



ABSTRACT

USE CASES

PROJECT PROFILES

NORMS AND STANDARDS

## TESTING OF USE CASES (V2H, V2B, V2G) FOR MANAGING CHARGING PROCESSES IN ELECTROMOBILITY

- AN INTERACTIVE IMPULSE PAPER -

# IMPRINT

## PUBLISHER

TÜV Rheinland Consulting GmbH

Institute for Innovation and Technology (iit) at VDI/VDE Innovation + Technik GmbH

On behalf of the Federal Ministry of Economics and Climate Protection (BMWK)

Dr Sören Grawenhoff, Am Grauen Stein, 51105 Cologne, soeren.grawenhoff@de.tuv.com

## AUTHORS

Accompanying research “Elektro-Mobil“

Lars Ostendorf (TÜV Rheinland Consulting GmbH)

Doris Johnsen (Institute for Innovation and Technology)

Sandra Gensch (Institute for Innovation and Technology)

Arno Spreen (Institute for Innovation and Technology)

### Translation

Annette Schostak (Institute for Innovation and Technology)

Various projects and project partners were actively involved in providing data for the impulse paper. The data is as of September 2022 and subject to change during the course of the project.

Gender-neutral language is used in this report. In individual cases, for reasons of readability, the masculine and feminine forms are not used when referring to persons. The masculine form applies to both genders in all cases in which this is not explicitly excluded.

## CONTACT PERSONS OF PARTICIPATING PROJECTS IN THE PROVISION OF DATA

### ARNi

Peter Kellendonk

### LamA / LamA-connect

Dr. Daniel Stetter

### BDL

Dr. Jens Berger

### TradeEVs

Kelaja Schert

### ELBE

Lennart Rommel

### unIT-e<sup>2</sup>

Michael Hinterstocker

Dr. Simon Köppl

## COVER PICTURE

Own presentation

## STATUS OF

November 2023



## IMPULSE PAPER

### ABSTRACT

The sustainable transformation of the transport sector in Europe and Germany is becoming increasingly important. The German government's push to establish Germany as a lead market for electromobility and to enable bidirectional charging of electric vehicles by 2025 has further accelerated the ramp-up phase of electromobility<sup>1</sup>.

In the projects of the funding programme Elektro-Mobil of the Federal Ministry of Economic Affairs and Climate Action (BMWK), a lot of experience is currently being gathered, particularly in the Vehicle2Business (V2B) and Vehicle2Grid (V2G) use cases, which are necessary for implementation in practice. The first areas of application are single-family homes, workplaces and apartment blocks.

Both unidirectional intelligent charging and bidirectional charging are being trialled in the projects. This is mainly done in real field tests, but also in laboratory set-ups.

The grid-supportive operation of electric vehicle batteries is emphasised in the projects as having clear potential and is of particular interest with regard to active integration into the electricity grid, which can relieve the burden on the electricity grids. As a result, system costs (including for grid expansion) can be reduced and the transition to grid expansion can be supported<sup>2</sup>. In the Elektro-Mobil funding programme, solutions for this are being developed and tested in the laboratory and under real conditions.

The stakeholders are actively involved in shaping the necessary standardisation. To this end, the requirements and challenges for standardisation and regulation identified from the projects are published and actively discussed with the stakeholders (more about the Stakeholder groups on page 4).

This paper contains profiles of the projects involved and offers insights into project structures and the opportunity to make direct contact.

### INTRODUCTION

The aim of this interactive paper is to show the range of implementations and trials of controlled charging in the research projects funded by the BMWK. An overview of the current activities and results of research and development within the framework of the programme is given to the readers.

This impulse paper is also intended to provide further structure. The implementations in the projects are assigned to the currently common categorisation of use cases for control processes in electromobility. A standardised use of terms in connection with use cases must be ensured in the future. The terms V2X generally refer to bidirectional charging. However, the term is also widely used in specialist circles in combination with "unidirectional".

A brief definition of the terms is provided under the "Use Cases" graphic element in order to create clarity for the other information levels. Brief descriptions of the norms and standards can be found under the graphic element "Standardisation".

The six use cases between market-based price control and emergency control of controlled charging processes outlined in the white paper of the accompanying research Elektro-Mobil were also categorised<sup>3</sup>. It is shown which stakeholder groups are involved in the subsidised projects, which norms and standards are used in the implementation and in which spatial environment (home, workplace, etc.) the testing takes place.

This paper is based on a survey of seven of the funded projects (ARNi, BDL, ELBE, LamA, LamA-connect, TradeEVs and uniT-e<sup>2</sup>) that deal with the management of charging processes and the results of the workshops organised by the accompanying research. Profiles of the seven projects that took

part in the survey are attached to the document. The interactive paper is designed in such a way that readers can jump directly to each graphic element

on the title page and find out about the specific aspect in question. Due to the complexity of the data, the analyses are limited to a few filter levels.

USE CASES	BI-/UNIDIRECTIONAL	PROJECTS
VEHICLE2HOME	unidirectional	unIT-e <sup>2</sup> , LamA-connect, TradeEVs
	bidirectional	unIT-e <sup>2</sup> , BDL, ARNi
VEHICLE2BUSINESS	unidirectional	unIT-e <sup>2</sup> , TradeEVs, LamA, LamA-connect
	bidirectional	unIT-e <sup>2</sup> , BDL
VEHICLE2GRID	unidirectional	unIT-e <sup>2</sup> , LamA, ARNi
	bidirectional	unIT-e <sup>2</sup> , BDL, ARNi
VEHICLE2INFRASTRUCTURE	unidirectional	TradeEVs
OTHER	unidirectional	ELBE
	bidirectional	BDL

Table 1: Use cases of the projects divided into unidirectional and bidirectional charging (own illustration)

## CORE RESULTS

### V2H ALREADY EXTENSIVELY TRIALLED, V2B AND V2G DOMINATE RESEARCH AND DEVELOPMENT

In their research and development work, the projects basically map the overarching use cases Vehicle2Home (V2H), Vehicle2Business (V2B), Vehicle2Grid (V2G) and Vehicle2Infrastructure (V2I) (Table 1).

V2H has already been extensively trialled and can be implemented both unidirectionally and bidirectionally in practice. According to the project partners in the accompanying research workshops, the V2H use case - also bidirectional - can already be implemented in single-family homes today with the existing norms, standards and regulations. It was also noted that the developments for unidirectional implementation represent direct preparatory work for the implementation of bidirectional charging.

