demand response literature, in the use cases, a distinction between the Business As Usual (BAU) and the Emergency settings was made. The DSO approach can be combined with dynamic prices (based on the spot market) for the supplier / Balance Responsible Parties (BRP). OSCD concluded that the needs of the DSO and market parties are aligned most of the times.

Furthermore, based on the protocol study, a set of specific protocols for specific interfaces have been selected. For each use case, architectural choices were made.

OSCD started the further development of the necessary protocols for the charging stations to exchange the information needed for smart charging and developed a hardware module to establish communication between EV and Charger according to ISO 15118.

Mar 2018 – Mar 2021
Total funding € 1,500,000
Total cost € 2,650,000

Website OSCD

An existing platform has been updated to support large scale energy control via smart charging. The needs of the different stakeholders were waged to allow for decision when they were contrary. The implemented algorithm requires considerable computing power, and thus additional virtual layering, assumptions and compositions are required to make it usable in very large installations. One of its basic compositions is that local needs are preferred over national needs.

BAU and Emergency settings were given as context in which smart charging is applied. Considering the Emergency setting, a direct connection with the smart meter is (in some countries) considered as a good way to control the load in these settings. The implementation in which the smart meter was used to send a profile to the charging station was demonstrated.

Partners

- Austrian Institute of Technology, Austria
- Compleo Charging Solutions, Germany
- Driivz, Israel
- Technical University of Delft, The Netherlands
- ElaadNL, The Netherlands

Project Impacts

- The analysis and simulations helped to explain the challenge of EVs' grid impact.
- OSCD showed that Multi-Actor Optimisation (MAO) is possible, and smart charging brings advantages to stakeholders.
- Gaps between protocols on different interfaces were provided to the Standard Development Organizations (SDOs).
- Home Energy Management Systems were explored and a lack of interoperability settings identified.

COSTART

Comprehensive strategy to accelerate the integration of electric buses into existing public transport systems

E-bus advancement – industry and academia going together

COSTART mitigates barriers to the implementation of electric buses into existing fleets. It addresses critical issues on different levels: vehicle components to extend the range and achieve high indoor thermal quality; vehicle operations in various geographies and traffic conditions; simulation and optimal fleet management; ownership, governance and business models.

Main results

By applying components like advanced Heating, Ventilation and Air Condition (HVAC) systems in e-buses to meet passenger comfort requirements, COSTART has extended the range of e-buses without using fossil-based winter heating engines. The development and use of heat pump systems allow for true zero-emission e-buses throughout the seasons, even tested in arctic winter climate.

Through the monitoring and evaluation of e-buses in operations, COSTART has also developed improved components that support the Controller Area Network (CAN bus) for better communication between devices relating to the Energy Management System, extending the range and providing information to the drivers and the traffic management.

A vehicle & fleet level analysis of grid-to-wheel energy consumption investigation for driving and climate control of e-bus fleet has been developed and tested. The result is a fleet assessment tool to guide authorities and operators while choosing a suitable fleet composition.

Concerning large-scale implementations, battery buses with overnight depot charging tend to be an attractive and cost-effective solution on a mature bidding market for smaller and mid-sized cities. No additional charging points along

Jan 2018 – Nov 2020
Total funding €1,178,000
Total cost €1,345,000

Website COSTART

Project Impacts

COSTART demonstrates key steps towards true emission free e-bus fleets through:

- An energy-efficient Thermal Management System, resulting in extended range.
- An improved CAN bus interface circuit for on-board measurement and continuous monitoring.
- An Assessment Tool for decision support, presenting data on energy and vehicle costs, emissions and consumptions.
- A set of governance recommendations.

the lines are required, which allows for greater flexibility and fewer infrastructure measures. Additional opportunity charging may still be the optimal choice for larger cities with longer routes and high-capacity vehicles in Bus Rapid Transit (BRT) systems.

The inclusion of e-buses in existing fleets requires enhanced cooperation between private and public actors and academia. The new technology is rapidly developing, and new actors may need to be involved in the realisation of efficient urban public transport, knowledge exchange and development of components, assessment and control tools for cost-efficient services. The gradual market maturing lowers the once much higher investments and operating costs. Changes in technology and the market may bring a window of opportunity for revising existing business models, making them more sustainable and resilient.

Making public transport an even more sustainable mode of transport in European cities through technology innovation is possible. European cities public transport authorities should initiate and support collaborations with industry and academia, which will have positive innovation effects and speed up the development of sustainable urban mobility.

