SCALE

Guidelines for a Joint Procurement program for V2X/Smart Charging Infrastructure

Project deliverable D5.4

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Authors	Gertjan Geurts (City of Utrecht)
Internal reviewers	Bart van der Ree (Utrecht Sustainability Institute) Matthijs Kok (City of Utrecht) Frank Geerts (ElaadNL) Danielle Kutka (AVERE) Pedro Gomes (Polis) Constantin Heitzer (Polis) Edwin Bestebeurtje (FIER Sustainable Mobility)
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1.1. Legal Disclaimer

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2. SCALE Introduction

SCALE (Smart Charging Alignment for Europe) is a three-year Horizon Europe project that explores and tests smart charging solutions for electric vehicles. It aims to advance smart charging and Vehicle-2-Grid (V2G) ecosystems to shape a new energy system wherein the flexibility of EV batteries' is harnessed. The project will test and validate a variety of smart charging and V2X solutions and services in 13 use cases in real-life demonstrations in 6 European contexts: Oslo (NO), Rotterdam/Utrecht (NL), Eindhoven (NL), Toulouse (FR), Budapest/Debrecen (HU) and Gothenburg (SE). Going further, project results, best practices, and lessons learned will be shared across EU cities, regions, and relevant e-mobility stakeholders. SCALE aims to create a system blueprint for user-centric smart charging and V2X for European cities and regions.

SCALE's consortium comprises 28 cutting-edge European e-mobility actors covering the entire smart charging and V2X value chain (equipment and charging manufacturers, flexibility service providers, research and knowledge partners, public authorities, consumer associations, etc.) It is led by ElaadNL, one of the world's leading knowledge and innovation centres in smart charging and charging infrastructure.

3. Report Executive Summary

Key words

Smart charging, Bidirectional charging, Vehicle-to-Grid (V2G), Vehicle-to-Everything (V2X), Electric Vehicles (EVs), Charging infrastructure, Public procurement, Technical requirements, Tender guidelines, Interoperability, Open standards, ISO 15118, Open Charge Point Protocol (OCPP), Harmonization, SCALE project

Summary

Electric vehicles (EVs) are becoming commonplace, and with them comes a need for smart charging and bidirectional charging solutions that can support the energy grid. **Smart charging** (often called V1G) optimizes how EVs draw power, while **bidirectional charging** (V2G, vehicle-to-grid, or more generally V2X, vehicle-to-everything) enables EV batteries to both charge and discharge, providing energy back to the grid or buildings. The SCALE project – Smart Charging Alignment for Europe – is a Horizon Europe initiative bringing together 28 partners across industry, cities, and research to accelerate the rollout of these technologies in an **open, interoperable ecosystem**. One key objective of SCALE is to facilitate a **Joint European Procurement** for V2X-capable charging infrastructure, leveraging the collective demand of multiple cities to drive market innovation and adoption of open standards.

Deliverable 5.4, "Guidelines for a Joint Procurement Program for Smart and V2X Charging Infrastructure," captures the results of SCALE's efforts to help public authorities procure future-proof charging systems. It provides practical guidance and requirements for cities and regions to include smart charging and V2X capabilities in their tenders for charging infrastructure. Rather than executing a single combined tender across countries – which proved complex in practice – the project focused on **harmonizing procurement criteria** and sharing best practices. This approach enables cities to **speak with one voice to the market**, aligning their technical requirements and expectations. By doing so, even separate local tenders can collectively stimulate the market for smart and V2X charging, ensuring that charging hardware and software procured in different cities and regions all adhere to common open standards and functionalities.

As part of this joint procurement program, SCALE convened a series of "**Bidirectional Cities**" knowledge-sharing **events** in 2024 and 2025. These brought together over 15 European cities (along with grid operators and other stakeholders) to exchange experiences on smart charging and V2G deployment. The events confirmed a high level of interest in V2X technology and highlighted both the potential benefits and the practical challenges faced by cities. Insights from these discussions, as well as from earlier research in SCALE (Deliverable 1.3 and more), fed into the guidelines and technical specifications compiled in this deliverable.