The V2B and V2G use cases dominate as the forms of technology that are being tested and developed most comprehensively in the programme.

### PEAK SHAVING AND LOCAL CONGESTION MANAGEMENT MOST FREQUENTLY TRIALLED

The following system-related services and load management solutions are being trialled in the use cases as part of the projects<sup>1</sup>:

- Local congestion management (grid serviceability, §14a)
- Peak shaving
- Increase in own consumption
- Emergency power supply
- Primary control reserve (PCR)
- Tariff-optimised charging
- Redispatch
- Intraday trading

Peak shaving (10 out of 41 mentions) and local grid serviceability (§14a) (9 out of 41 mentions) are most frequently implemented in field trials in the projects of the funding programme. These use cases are primarily tested in pilot projects (field trials) (18 of 28 mentions), in laboratory set-ups (7 of 28 mentions) and, to a very limited extent, in the form of simulations (3 of 28 mentions).

The low-voltage grid connection level dominates in the subsidised projects (14 out of 22 mentions). Eight trials are being implemented at medium voltage.

Current (amperes) (7 of 18 mentions) and active power (kilowatts) (6 of 18 mentions) are used most frequently and to the same extent as control signals.

The TLS 1.2 security level dominates in the applications of the funded projects (14 out of 19 mentions). TLS 1.3 is used to a lesser extent (5 out of 19 mentions). This means that encryption with a lower security level than TLS 1.2 was not used in any of the projects.

Figure 1 shows the superordinate use cases V2H, V2B, V2G, V2B and V2I, divided into unidirectional and bidirectional charging, in the inner circle. The respective numerical value corresponds to the number of mentions. In the outer circle, the breakdown is shown according to the specific classification - as mentioned above - of system-related services and load management solutions: local grid serviceability (§14a), peak shaving, self-consumption increase, emergency power supply, primary control reserve (PCR), tariff-optimised charging, re-dispatch and intraday trading. The respective numerical value also corresponds to the number of mentions.

It should be noted that in the use cases several system-related services were analysed, so multiple answers were possible.

[Click here to enlarge image 1](#)



Figure 1: Allocation of the use cases tested in the projects (inner circle) to the system-related services and load management solutions (outer circle) (own illustration)

### UNIDIRECTIONAL CHARGING STILL PREDOMINATES IN THE USE CASES CURRENTLY BEING TRIALLED, BUT WITH A VIEW TO BIDIRECTIONAL IMPLEMENTATION

So far, unidirectional implementations have taken up a larger part of the development work. However, bidirectional charging is also being researched and tested both in real field trials and in laboratory set-ups.

### THE USE CASES FOR FREE TRADE AND EMERGENCY REGULATION DOMINATE THE TRIALS

In the white paper of the accompanying research, a consensus of the projects was presented on a categorisation of the use cases into three traffic light phases and six use cases (see Figure 1). The control phases of the grid status are colour-coded according to the traffic light principle<sup>5</sup>. The green phase represents the situation in which price control can take place through free trade, electricity procurement and sales. The yellow phase stands for price control in order to be able to take preventive measures by the grid. In the red phase, the situation is such that curative measures must be taken for the grid and power limitation is used as emergency control<sup>3</sup>.

[Click here to enlarge image 2](#)

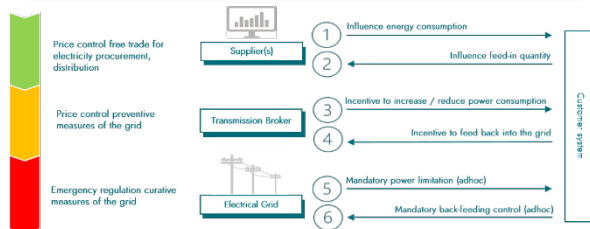


Figure 2: The six use cases according to a categorisation of their functionality (own illustration)

With a total number of  $N = 26$  responses, twelve research and development cases fall into the green phase, nine cases into the red phase and five into the yellow phase when categorised in the regulatory system. This means that the funding projects are currently still focussing on the use cases a) with price-oriented electricity procurement (green phase) and b) with the implementation of curative measures to ensure grid stability (red phase) in particular.

Use case 1 dominates under the green phase, free trading for electricity procurement (11 mentions), followed by use case 5, power limitation under the red phase (8 mentions).

Figure 2 shows the allocation of the use case trials to the six use cases between market-based price control and emergency control of controlled charging processes based on the feedback from the projects. In the right-hand column, the respective breakdown is shown according to the specific classification, namely, as mentioned above, system-related services and load management solutions: local grid serviceability (§14a), peak shaving, self-consumption increase, emergency power supply, primary control reserve (PCR), tariff-optimised charging, redispatch and intraday trading.

[Click here to enlarge figure 3](#)

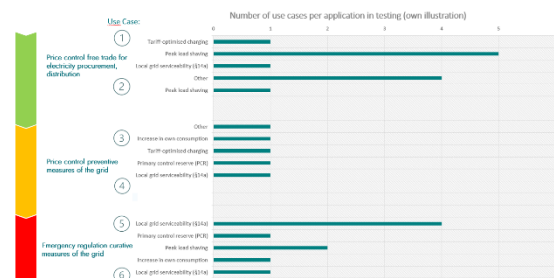


Figure 3: Number of use cases per functionality tested in the projects (own illustration)

### STAKEHOLDER GROUPS EXTENSIVELY REPRESENTED

The projects are organised in a variety of ways. The following different stakeholder groups are actively involved in the funding projects and the trials:

- Grid operators
- Charge Point Operators
- Hardware providers
- Software providers
- Universities/colleges
- Research facilities
- Association/NGO
- Companies in the automotive industry
- Authorities/regional authorities

### THE MAIN LOCATIONS ARE SINGLE-FAMILY HOMES, WORKPLACES AND MULTI-FAMILY HOMES

The scope of the use cases are single-family homes, multi-family homes, underground car parks, company fleet management, workplaces, public charging points, charging point on a property with additional systems next to the charging points (see Figure 4). In some use cases, the projects analysed several possible applications, so multiple answers were possible regarding the scope of the application.