Partners

- Lund University, Sweden
- Skånetrafiken, Sweden
- Swedish Bus and Coach Federation, Sweden
- Fachhochschule Aachen, Germany
- Aachener Straßenbahn und Energieversorgungs AG, Germany
- Eindhoven University of Technology, The Netherlands
- Fontys University of Applied Sciences, The Netherlands
- VDL Enabling Transport Solution BV, The Netherlands
- Bozankaya Otomotiv Makina, Turkey

CYB

Cloud Your Bus

Creating excellence in zero emission public transport is as easy as CYB

Zero Emission (ZE) buses in public transport bring new challenges and higher Operational and Capital Expenditures (Opex / Capex) as potential consequences. CYB modules drastically reduce ZE bus operations risks and costs, facilitating Return on Investment through access to live charging point data, driving style optimisation, energy usage forecasting and dynamic route planning.

Main results

In the recent transitions from fossil fuel to full electric concessions, many bus operators added extra buses to their fleets to secure a high quality of service. This 'risk buffer' can be greatly reduced by using smarter technologies, such as the ones developed by CYB.

Capex (asset intensity) for bus operators is likely to be reduced by more than 10 % and Opex (running costs) by over 25 % when the CYB tools are implemented. In this way, CYB contributes to the European Green Deal goals 'Increasing the EU's Climate ambition' and 'Accelerating the shift to sustainable and smart mobility'.

CYB presents a series of innovations designed to reduce both the Capex and Opex of ZE public transport operations, including: an ITxPT certified data gateway for e-buses; a data taxonomy and protocol for more than 10 different e-bus types; integration of charging infrastructure using Open Charge Point Protocol (OCPP) / Open Charge Point Interface (OCPI) protocols; a Cloud-based data hub with documented Application Programming Interface (API) for data sharing; an energy usage prediction model that accurately forecasts battery level at end-destination shortly after commencing a route, and a series of online Software as a Service (SaaS) modules for managing ZE operations, including:

- Live ZE dashboards with active alerting in case of (potential) operational disruptions.
- Charging Point management and remote diagnostics.
- Dynamic planning module for optimising day-to-day route and charge planning.

The hypothesis that 'all actors in the ZE transition space' can benefit from collaboration has proven correct. By leveraging a single data gateway in the e-bus, multiple (authorised) parties can be fed with data from a single source at incremental or no cost.

CYB has shown that creating both a taxonomy and a virtual protocol for e-bus data across makes and models is possible. This provides bus operators with flexibility and opens up for lower-risk, multi-vendor procurement strategies.

As the online data hub is designed to be open and collaborative in nature, additional 'connected specialists' are expected to join the CYB plat-

Jan 2018 – Oct 2020
Total funding € 900,000
Total cost € 1,400,000

Website CYB

form as partners. Similarly, the platform leaves open to bus operators and Original Equipment Manufacturer (OEM) alike to implement their proprietary systems around the platform.

The CYB eco-system platform will be further developed, and services expanded. The premise is that a strong and growing network of technically connected specialists will be a compelling value proposition to both OEMs, bus operators and other stakeholders in the zero emission supply chain.

Partners

- Sycada, The Netherlands
- Eindhoven University of Technology, The Netherlands
- Owasys, Spain
- Icron, Turkey

CLOUD YOUR BUS

Project Impacts

- Reduction of Capex required to run ZE operations as fewer e-buses are needed to safeguard service levels.
- Reduction of day-to-day operational disruptions and related operational expenses.
- Optimised driving styles lead to less energy usage, and longer range of e-buses and improved passenger comfort.
- Lower operational risk and exposure to fines related to not meeting prescribed service levels.

E-TRACT

E-TRACT

Innovative integrated electric traction system for minibuses

E-TRACT aims to integrate an innovative electric drive system into an existing 14 seats minibus and test the vehicle in real driving cycles. Alongside the tests, technical-economical evaluation to identify industrial feasibility and market potential were carried out.

Main results

There are two main possibilities to move towards electric mobility: (a) purchase a new electric minibus, or (b) transform the old traditional minibus into an electric vehicle.

There were 41,000 minibuses units in Europe in 2018: 95 % used for public transport and 5 % for private transport. For the study, 10,000 minibuses were considered eligible for the retrofit.