The outcome of Task 5.4 is a set of tools and recommendations to support public procurers:

- A comprehensive **Technical Requirements** document (Annex 1) detailing the specifications and standards that smart and bidirectional EV charging infrastructure should meet (e.g. connectivity, communication protocols, cybersecurity, V2G capabilities).

- A set of **Guidelines for Tendering** smart and V2X charging infrastructure, prepared as a proposed annex to the EU Sustainable Transport Forum's procurement handbook (Annex 2). This guide explains why and how to include smart/V2G criteria in calls for tenders, offering best practices from pioneering cities.
- A network of engaged cities with collaborative learnings from the **Bidirectional Cities events**, including real-world case studies (notably Utrecht's city-wide V2G rollout). The list of participating cities and organizations is provided in Annex 3.

The drafts of both the "Technical Requirements for Purchasing and Operating Smart and Bidirectional Charging" and the "Annex Bidirectional Charging for the STF Handbook" documents have been circulated among a broad range of European stakeholders for review.

By implementing the recommendations of Deliverable 5.4, public authorities can ensure their EV charging investments are "**future-proof**" – ready for the rapidly evolving EV ecosystem and capable of providing grid services. The harmonized approach across Europe aims to lower barriers for manufacturers and service providers, who can develop solutions knowing that multiple cities are aligned on requirements. While a fully joint cross-border procurement proved premature, the groundwork laid by SCALE will ease the path for such collaborations in the future. Moreover, the open standards and V2X Alliance promoted by SCALE will help maintain momentum beyond the project's lifetime, fostering an environment where smart charging and V2X solutions can thrive. Notably, the initiative's impact has attracted international attention (e.g. interest from South Korea and Australia), underscoring the global relevance of Europe's leadership in smart and bidirectional charging.

4. SCALE partners

List of participating cities:

- Oslo (NO)
- Rotterdam & Utrecht (NL)
- Eindhoven (NL)
- Toulouse (FR)
- Budapest & Debrecen (HU)
- Gothenburg (SE)

List of partners:

- (Coordinator) STICHTING ELAAD NL
- POLIS - PROMOTION OF OPERATIONAL LINKS WITH INTEGRATED SERVICES, ASSOCIATION INTERNATIONALE POLIS BE
- GoodMoovs NL
- Rupprecht Consult – Forschung & Beratung GmbH RC DE
- Trialog FR
- WE DRIVE SOLAR NL BV NL
- UNIVERSITEIT UTRECHT NL
- LEW Verteilnetz GmbH DE
- BAYERN INNOVATIV - BAYERISCHE GESELLSCHAFT FUR INNOVATION UND WISSENSTRANSFER MBH DE
- ABB BV NL
- Enervalis BE
- GEMEENTE UTRECHT NL
- Equigy B.V. NL
- Meshcrafts As (Current) NO
- Research Institutes of Sweden AB SE
- ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (CERTH) GR
- FIER Sustainable Mobility FIER NL
- Emobility Solutions Kft. HU
- Serviced Office Belbuda Kft HU
- Enedis FR
- L'ASSOCIATION EUROPEENNE DE LA MOBILITE ELECTRIQUE (AVERE) BE
- Norsk elbilforening NO
- VDL ENABLING TRANSPORT SOLUTIONS BV NL
- Urban Electric Mobility Initiative UEMI DE
- Renault FR

- Chalmers University SE
- Polestar SE
- Hyundai NL NL

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 www.youtube.com/channel/UC1HVFu5uJPCNSV96b3l_rcg

For further information please visit **WWW.SCALE-HORIZON.EU**

5. Content

6. Introduction and deliverable

Electrification of transport is accelerating across Europe. Cities and regions are installing thousands of new EV charging points to support growing electric car adoption. At the same time, there is a clear need to integrate this charging infrastructure with the electrical grid in a smart way. **Smart charging** allows dynamic adjustment of charging power (for example, to avoid grid overload during peak times or to utilize excess renewable energy), while **bidirectional charging** (also known as V2G – vehicle-to-grid, or more broadly V2X – vehicle-to-everything) enables EVs to become energy resources, feeding power back when needed. **These technologies can bring significant benefits**: reduced strain on electricity networks, lower energy costs, and better use of renewable energy.