[Click here to enlarge figure 4](#)



Figure 4: Assignment of the use cases tested in the projects (inner circle) to the deployment locations (outer circle) (own illustration)

#### THERE IS ALREADY A CONSENSUS ON NORMS AND STANDARDS; NEED FOR MINOR ADJUSTMENTS

For consistent and interoperable communication between the stakeholders, norms and standards and their consistency in the flow of information are essential and elementary. The projects in the funding programme use the following norms and standards for the communication channels in their use case trials (in alphabetical order):

- EEBUS
- IEC 60870-5-104
- IEC 61850
- IEC 63110
- IEC PT 63380
- ISO 15118-2
- OCPP
- openADR
- VDE-AR-E 2122-1000 (congruent with VDE-AR-E 2829-6, EEBUS)

These norms and standards form the basis for the communication channels of electromobility: from the distribution system operator via a smart metering system and energy management system to the charging infrastructure, back-end and vehicle - as they are currently being trialled.

A core of the norms and standards applied in the research projects are congruent with the "normative

triad" of VDE-AR-E 2829-6 (EEBUS), IEC 63110 (OCPP) and ISO 15118, which was formulated as a consensus in the white paper of the accompanying research Elektro-Mobil (p.13)<sup>3</sup>. This normative triad applies to the control system behind the grid connection point for communication between the transfer at the grid connection, the charging point, the charge point operator and the vehicle.

In the workshops conducted by the accompanying research, it was also consistently formulated that the relevant norms and standards require fine-tuning and that there is broad agreement on this.

[Click here to enlarge figure 5](#)

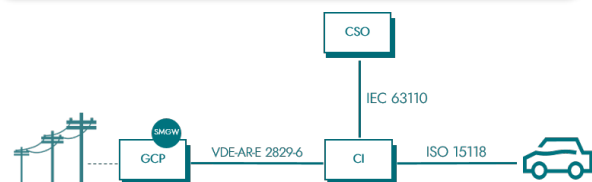


Figure 5: Normative triad behind the grid connection point from the perspective of the charging infrastructure (GCP: grid connection point; CI: charging infrastructure; CSO: charge station operator) (own illustration)

#### THE CHALLENGES

The use cases illustrate the challenges of expanding electromobility.

These consist of technical issues, specific work on interfaces and adaptation in standardisation. For internationally interoperable communication, uniform standards must be applied at the interfaces and national norms and standards must be harmonised with international developments.

With regard to specific use cases, the projects express challenges in grid status monitoring, forecasting and aggregation. In addition, the BDL project in particular formulated requirements for the regulatory framework in the form of three position papers<sup>6,7,8</sup> which were developed into concrete implementation proposals and discussed with the relevant stakeholders as part of the accompanying research activities.



## CONCLUSION AND OUTLOOK

The goals of the energy transition by 2030 are clearly defined and the expansion of renewable energies, the mobility transition and the heating transition are progressing. Electromobility is the key to the climate-friendly transformation processes of the mobility of the future and the energy transition in transport. In addition to the ramp-up of decentralised renewable energy generation and the increasing use of heat pumps, it poses particular challenges for distribution grids. Here, electric vehicles can also serve as mobile storage units via the uni- and bidirectional management of charging processes, particularly in the distribution grids, and become a means of balancing grid fluctuations. In addition to passenger transport, the first R&D activities to manage charging processes in the commercial vehicle sector are being carried out in subsidised projects and by their stakeholders. Larger batteries and better planning are emphasised as advantages. In depots, for example, managing the charging processes of electric vehicle fleets is categorised as an integral part of the system solution for the property's electricity procurement and consumption. Areas of application for V2G are seen in control power or redispatch. Some stakeholders estimate a significant potential for the provision of flexibility (e.g. theoretical potential of over 4 GW of positive and negative flexibility in the time window between 4 p.m. and 4 a.m.)<sup>9</sup>.

The grid-supportive operation of electric vehicle batteries is emphasised by the projects involved in the survey as having clear potential and is of great interest, particularly with regard to active integration into the electricity grid, which can relieve the burden on local electricity grids. As a result, system costs (also for grid expansion) can be reduced and the transition of the grid expansion can be supported.

The funded projects in the Elektro-Mobil programme make an important contribution to research

and development, the clarification of technical issues, as well as work on interfaces for standardisation and regulatory requirements. The Vehicle2Home use case has already been extensively trialled in the passenger car sector and can be implemented both unidirectionally and bidirectionally in practice. A great deal of experience is currently being gathered in the funding projects, particularly in the Vehicle2Business and Vehicle2Grid use cases. This experience is necessary for practical implementation. The initial areas of application for the pilot projects are dominated by single-family homes and employers, but implementation in multi-family homes is also being trialled.

In particular, the cross-stakeholder composition of the consortia, including the active role of the grid operators, demonstrates the commitment of all stakeholders required for market implementation. At the same time, it also serves to establish the necessary structures in the organisations for the concrete implementation of business activities.