Today purchase an electric minibus costs about EUR 95,000, and adding the average operating cost of EUR 1,500 / year, in 10 years of use, the total cost of the vehicle amounts to around EUR 110,000. With the E-TRACT solution, the cost for the retrofit is about EUR 30,000 (without further operating costs), thus obtaining a 70 % reduction in costs compared to the purchase of a new vehicle.

Apr 2018 – Feb 2021
Total funding €957,702
Total cost €1,767,497

Project Impacts

- The integration of innovative retrofit kit for minibuses can generate profits for all stakeholders and could accelerate EV market adoption.
- The presented solution allows cost reduction for users in terms of purchase costs and maintenance.
- The retrofit kit offers a strong reduction of CO_2 emission with a positive impact on the entire society.

This cost-saving solution is due to the industrialisation of the retrofit kit, which estimates a possible reduction of costs of up to 30-50% compared to the initial prototype costs.

The proposed solution is compliant with EU and has been assessed with the Life Cycle Assessment (LCA) methodology. The areas of protection assessed are: (a) the global warming potential, (b) the global energy footprint, (c) the global water footprint, and (d) the global effect on human health;

The E-TRACT kit has a lower LCA impact than the diesel propulsion scenario in three out of four areas of protection.

Impact Category	200,000 km Retrofit	250,000 km Retrofit	300,000 km Retrofit
GWP100 kg [$CO_{2\,eq}$]	−34%	−43%	−49%
Energy Footprint [MJ]	−36%	−43%	−48%
Water Footprint [m^3_{H2O}]	+232%	+197%	+173%
Human Health [DALY]	−79%	−84%	−86%

Such an over performance amounted on average to:

−42% for the energy footprint,

−43% for the carbon footprint,

−83.5% for the effects on human health,

The light-duty vehicle parameters will improve proportionally to the kilometres travelled compared to a non-retrofitted vehicle.

From the economic point of view, the analyses show that the final cost of the electrification system allows profit margins between 20 and 30% in each transformation phase for both kit manufacturers and installers. Furthermore, the materials costs will be continuously updated with periodical introduction of alternative less expensive components keeping overall performance improvement.

The intervention of most EU governments on local policies and the EU commitment to sustainability could be an improving factor to stimulate the market.

Partners

- Mecaprom, Italy
- Imecar, Turkey
- Bosmal, Poland

PLATON

Planning process and tools for step-by-step conversion of the conventional or mixed bus fleet to a 100 % electric bus fleet

Bus electrification planning – a participative process

PLATON analyses and defines a planning process for converting a given bus fleet to 100 % electric through a collection of software tools. Due to its complexity, the planning process is based on individual methods. The result is a flexible toolkit that can support the decisions on different levels of strategic management and operational transport planning.

Main results

The provision of an interoperable decision support toolkit depends on distinct and well-defined interfaces for information exchange between tool components.

For the development of the toolkit, interdisciplinary cooperation was important. It required a high degree of integration and architectural design to ensure the seamless interoperability of the resulting tool components in the workflow. The provision of supporting tools for the planning process of bus fleet electrification must be as flexible as possible in terms of economical, administrational, technological, infrastructural and transportational aspects. This is justified by the number of dependencies between entities in the connected domains of legislation, economy, public transport and electric power supply, which is high and manifold.

In order to meet these requirements and take heed of the interdependencies, PLATON developed a fine-tuned information and data architecture composed of 11 tool components: DataProc, CellParameters, CollectApp, SyntheticalTrips, BusVehicleSimulation, ECBus+, TCOModel, OptimSched, VisualGrids, NMEA simulator and ReportGenerator. These are presented on the project's website platon.publictransport.info in section "Download".