Recognizing these benefits, European policies are now pushing for smart charging to become the norm. For instance, the new Alternative Fuels Infrastructure Regulation (**AFIR**) **mandates that all publicly accessible chargers in the EU support smart charging functionality by 2024.** This means that any new tenders for public charging infrastructure must include requirements for smart charging capabilities. Bidirectional charging is not yet mandated, but it is increasingly seen as the next step to further enhance grid flexibility and energy resilience in cities.

However, incorporating smart and bidirectional charging into procurement processes can be challenging for public authorities. Many city administrations lack prior experience with these technologies and are unsure what technical specifications to ask for. Additionally, without coordination, cities might each request different standards or features, leading to market fragmentation and higher costs for everyone. This is where the SCALE project comes in. **SCALE** (Smart Charging Alignment for Europe) is a collaborative project (2022–2025) co-funded by the European Union's Horizon Europe program, with the mission to **align efforts across Europe** for deploying smart charging and V2X infrastructure at scale. By bringing together 28 partners – including leading cities, industry experts, grid operators, and researchers – SCALE works to identify and overcome barriers in technology, policy, and implementation.

Task 5.4 of the SCALE project specifically addresses the challenge of joint procurement for smart and V2X charging infrastructure. The idea, as outlined in the project's Grant Agreement, was to initiate a **Joint European Procurement** of V2X-capable chargers, leveraging the combined buying power of multiple cities to accelerate the availability of interoperable, standards-based solutions. In practical terms, this meant developing common guidelines and requirements that several pilot cities could use in their tenders, ideally even launching a coordinated tender process across borders. Task 5.4 has been led by the City of Utrecht (one of the frontrunner cities in V2G deployment) with support from partners and other cities in the consortium.

Deliverable 5.4, "**Guidelines for a Joint Procurement Program for Smart and V2X Charging Infrastructure**," is the outcome of Task 5.4. To address the topic comprehensively, this deliverable was subdivided into three parts:

- **Deliverable 5.4A**: Main report – Guidelines for a Joint Procurement Program (this document). It summarizes the approach taken, findings, and recommendations for cities and stakeholders.
- **Deliverable 5.4B (Annex 1)**: Technical Requirements for Purchasing and Operating Smart and Bidirectional Charging. A detailed compilation of technical specifications (hardware, software, standards) that can be directly used in tender documents to ensure chargers are smart and V2X-ready.
- **Deliverable 5.4C (Annex 2)**: Smart and Bidirectional Charging in Public Infrastructure Tenders (STF Handbook proposal). A practical guide intended for inclusion in the European Sustainable Transport Forum's procurement handbook, providing advice and examples on including V2G in public tenders.

In addition, **Annex 3** to this deliverable provides the list of participants and contributors from the Bidirectional Cities events that were organized as part of this work. These annexes support the main report by offering concrete requirements (Annex 1), a ready-to-use guidance document (Annex 2), and evidence of stakeholder engagement (Annex 3).

In recent weeks, the drafts of both the "**Annex Bidirectional Charging for the STF Handbook**" and the "**Technical Requirements for Purchasing and Operating Smart and Bidirectional Charging**" documents have been circulated among a broad range of European stakeholders for review. Stakeholders included the full SCALE consortium - among them OEMs such as Renault, Polestar, Hyundai, ABB and We Drive Solar - as well as all participants of the Bidirectional Cities events (see Annex 3 for a full list), and connected cities including Oslo, Edinburgh, Stockholm, Leuven, Trondheim, Helsinki, Bergen, Gothenburg, Karlsruhe, Almada, Rotterdam, The Hague, Amsterdam, Uppsala, Istanbul (Kadikoy district), and Tampere.