## REFERENCES

- <sup>1</sup> Die Bundesregierung (2021): Mehr Fortschritt wagen. Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit - Koalitionsvertrag zwischen SPD, Bündnis 90/Die Grünen und FDP. Available online at: <https://www.bundesregierung.de/re-source/blob/974430/1990812/04221173eef9a6720059cc353d759a2b/2021-12-10-koav2021-data.pdf?download=1>, last accessed on 21.03.2023
- <sup>2</sup> Verkehrswende 2019: Verteilnetzausbau für die Energiewende. Available online at: [https://www.agora-verkehrswende.de/fileadmin/Projekte/2019/EV-Grid/Agora-Verkehrswende\\_Agora-Energiewende\\_EV-Grid\\_WEB.pdf](https://www.agora-verkehrswende.de/fileadmin/Projekte/2019/EV-Grid/Agora-Verkehrswende_Agora-Energiewende_EV-Grid_WEB.pdf), last accessed on 21.03.2023
- <sup>3</sup> Lars Ostendorf, Doris Johnsen, Mischa Bechberger (2022): Steuerung von Ladevorgängen in der Elektromobilität; Whitepaper; Darstellung der Kommunikationswege anhand einer Landkarte – erweiterte Edition I. Available online at: [https://www.iit-berlin.de/wp-content/uploads/2022/10/Whitepaper\\_Gesteuertes-Laden-Erweiterte-Edition-1.pdf](https://www.iit-berlin.de/wp-content/uploads/2022/10/Whitepaper_Gesteuertes-Laden-Erweiterte-Edition-1.pdf), last accessed on 21.03.2023
- <sup>4</sup> Initiative „Bidirektionales Laden“ (2022): Positionspapier zu notwendigen regulatorischen Anpassungen im Kontext des bidirektionalen Ladens. Available online at: <https://ceco.de/user/pages/downloads/14.bidirektionales-laden-von-eautos-als-schlüssel-zur-flexibilisierung-des-energiesystems/Initiative%20Bidirektionales%20Laden%20Positionspapier%20M%C3%A4rz%202022.pdf>, last accessed on 21.03.2023
- <sup>5</sup> VDE e.V. (2022): Eckpunkte zum künftigen Netzbetrieb mit Flexibilitäten in der Niederspannung. Available online at: <https://www.vde.com/re-source/blob/2191870/c830251e02291ca67fd187c02381783e/eckdatenpapier-flexibilitaet-data.pdf>, last accessed on 25.04.2023
- <sup>6</sup> Research project " Bidirektionales Lademanagement – BDL" (2022): Zwischenspeicherung von Energie in bidirektional ladenden Elektrofahrzeugen zur Optimierung des Ladevorgangs am Intraday-Markt, position paper. Available online at: <https://www.ffe.de/veroeffentlichungen/positionspapier-zur-vehicle-to-intraday-anwendung/>, last accessed on 25.04.2023
- <sup>7</sup> Research project " Bidirektionales Lademanagement – BDL" (2021): Betrachtung der Umsetzung des Bidirektionales Lademanagement im Kontext von Vehicle-to-Home (V2H) (Eigenverbrauchserhöhung), position paper. Available online at: [Betrachtung der Umsetzung des Bidirektionalen Lademanagements im Kontext von Vehicle-to-Home \(V2H\) - FfE](#), last accessed on 21.03.2023
- <sup>8</sup> Research project " Bidirektionales Lademanagement – BDL" (2022): Bereitstellung von Systemdienstleistungen aus Elektrofahrzeugen mit bidirektionalem Lademanagement, a BDL position paper to vehicle-to-grid-applications. Available online at: [Positionspapier zur Bereitstellung von Systemdienstleistungen aus Elektrofahrzeugen mit bidirektionalem Lademanagement - FfE](#), last accessed on 21 March 2023
- <sup>9</sup> Daimler Truck AG, TenneT TSO GmbH (2022): Flexibility marketing options for charging processes of electric medium-duty and heavy-duty commercial vehicles, Feasibility study, 30.06.2022. Available online at: [Flexibility marketing options for charging processes of electric medium-duty and heavy-duty commercial vehicles](#), last accessed on 21/03/2023

Figure 1: Assignment of the use cases tested in the projects (inner circle) to the system-related services and load management solutions (outer circle) (own illustration)



Figure 2: The six use cases according to a categorisation of their functionality (own illustration)

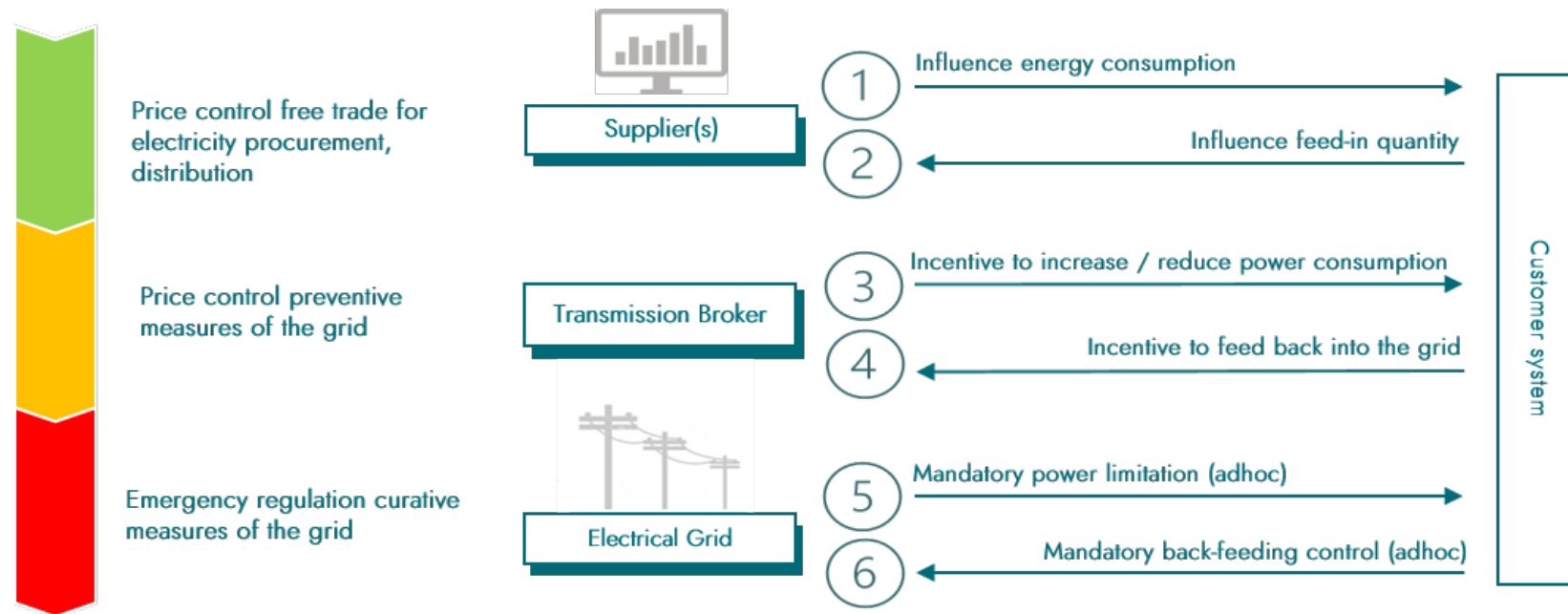


Figure 3: Number of use cases per functionality tested in the projects (own illustration)