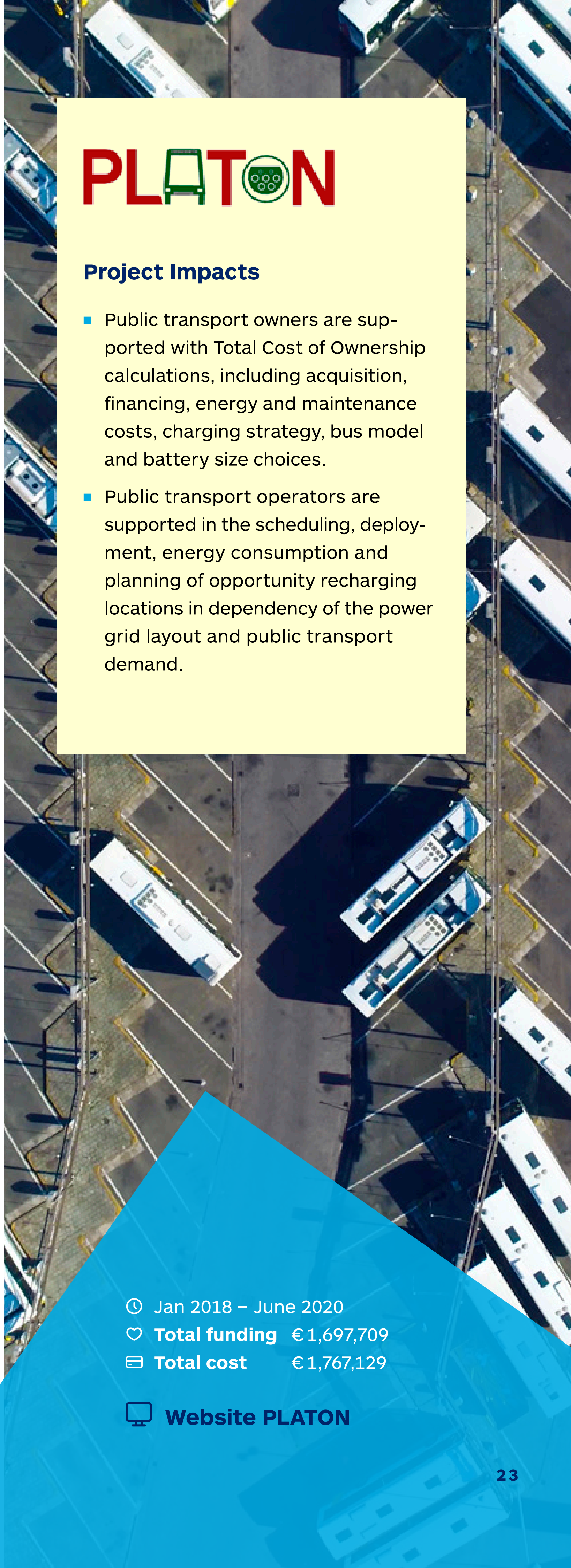
Major contributions include the development of the toolkit for determining the energy requirements of electric buses using a sub-microscopic vehicle simulation for a real route with an elevation profile and a simulation-based method for estimating the electrical parameters of lithium-ion batteries as energy storage devices for electric buses. When the developed toolkit is applied in conjunction with output data provided by potential users, an improved decision-making basis can be created supporting the transition from conventional to battery-electric drives in transport companies.

The toolkit also includes the possibility of a proportional electrification of the bus fleet as an important milestone. The toolkit may reveal different country-specific results. Concerning the energy supply structure, real zero emission mobility may be only achieved in countries with low carbon power generation. The use of the provided toolkit helps to make this aspect transparent.

Comprehensive tests in conjunction with use case scenarios for selected transport networks according to the respective use cases confirmed the functionality of the service chain and the seamless exchange of data between the PLATON tool components.

Partners

- Institut für Automation und Kommunikation e.V. Magdeburg, Germany
- Effiziente.st Energie- und Umweltconsulting e.U., Austria
- Joint Institute of Mechanical Engineering, National Academy of Sciences of Belarus, Belarus
- Open Joint Stock Company «BELKOMMUNMASH», Belarus
- Silesian University of Technology, Poland
- United Institute of Informatics Problems, National Academy of Sciences of Belarus, Belarus
- Closed Joint Stock Company "Stadler-Minsk", Belarus
- Przedsiebiorstwo Komunikacji Miejskiej Sp. z o.o. w Sosnowcu, Poland
- The Urban Transport Company in Jaworzno, Poland
- Volvo Bus Corporation, Sweden



PLATON

Project Impacts

- Public transport owners are supported with Total Cost of Ownership calculations, including acquisition, financing, energy and maintenance costs, charging strategy, bus model and battery size choices.
- Public transport operators are supported in the scheduling, deployment, energy consumption and planning of opportunity recharging locations in dependency of the power grid layout and public transport demand.