Other key stakeholders involved in the review were coming from a broad range of European organizations including Charge Point Manufacturers, Charge Point Operators, Mobility Service Providers, Distribution System Operators, Energy Suppliers, Flexibility Service Providers, EV Manufacturers, Software companies, Research and Knowledge institutions and Consulting companies.

We received substantial and valuable feedback from many of these European stakeholders, which has been incorporated into the final versions of the Technical Requirements (Annex 1) and the proposed STF Handbook Annex (Annex 2). This thorough stakeholder input ensures that European cities and other public authorities can confidently adopt these technical requirements and procurement guidelines, effectively supporting the deployment and scaling of smart and bidirectional charging infrastructure.

The finalized "**Technical Requirements for Purchasing and Operating Smart and Bidirectional Charging**" document is published and will be regularly updated by ElaadNL here on their website

- **https://elaad.nl/en/requirements-smart-and-bidirectional-charging-infrastructure**

, ensuring that the most current and relevant version is always publicly accessible. We expect these documents to significantly advance the widespread adoption of smart and bidirectional charging solutions within an open ecosystem approach, both across Europe and internationally.

The remainder of this report is structured as follows: first, we describe the approach and activities undertaken in Task 5.4, including the action research with real tenders and the engagement of cities through events (Section 7). We then present the key outputs and insights – the proposed guidelines and requirements for joint procurement of smart/V2X infrastructure (Section 8). Finally, we conclude with overarching findings and recommendations, including next steps and the broader implications for European smart charging rollout (Section 9).

7. Approach and Activities

Task 5.4 combined **real-world procurement experience** with extensive **stakeholder engagement**. Our approach consisted of three main pillars:

Leveraging insights from previous SCALE research (D1.3)

Early research identified significant uncertainties among cities regarding technical standards and procurement criteria for smart and bidirectional charging. Cities indicated a clear need for practical examples and harmonized requirements. These insights helped define the scope and priorities of Task 5.4.

Action research through Utrecht's tender

The City of Utrecht served as a pioneering case study, embedding smart and V2G capabilities in its large-scale public charging infrastructure tender(s). Utrecht's hands-on experience offered invaluable insights into technical, operational, and market considerations, such as the availability of V2G-capable equipment, realistic technical specifications, and procurement challenges. These lessons informed the guidelines and technical requirements compiled in this deliverable.

Stakeholder engagement via Bidirectional Cities events

As part of SCALE's joint procurement activities, a successful series of online **Bidirectional Cities events** was organized, focused specifically on Vehicle-to-Grid (V2G) and smart charging procurement. These webinars provided a valuable platform for cities, grid operators, industry stakeholders, and knowledge institutions from across Europe (and beyond) to exchange concrete experiences, validated knowledge, and best practices.

Three webinars have already taken place, attracting participants from 150 organizations thus-far:

- **1st event (3 October 2024)**: Featured presentations by Utrecht, Oslo, Leuven, Istanbul (Kadikoy), and Tampere, sharing pioneering experiences and lessons learned (**event insights available here, at the SCALE website**).
- **2nd event (18 November 2024)**: Involved Utrecht, Gothenburg, Helsinki, and Edinburgh, highlighting practical procurement strategies, technical insights, and successful local implementations (**event insights available here, at the SCALE website**).
- **3rd event (20 February 2025)**: Included key presentations from Stockholm and other frontrunner cities, further expanding on practical solutions and future ambitions.

The Bidirectional Cities events significantly contributed to establishing the envisioned joint working group (Deliverable 5.4 A), actively facilitating knowledge sharing and cooperation among European cities and regions. Two more events are scheduled for May 2025 and November 2025 (SCALE final event), ensuring continued community growth and collaboration.

A comprehensive list of participating organizations is provided in Annex 3 of this report. All recordings and detailed insights remain available online through the provided links.