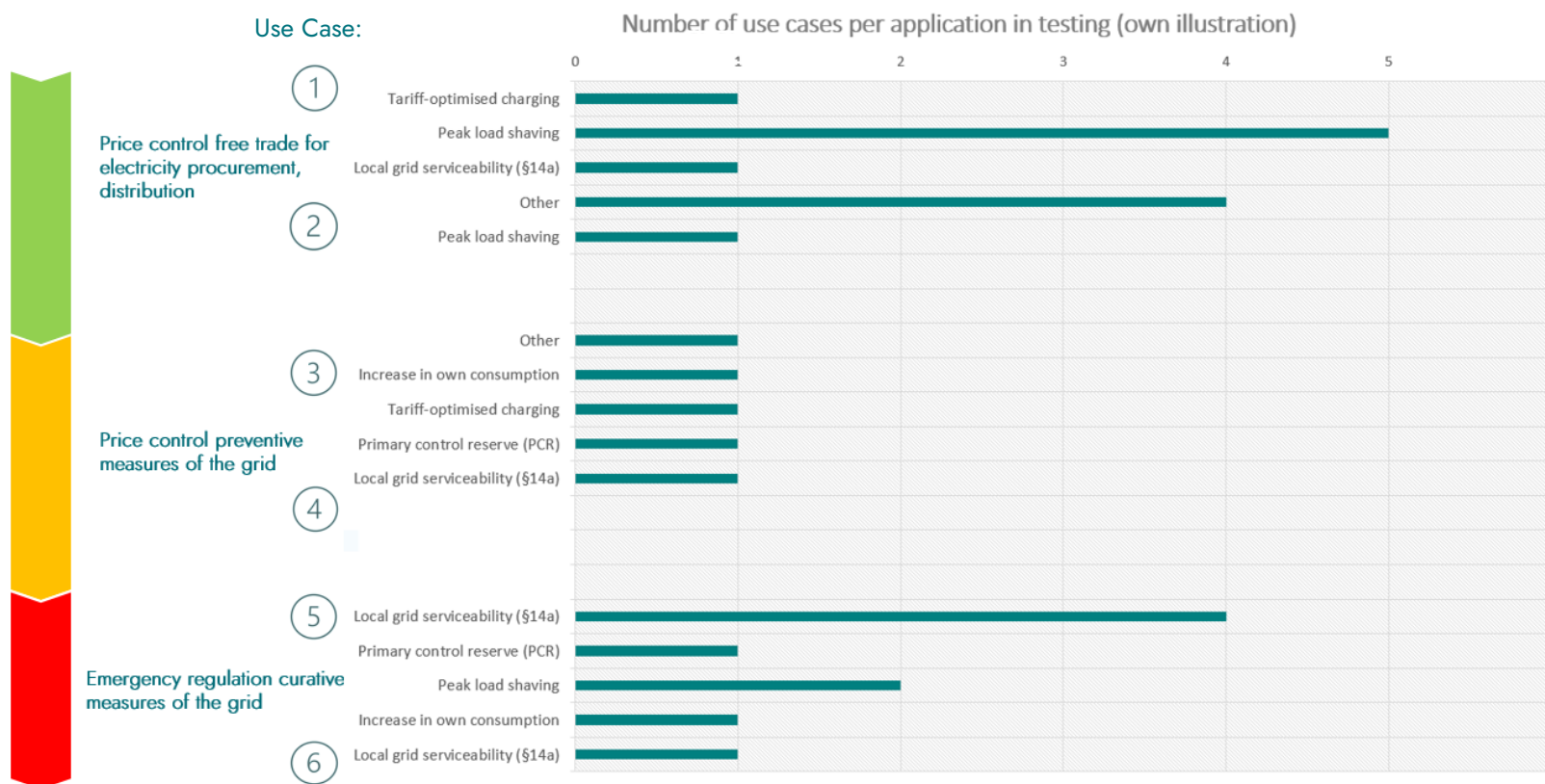


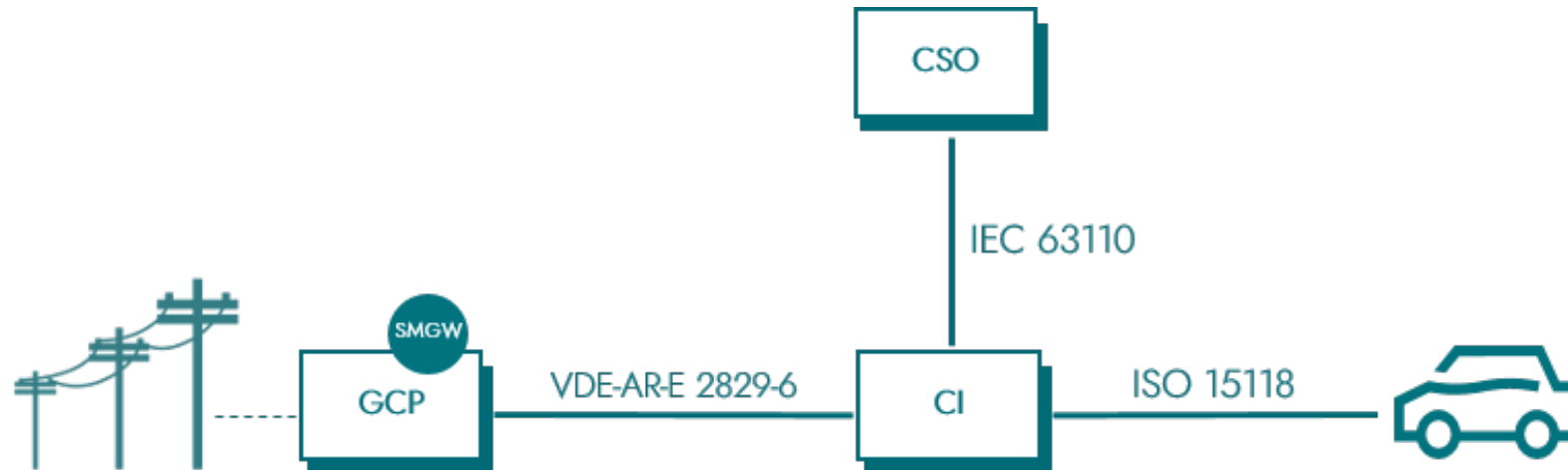
Figure 4: Assignment of the use cases tested as part of the projects (inner circle) to the deployment locations (outer circle) (own illustration)



Figures reflect the number of responses in the survey.

In some cases, several possible applications were analysed as part of individual use cases, so multiple answers were possible.