Jan 2018 – June 2020
Total funding € 1,697,709
Total cost € 1,767,129

Website PLATON

The way forward: trolley systems of the future

trolley:2.0 combines the advantages of battery-electric buses with trolleybuses allowing for the partial off-wire operation while making more efficient use of the catenaries to charge the batteries in motion. Trolley 2.0 contributes to improve the flexibility of trolleybus systems and further strengthen the economic and operational competitiveness of trolley systems.

Main results

Throughout the trolley:2.0 project, several drivers and barriers for the new systems have been identified. The following four drivers would undoubtfully have a positive impact on the use of public transport in general, electric buses or battery-trolleybuses in particular:

A major driver for electric buses, in general, is the technological advancement in batteries. Better batteries are lighter, more efficient, or hold more energy due to a higher energy density. All improvements would reduce the price per km and the total lifecycle costs and make electric buses more competitive than diesel buses.

An EU policy that supports the transformation of transport systems towards a zero emission level would significantly impact the use of electric buses of any kind, i.e. decision-makers should not neglect or ignore (in-Motion-Battery(IMC)-) trolleybus as means of a sustainable public transport system.

Investment opportunities in the catenary infrastructure would push the use of (IMC battery-) trolleybuses. Currently, there is a lack of financing and funding programs to invest in the catenary infrastructure.

A clear prioritisation of public transport vehicles in traffic, i.e. bus lanes, would radically improve the attractiveness of IMC concepts and public transport in general.

On the other hand, the main barriers identified are the high upfront costs for purchasing the modern IMC-capable vehicles and the often old-fashioned image of trolleybus technology, which can only be overcome by increasing the awareness of innovations around IMC concepts. Another barrier is that there is no standard legal definition yet for the hybrid trolleybuses in the European Union, leading to delays and bureaucratic difficulties.

By merging the electric bus and the trolleybus categories, the following results could be achieved: (a) unified market for IMC and trolleybus vehicles, instead of country-by-country rules, enabling a second-hand market as well; (b) more simplicity for the manufacturers: no more separate testing and authorisation requirements for trolleybuses;

and, (c) encouraging a choice and combination in charging infrastructure: today heavy-duty electric buses usually combine overnight and opportunity charging (range extender). IMC could be used as a range extension, for example, by running 10 % of the route under the catenary grid.

Partners

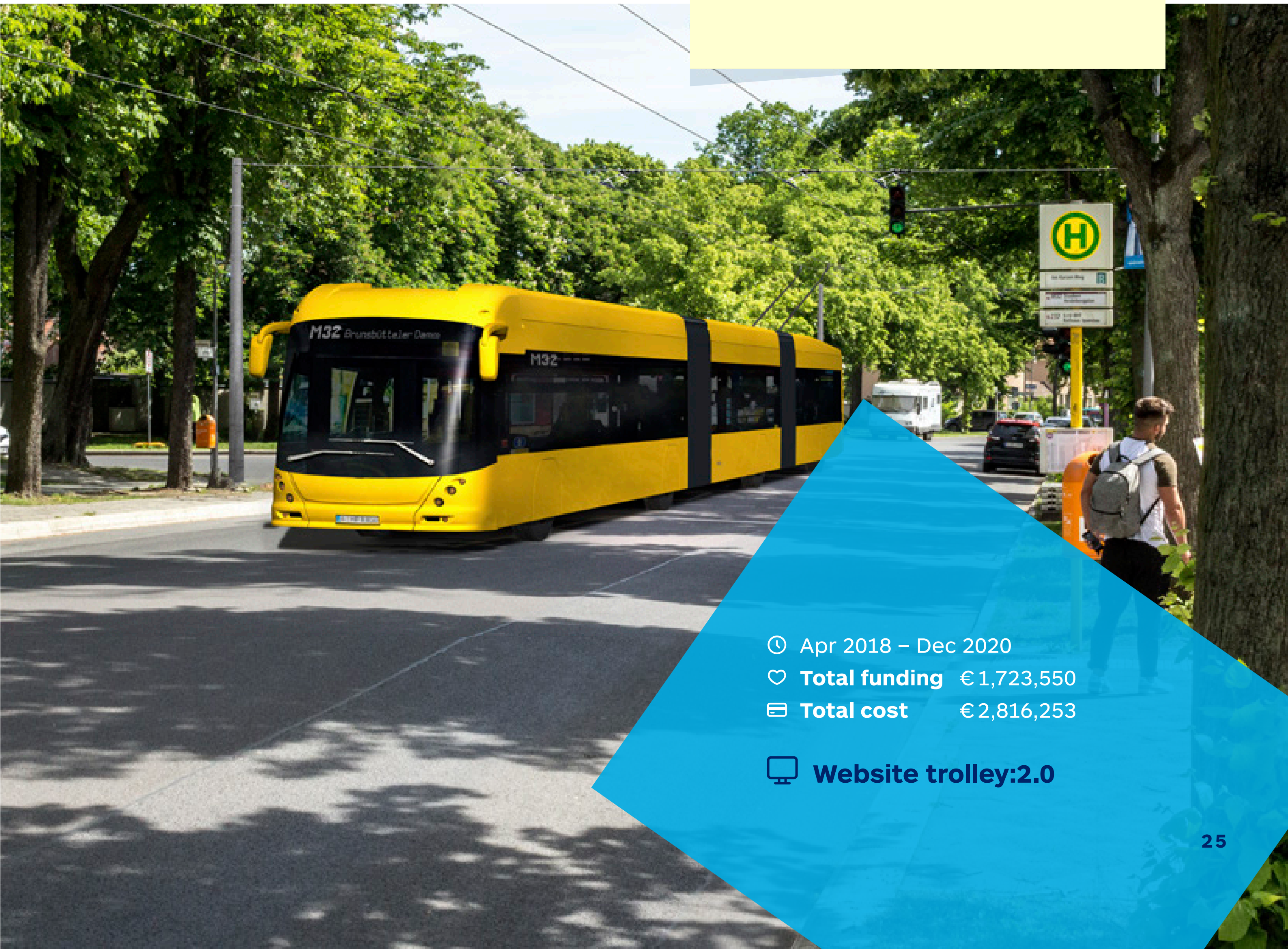
- trolley:motion, Austria
- BBG Barnimer Busgesellschaft, Germany
- evopro Holding Zrt, Hungary
- University of Delft, The Netherlands
- PRE power developers, The Netherlands
- University of Szeged, Hungary
- University Gdansk, Poland
- Technische Universität Dresden, Germany
- SZKT, Hungary