Initially, the idea was to implement a fully coordinated, cross-border joint procurement. However, practical complexities – such as differing procurement rules, timelines, and local contexts – made this unrealistic in the short term. The approach evolved instead toward a more pragmatic model of harmonization: enabling

cities to align their procurement criteria while conducting their own tenders individually. The strategy behind this is creating unified market signals without the complexity of formal joint procurement processes.

8. Results: Guidelines and Key Outputs

Deliverable 5.4 provides public authorities with actionable resources to procure future-proof, smart, and V2X-ready charging infrastructure. The outcomes include detailed technical requirements, practical procurement guidelines, and an emphasis on harmonizing market demands.

9.1 Technical Requirements for Smart and Bidirectional Charging (Annex 1)

Annex 1 contains clear, detailed technical specifications designed for easy inclusion in public tenders. These cover essential capabilities, organized into logical categories:

- **Generic requirements (all charging points)**: Ensuring basic functionalities like reliable connectivity, remote monitoring and control, real-time communication, and compliance with open standards (e.g. OCPP for charger-backend communications).
- **Smart charging capabilities**: Features that allow chargers to dynamically respond to grid conditions, including load management, controlled charging, and integration with renewable energy sources.
- **Bidirectional (V2G) requirements**: Specific criteria ensuring chargers can safely and effectively discharge electricity back into the grid, such as compliance with standards like ISO 15118-20, advanced hardware for bidirectional flows, and software capable of managing grid interactions.
- **Cybersecurity and interoperability**: Requirements to secure the infrastructure and guarantee compatibility across various EV brands, charging operators, and grid systems.

These requirements are formulated based on existing standards and real-world experiences (notably Utrecht's tender), ensuring practical feasibility and market acceptance. By adopting these common specifications, public authorities can simplify their procurement processes and significantly reduce uncertainty for suppliers and manufacturers.

5.2 Guidelines for Including Smart/V2X Criteria in Tenders (Annex 2)

Annex 2 is a proposed chapter to the European Sustainable Transport Forum's widely-used procurement handbook, specifically addressing smart and bidirectional charging. It complements the detailed technical specifications of Annex 1 by providing narrative guidance, practical examples, and tips for public procurers. Key contents include:

- **Rationale and benefits**: Clearly explains why investing in smart and V2X charging infrastructure makes strategic sense (grid stability, renewable integration, cost savings, future-proofing).
- **Practical tender approaches**: Offers recommendations on incorporating smart and V2X requirements into tenders, including mandatory versus optional criteria, tender language examples, and evaluation strategies for supplier proposals.
- **Real-world advice and best practices**: Highlights insights from cities already implementing smart/V2G procurement, providing valuable context and tips such as dealing with uncertainty, evaluating bids fairly, and cooperating effectively with grid operators.

By becoming part of the widely-consulted STF procurement handbook, this annex has the potential to significantly influence how cities across Europe approach smart and bidirectional charging procurement.

5.3 Harmonizing Procurement to Support the Market

Although fully coordinated cross-border tenders remain challenging, the harmonized procurement approach championed by SCALE successfully aligns requirements and expectations among European cities. By jointly defining and promoting standardized technical specifications and guidelines, cities collectively shape the market for smart and V2X charging infrastructure.

This approach reduces fragmentation and sends a unified signal to charging manufacturers, service providers, and the broader EV industry. For suppliers, this alignment means clearer market opportunities, reduced compliance costs, and stronger incentives to invest in developing smart and bidirectional solutions. Cities and regions benefit by procuring future-proof, standardized equipment that can support their sustainability and energy resilience goals.

Moreover, the establishment of the V2X Alliance as an outcome of SCALE provides a durable structure for ongoing collaboration, sharing of best practices, and alignment efforts among cities and industry stakeholders. This open, cooperative ecosystem approach has already attracted attention beyond Europe – stakeholders in countries like South Korea and Australia have expressed interest in adopting similar frameworks, reinforcing Europe's role as a global leader in smart EV infrastructure.