Figure 5: Normative triad behind the grid connection point from the perspective of the charging infrastructure (GCP: grid connection point; CI: charging infrastructure; CSO: charge station operator) (own illustration)



## USE CASES

[MAIN PAGE](#)

USE CASES	EXPLANATION
V2H	Vehicle2Home: intelligently managed charging and release of electrical energy from the electric vehicle's traction battery back into a domestic grid. Differentiation between uni- and bidirectionality under the categorisation V2H.
V2B	Vehicle2Business: intelligently managed charging and delivery of electrical energy from the electric vehicle's traction battery back to other buildings on a property. Differentiation between unidirectionality and bidirectionality under the categorisation V2B.
V2G	Vehicle2Grid: intelligently managed charging and release of electrical energy from the electric vehicle's traction battery back into the power grid. A distinction is made here between unidirectional and bidirectional charging under the categorisation V2G. Some players also use the abbreviation V1G for unidirectional controlled charging.
V2X	Vehicle2X: intelligently managed charging and delivery of electrical energy from the electric vehicle's traction battery back to any entity.
V2I	Vehicle2Infrastructure: intelligently managed charging and delivery of electrical energy from the electric vehicle's traction battery back to the roadside infrastructure.
V2V	V2V: intelligently managed charging and transfer of electrical energy from the electric vehicle's traction battery back to other vehicles.



## NORMS AND STANDARDS

Norms and standards	Explanation
EEBUS	EEBUS describes the communication interface (= application, transport, communication) to enable the connection between energy-related devices and the corresponding control systems.
IEC 60870-5-104	The IEC is a general transmission protocol between (network) control systems and remote control terminals. The IEC 60870-5-104 standard ensures that telecontrol and control technology devices and systems from different manufacturers can communicate with each other without the need for fundamental customisation.
IEC 61850	IEC 61850 defines an architecture that fulfils the requirements of electrical switchgear. The standard specifies a model and the communication services for interaction with and between elements of a switchgear (such as feeders, disconnectors, protective devices).
IEC 63110	IEC 63110 is an international standard that defines a protocol for the management of charging and discharging infrastructures for electric vehicles.
IEC PT 63380	Communication standard between energy management system and charging station.
ISO 15118-2	Road vehicles - communication interface between vehicle and charging station - part 2: network and application protocol requirements
OCPP	Open Charge Point Protocol - protocol for the management of charging infrastructure for electric vehicles.
OPENADR	Standard for communication between distribution system operators and charge point operators.
VDE-AR-E 2122-1000	Communication standard between energy management system and charging station.
DIN SPEC 70121	Digital communication between a DC charging station and an electric vehicle to control DC charging in the integrated charging system.

## PROJECT PROFILES

[MAIN PAGE](#)

### ARNI

APPLICATION RULE NETWORK INTEGRATION WITH MARKET AND CUSTOMER INTERESTS

LOCATION: COLOGNE

#### BRIEF DESCRIPTION

The ARNi project lays the foundations for devices from different manufacturers and domains to interact with each other in the digitalised energy system. This interoperability is necessary in order to seamlessly integrate the charging infrastructure for electric vehicles into the overall energy and building management landscape. The project is developing and testing practical mechanisms to coordinate the different interests of customers, energy traders and grid operators and automatically resolve conflicts of interest. The project will develop draft standards, implementation specifications and implementation and test instructions for the interoperable interaction of devices from different manufacturers and domains. In order to enable the easiest possible access to the results, a living lab is also being set up

and operated where all stakeholders can test their solutions.

#### PRACTICAL APPLICATIONS

In the Livinglab Cologne and other real-world laboratories, the application aids for interoperable products created in the project are tested with regard to their customer-, market- and network-orientated operation. The solution developed consists of simple building blocks that build on each other and allow manufacturers to integrate themselves into the energy system step by step. Due to the broad membership base of the EEBUS Initiative e.V. and the network activities that go beyond this, the work results are already being intensively coordinated with the industry during the project period and therefore represent a directly applicable consensus.

#### USE CASES

##### SUPERORDINATE CATEGORISATION

Vehicle2Grid (uni- and bidir.)

##### FRAMEWORK OF THE ASSIGNMENT

Open

Open

Vehicle2Home (uni- and bidir.)

Open

##### SPECIFIC CATEGORISATION

Local grid serviceability (§14a)

Open

Open

#### CONSORTIUM

EEBus Initiative e.V.

CONTACT PERSON Peter Kellendonk - EEBus Initiative e.V. - [kellendonk@eebus.org](mailto:kellendonk@eebus.org)

# BDL

[MAIN PAGE](#)

BIDIRECTIONAL CHARGING MANAGEMENT

LOCATION: MUNICH

## BRIEF DESCRIPTION

The research project "BDL" - bidirectional charging management - approaches the topic of intelligently managed integration of electric vehicles into the power grid with a holistic approach that links vehicles, charging infrastructure and power grids. The focus is on the development and testing of systems for vehicles and charging stations with which e-vehicles plugged in for charging can not only absorb and store energy, but also release it again. Charging processes are controlled using appropriate hardware and software. Legal and regulatory framework conditions for subsequent regular operation are also taken into account.

## PRACTICAL APPLICATIONS

The practical phase of the project began in spring 2021. 50 private and fleet customers were equipped with regenerative BMW i3s, suitable charging hardware and associated digital services as part of a one-year pilot phase in order to test the customer benefits and user-friendliness of the solutions developed to date under real-life conditions. This created the basis for the subsequent series production and thus widespread use of the technology for the intelligent integration of electromobility into the German power grid.

Final report of the consortium: ([Project: ffe.de](#)) Final report FfE: [Bidirectional charging management - Final report of the FfE](#)

## USE CASES

### SUPERORDINATE CATEGORISATION

### FRAMEWORK OF THE ASSIGNMENT

### SPECIFIC CATEGORISATION

Vehicle2Home (bidir.)	Single-family home	Increase in own consumption
Vehicle2Grid (bidir.)	Single-family home	Redispatch, intraday trading, local grid service (§14a), primary control reserve (PCR)
Other	Single-family home	Other
Vehicle2Business (bidir.)	Employer car park	Peak shaving

## CONSORTIUM

BMW Group (consortium leader), Bayernwerk Netz GmbH, Forschungsgesellschaft für Energiewirtschaft mbH, Forschungsstelle für Energiewirtschaft e. V., Karlsruher Institut für Technologie, KEO GmbH, KOSTAL Industrie Elektrik GmbH, TenneT TSO GmbH, Universität Passau

CONTACT PERSON Dr. Jens Berger - BMW Group - [Jens.A.Berger@bmw.de](mailto:Jens.A.Berger@bmw.de)

# ELBE

[MAIN PAGE](#)

ELECTRIFY BUILDINGS FOR EVs

LOCATION: HAMBURG

## BRIEF DESCRIPTION

The ELBE research project is developing a practical and transferable model for grid-supportive charging. An IT interface developed in the project ensures that peaks in the electricity grid caused by charging electric vehicles are reduced or avoided altogether. The integration of the IT interface into the backends of the charging station operators ensures that power consumption can be regulated in the event of short-term demand on the grid. Thanks to this forward-looking grid control, the city's general security of supply can be guaranteed even when electricity demand increases. Innovative business models are being developed that promote the demand-orientated development of charging infrastructure and ensure the economic operation of the charging infrastructure.