trolley:2.0 for smart cities

Project Impacts

Trolley:2.0 project has helped to:

- Create a better basis for the evaluation of hybrid trolleybuses or IMC systems.
- Prepare feasibility studies for the installation of hybrid trolleybus lines.
- Showcase deep integration of mobility and energy sectors, increasing system stability and economic feasibility.
- Get an insight into battery usage, energy efficiency, automatic wiring and charging infrastructures.



Apr 2018 – Dec 2020

Total funding € 1,723,550

Total cost € 2,816,253

Website trolley:2.0

evRoaming4EU

evRoaming for electric mobility in Europe

Realising cross-border charging in Europe

evRoaming4EU facilitates roaming services for charging electric vehicles and provides transparent information about charging locations and prices in Europe by using the open independent Open Charge Point Interface (OCPI) protocol. The goal is to allow any EV driver to charge at any charging station in the EU, by addressing functional, technical, legal and fiscal obstacles.

Main results

The use of OCPI as a generic roaming protocol was demonstrated in several pilot settings in Denmark, Germany, Austria and the Netherlands. In parallel, a roadmap was presented based on practical experiences and academic research to move forward towards a fully interoperable EV charging ecosystem where every EV driver can charge at every station.

During the last phase of the project, the progress of demonstrations across the different involved countries was prioritised and assured the broad involvement of market stakeholders and EV drivers.

At the same time, the academic track has delivered a thorough comparative analysis on the different roaming protocols, based on interviews and research, and delivered building blocks and scenarios for a future roadmap.

The development of the OCPI protocol itself, as the fundament for the above, has focused more on adequate support and sustainable governance than adding new features: the EV charging market is still in its early phase, and it is important to invest in a reliable framework for the future charging ecosystem. Therefore, a lot of attention has gone into improving support documentation and implementations and into the development of a mature and independent foundation for the maintenance and further development of the OCPI protocol.

The latter has resulted in a webinar where all project results have been shared with the world, and the new management organisation for OCPI has been announced, the EVRoaming Foundation 🖵 evroaming.org / about-us.

The main conclusion of the project is that it is indeed possible to provide national and cross-border e-roaming through the use of the OCPI protocol. However, if interoperability issues in Europe are not addressed and mitigated adequately, the publicly available charging infrastructure in Europe runs the risk of scaling forward along fragmented pathways. This can lead to higher costs, stranded investments for the charging operator and a mediocre, certainly less

Jan 2018 – June 2020
Total funding €1,143,500
Total cost €1,960,000

Website evRoaming4EU

than satisfying, customer experience accessing different charging networks anywhere in Europe.

evRoaming4EU suggests that policy and market parties form, at EU level, a coalition and board consisting of major market operators for harmonisation, further protocol development and e-roaming agreements. This will require the participation of market players of sufficient size, reach and financial acumen to build critical mass behind a uniform standard.

Partners

- Nationaal Kennisplatform Laadinfrastructuur, The Netherlands
- Copenhagen Electric, Denmark
- E.ON Danmark A/S, Denmark
- ENIO GmbH, Austria
- MRA-Electric, The Netherlands
- Smartlab GmbH, Germany
- Stromnetz Hamburg GmbH, Germany
- Eindhoven University of Technology, The Netherlands

evRoaming4EU
Realising cross-border charging in Europe

Project Impacts

- The protocol developments and roaming demonstrations showed that open roaming protocols can tackle obstacles experienced by users when charging across borders, such as lack of information (price, availability) and non-transparent business models.
- With the launch of the EVRoaming Foundation, the project has laid the basis for further development and implementation of roaming solutions on a European level.

proEME

Promoting Electric Mobility in Urban Europe

Supporting electric mobility decision-makers in Europe

proEME aims to increase the uptake of e-mobility in Europe by building capacities, networks and tools to support decision-makers. The approaches and decision support tools developed shall serve as blueprints for further development of the EV market and expand the knowledge of electric mobility, acting as a catalyst to create impact and accelerate market uptake.

Main results

The complex decision situation of market actors for electric mobility was analysed and tools were developed. In a multidisciplinary system analysis, the relevant factors and interests of private car owners were examined, and the Adoption Dynamic Analysis Model for Electric Vehicles (ADAM&EV) was developed. ADAM&EV focuses on the decision-making process for policymakers and is online available at www.pro-eme.eu / tools. The multidisciplinary system analysis shows that the total cost of ownership parity between conventional and electrical technologies plays a decisive role in the decision-making process.

The developed Electric Vehicle Decision Support Model (EV-DSM) tests the economic suitability of EVs for individual vehicle operations. It covers multiple EU countries, vehicle segments, and ownership types and targets private car owners, fleet operators, and companies.

The ECO-Driving tool app aims to improve the attitude towards EVs and provide supports in finding the proper EV for daily uses when switching from a conventional vehicle. The App enables users to track and analyse their driving behaviour and is available for download at play.google.com/store/apps/details?id=com.reichert.proeme. The overall development of the decision support models has been valuable for understanding the EV market.

The tool development was accompanied by data and policy analysis, such as analysing new and used EV models and their specifications. The analyses showed that there is no reliable or easy to access EU-wide database available. Furthermore, analyses were conducted on the effectiveness of incentives for EVs in different EU countries. A distinction was made between the purchase price and price sensitivity, and it was concluded that incentives could balance TCO parity.

A global survey was conducted on the state of knowledge and attitude regarding electric driving in selected European countries. The objective was to determine the status of the EV market progress on the same basis. The survey shows that there is still a knowledge gap on electric mobility among the respondents within the participating countries but also in an international comparison. Nevertheless, there is still a need to communicate essential information on the purchase and operation of EVs to the public. Initial experiences with electric vehicles can help to dispel myths about electric driving.

Apr 2018 – Oct 2020

Total funding € 1,421,843

Total cost € 1,667,483

Website proEME

PROMOTING proEME ELECTRIC MOBILITY EUROPE

Project Impacts

- The analysis, dissemination and exchange of results to the established international network of stakeholders and policymakers boosted policy support.
- The decision support research and dissemination activities in the project increased the understanding of the EV system.
- The transnational project work provided new impulses for emerging EV markets in Belarus and Hungary.

Partners

- German Aerospace Center, Germany
- FIER Automotive, The Netherlands
- University of Twente, The Netherlands
- Copenhagen Electric, Denmark
- Kommunen in der Metropolregion Hannover Braunschweig Göttingen Wolfsburg e.V., Germany
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- Lund University, Sweden
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MINISTRY FOR NATIONAL ECONOMY

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NWO
Netherlands Organisation for Scientific Research

Rijkswaterstaat
Ministry of Infrastructure and Water Management

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www.electricmobilityeurope.eu