## PRACTICAL APPLICATIONS

As part of the project, a large number of residential and commercial properties as well as company premises will be equipped with controllable charging facilities. The comprehensive infrastructure expansion will be accompanied by research into innovative technologies for secure and data protection-compliant charging and billing. An integral part of the project is a three-phase field test of the grid-friendly control of the charging infrastructure, in which all subsidised location partners are involved. The aim of this field test is to test the communication channels between the various stakeholders involved.

### USE CASES

#### SUPERORDINATE CATEGORISATION

Unidirectional charging

#### FRAMEWORK OF THE ASSIGNMENT

Multi-family home

Underground car park

Fleet management

#### SPECIFIC CATEGORISATION

Local grid serviceability (§14a), peak shaving

Local grid serviceability (§14a), peak shaving

Local grid serviceability (§14a), peak shaving

### Consortium

Freie und Hansestadt Hamburg (consortium leader), Alphabet Fuhrparkmanagement GmbH, Charge-Point Germany GmbH, Energy Project Solutions GmbH, Hamburg Energie GmbH, Helmut-Schmidt-Universität Hamburg, Stromnetz Hamburg GmbH, The New Motion Deutschland GmbH, TotalEnergies Marketing Deutschland GmbH, ubitricity Gesellschaft für verteilte Energiesysteme mbH

CONTACT PERSON Lennart Rommel - Freie und Hansestadt Hamburg -

[lennart.rommel@bwi.hamburg.de](mailto:lennart.rommel@bwi.hamburg.de)

# LAMA

[MAIN PAGE](#)

CHARGING AT THE WORKPLACE - NATIONWIDE DEVELOPMENT OF CHARGING INFRASTRUCTURE AT FRAUNHOFER INSTITUTES IN ELIGIBLE MUNICIPALITIES

LOCATIONS: STUTTGART, FREIBURG, DRESDEN

## BRIEF DESCRIPTION

The joint project "LamA - Charging at the Workplace" is setting up charging infrastructure for electric vehicles at 37 Fraunhofer Institutes across Germany. By 2022, 440 normal charging points and a further 40 fast charging points are to be set up. The charging points are available to employees, company car fleets and third parties. Stuttgart, Freiburg and Dresden are the lighthouse locations in the project. Seven Fraunhofer Institutes will pool their research activities here and make the results available to interested parties. A particular focus is the inves-

tigation of new business models through the integration of fleet and charging management for company car fleets.

## PRACTICAL APPLICATIONS

A total of 338 charging points will be built by September 2020, of which 310 are normal charging points (22 kW) and 28 are fast charging points (150 kW). A further 142 charging points, including 130 normal charging points and 12 fast charging points, will then be installed.

## USE CASES

### SUPERORDINATE CATEGORISATION

Vehicle2Grid (unidir.)

### FRAMEWORK OF THE ASSIGNMENT

Workplace

### SPECIFIC CATEGORISATION

Peak shaving (§14a), local grid services (§14a)

Charging point on the property\*

Peak shaving (§14a), local grid services (§14a)

Vehicle2Business (unidir.)

Workplace

Peak shaving (§14a), local grid services (§14a)

Charging point on the property\*

Peak shaving (§14a)

Vehicle2Home (bidir.)

Single-family home

Peak shaving

Other

Increase in own consumption

\*with other systems that are not charging points

## CONSORTIUM

Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO (consortium leader), Badenova AG & Co. KG, Stuttgart Netze GmbH (associated partner), Fraunhofer Institute (EMI, IFAM, ISE, ISI, IVI, SIT)

CONTACT PERSON Dr. Daniel Stetter - Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO - [Daniel.Stetter@iao.fraunhofer.de](mailto:Daniel.Stetter@iao.fraunhofer.de)

# LAMA-CONNECT

[MAIN PAGE](#)

BSI-COMPLIANT CHARGING WITH THE HELP OF SMART METER GATEWAYS

LOCATIONS: STUTTGART, FREIBURG

## BRIEF DESCRIPTION

The integration of smart meter gateways (SMGW) plays a decisive role in the field of electromobility. The "LamA-connect" project is laying the foundations for the targeted mapping of electromobility in the energy system. Based on the highest safety standards, it is about integrating the SMGW into the grid operator's processes, analysing and applying its range of functions and the consistency of communication via the control box to the vehicle. The legal basis for various use cases is also analysed. The different safety architectures from international standardisation and national legislation must be harmonised.

## PRACTICAL APPLICATIONS

As part of the existing "LamA - Charging at the Workplace" project, charging infrastructure is being established on the premises of 37 Fraunhofer institutes throughout Germany.

LamA-connect is developing and testing BSI-compliant SMGW at the Fraunhofer IAO in a public car park of PBW in Stuttgart and in a residential area in Freiburg (Fraunhofer ISE) to control this charging infrastructure and bill charging processes in compliance with calibration law. In order to ensure the highest possible degree of sustainability and corresponding investment security for the automotive industry, charging infrastructure operators, network operators, manufacturers and suppliers, standardisation projects from relevant and related areas are included in the overall project and their interaction is examined, investigated and supported as part of the overall objectives.

## USE CASES

### SUPERORDINATE CATEGORISATION

Vehicle2Business (unidir.)

Vehicle2Home (unidir.)

### FRAMEWORK OF THE ASSIGNMENT

Workplace  
Underground car park

Single-family home

Multi-family home

### SPECIFIC CATEGORISATION

Other  
Local grid serviceability (§14a),  
peak shaving

Local grid serviceability (§14a)

## CONSORTIUM

Fraunhofer-Institut für Arbeitswirtschaft und Organisation (consortium leader), Badenova AG & Co. KG with badenovaNETZE GmbH, Becker Büttner Held Part GmbH, Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (DKE), Fraunhofer-Institut für Sichere Informationstechnologie SIT, Fraunhofer-Institut für Solare Energiesysteme ISE, PBW Parkraumgesellschaft Baden Württemberg mbH, Physikalisch Technische Bundesanstalt PTB, Power Plus Communications AG, Universität Stuttgart

CONTACT PERSON Dr. Daniel Stetter - Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO - [Daniel.Stetter@iao.fraunhofer.de](mailto:Daniel.Stetter@iao.fraunhofer.de)

# TRADEEVs II

[MAIN PAGE](#)

SUB-AGGREGATION OF ELECTRIC VEHICLE FLEETS FOR INTEGRATION INTO VIRTUAL POWER PLANTS

LOCATIONS: WALLDORF, SCHÖNAU IN THE BLACK FOREST, ARNSTADT, MUNICH

## BRIEF DESCRIPTION

Overall, electric vehicles will become the largest consumer of electricity in the future. The rapidly increasing number of electrified cars and commercial vehicles is placing ever greater demands on the charging infrastructure and the electricity grid - combined with considerable expansion costs. At the same time, the storage capacity of vehicle batteries - especially in fleets - offers the opportunity to generate revenue on the energy market and thus partially offset the costs. The "TRADE EVs II" project is developing a solution for connecting e-fleets to the electricity market. The fleet vehicles are to be combined via control centres in such a way that they become fleet power plants whose stored energy is fed back into the electricity grid for a fee when required.

via fleet-specific control centres. The virtual power plants will then be integrated into a balancing group together with other consumers, storage facilities and generators. The balancing group is a virtual account for energy quantities that ensures that the energy generated and the energy consumed in the entire supply area are always in balance. In addition, commercial billing is handled via the balancing group.

In this context, research is being conducted into how electricity procurement costs can be optimised. In 2022, several fleets will also test the revenue potential based on system services such as grid regulation through redispatch - i.e. the readjustment of power plant deployment to counteract overloading of the electricity grid.

## PRACTICAL APPLICATIONS

By 2022, several e-fleets with hundreds to thousands of vehicles will be networked with each other

The project partners involved initially developed the necessary software modules for their own in-house fleets and later integrated them into the overarching pool, which also includes fleets from other companies.

### USE CASES

#### SUPERORDINATE CATEGORISATION

Vehicle2Home (unidir.)  
Vehicle2Infrastructure (unidir.)  
Vehicle2Business (unidir.)

#### FRAMEWORK OF THE ASSIGNMENT

Single-family home  
Public charging points  
Fleet management  
Employer car park  
Fleet management

#### SPECIFIC CATEGORISATION

Local grid serviceability (§14a)  
Increase in own consumption  
Tariff-optimised charging  
Peak shaving  
Primary control reserve (PCR)

### CONSORTIUM

SAP SE (consortium leader), EWS Elektrizitätswerke Schönau eG, CYX mobile KG, FfE Forschungsstelle für Energiewirtschaft e.V.

CONTACT PERSON Kelaja Schert - SAP SE - [k.schert@sap.com](mailto:k.schert@sap.com)



## UNIT-E<sup>2</sup>

[MAIN PAGE](#)

REAL-WORLD LABORATORY FOR NETWORKED E-MOBILITY

LOCATIONS: MUNICH, RATINGEN, ALLENDORF, REGENSBURG, STUTTGART, OLDENBURG, BAYREUTH, KASSEL, WOLFSBURG, PENTLING, MANNHEIM, COLOGNE, LÜDENSCHIED, AACHEN, DUISBURG, WÜRZBURG, PASSAU, DARMSTADT

### BRIEF DESCRIPTION

E-vehicles can be charged flexibly and thus utilise energy when surpluses are available or when it makes systemic or economic sense; if necessary, it is also possible to feed energy back into the grid. The "unIT-e<sup>2</sup>" project is developing and testing hardware and software solutions in a real-world laboratory with which electric mobility can be integrated holistically, sustainably and intelligently into the energy system. The project partners involved cover the entire energy industry value chain. The large consortium ensures the practicability of these solutions and facilitates the transfer of the project results into standardisation.

### PRACTICAL APPLICATIONS

In four practice clusters with different grid structures, different energy supply companies and car manufacturers are working together with other companies and institutes to implement and analyse the developed solutions in practice. The project will develop and test a platform that coordinates the requirements of the grid and the market. This will enable innovative business models and facilitate the integration of vehicles into the electricity grid. Another focus of the clusters is the consideration of customer needs and requirements in order to ensure acceptance and satisfaction with the developed products.

### USE CASES

#### SUPERORDINATE CATEGORISATION

#### FRAMEWORK OF THE ASSIGNMENT

#### SPECIFIC CATEGORISATION

Vehicle2Home (unidir.)	Single-family home	Increase in own consumption
Vehicle2Business (unidir.)	Employer car park	Peak shaving (§14a)
Vehicle2Grid (unidir.)	Single-family home	Local grid serviceability (§14a), tariff-optimised charging, primary control reserve (PCR), other
Vehicle2Grid (bidir.)	Single-family home	Local grid serviceability (§14a)
Vehicle2Home (bidir.)	Single-family home	Increase in own consumption, emergency power supply

### CONSORTIUM

FfE GmbH (consortium leader), Bayernwerk Netz GmbH, BMW AG, Consolinno Energy GmbH, EAM Netz GmbH, EEBUS Initiative e.V., EWE GO GmbH, EWE NETZ GmbH, FfE e.V., Flavia IT Management GmbH, Fraunhofer SIT, Kostal Industrie Elektrik GmbH, Mercedes Benz AG, Power Plus Communications AG, Regionalmanagement Nordhessen GmbH, RWTH Aachen, Schneider Electric GmbH, Stadtwerke München GmbH, Stiftung Umweltenergierecht, TenneT TSO GmbH, The Mobility House GmbH, Universität Duisburg-Essen, Universität Kassel, Universität Passau, Viessmann Climate Solutions SE, Volkswagen AG Group Innovation

CONTACT PERSONS Michael Hinterstocker, Dr Simon Köppl - FfE GmbH - [mhinterstocker@ffe.de](mailto:mhinterstocker@ffe.de), [SKoeppl@ffe.de](mailto:SKoeppl@ffe.de)