9. Conclusion and next steps

Deliverable 5.4 offers public authorities clear and practical guidance for procuring future-proof smart charging and V2X-ready infrastructure. Although fully coordinated cross-border tenders proved complex, harmonizing procurement criteria effectively aligns city requirements and simplifies market entry for suppliers.

Key conclusions:

• **Smart charging is essential**, driven by EU regulations and growing city demands. **Bidirectional (V2G/V2X) capabilities are increasingly realistic** and desirable for grid flexibility and renewable integration.

• **Major technical barriers** (e.g. unclear standards) **are being resolved**. The provided Technical Requirements (**Annex 1**) incorporate the latest standards (ISO 15118, OCPP 2.01/2.1), offering cities clear and consistent procurement criteria.

• **The Bidirectional Cities events confirmed strong demand** among cities for collaboration, knowledge sharing, and practical procurement guidance—addressed directly by the guidelines in **Annex 2**.

• Harmonization across cities' procurement approaches creates **unified market** demand, facilitating economies of scale and driving innovation in charging infrastructure.

Next steps and outlook:

The work on joint procurement in SCALE will not end with this deliverable. The momentum will be carried forward by initiatives like the V2X Alliance and future Bidirectional Cities Events, e.g., at the SCALE final event, where cities and industry partners continue working together on interoperability and deployment. We

anticipate more cities will take up the provided guidelines and adapt them to their local context, thereby expanding the harmonized approach. There may also be opportunities for clusters of cities (for example, within the same country or region) to attempt joint or coordinated procurement in the future, especially as legal and administrative barriers are gradually lowered through experience and possibly new EU directives facilitating joint buying.

Finally, the success of the Joint Procurement Program should be measured not only in documents produced, but in on-the-ground impact. Over the coming years, we expect to see the concepts from this deliverable reflected in actual charging infrastructure projects: chargers that are smart and V2X-capable being rolled out in multiple cities and regions, delivering services to the grid and users. As these deployments happen, they will validate and improve the guidelines further. In that sense, Deliverable 5.4 is part of an ongoing learning process. It sets a foundation and direction – toward a Europe where **every new charger is smart, V2X-ready,** and procured with an eye toward interoperability and innovation. This foundation is crucial for achieving the SCALE project's overarching vision: to **accelerate the transition to a sustainable, electric, and integrated mobility and energy future**.

11. Annexes

Annex 1: Technical requirements for purchasing and operating Smart – and Bidirectional Charging

Technical requirements for purchasing and operating Smart – and Bidirectional Charging

Short Introduction

This document outlines recommendations for specific technical requirements for purchasing and operating Smart and Bidirectional Charging Infrastructure. With this list of requirements a minimal and harmonized set of technical Smart and Bidirectional Charging requirements is presented, which aims to create clarity for all stakeholders involved, including drivers, contractors, clients, mobility stakeholders and energy stakeholders.

In European legislation smart (re)charging is becoming a legal requirement, especially for new infrastructure. Bidirectional charging is promoted, particularly for its grid-balancing potential. Also requirements as interoperability, data exchange, and integration with renewables and buildings are stated. However at time of publication of this document, a concrete translation of above into technical requirements is missing. This document presents recommendations for these technical requirements.

The document mainly consists of a bundle of existing standards and protocols, where the current state of technology is used as a starting point. As the technology for charging infrastructure is still maturing also requirements regarding regularly updates is included. This to safeguard that newly installed charging infrastructure remains up-to-date in the coming decade. The technical requirements finally also ensure that consumers can be given a concrete perspective to actively participate in the energy market.

The technical requirements listed in this document can be anchored in and used for:

- Drafting (inter) national legislation and regulations.
- Forming (inter) national and local policy, which is implemented in the purchase and operating of charging infrastructure.
- The development of products and propositions by market parties, as a checklist for manufacturers who develop and operate Smart and Bidirectional Charging infrastructure.

The requirements in this document are a supplement or addition to the general (charging) criteria for charging infrastructure. It has been developed based on:

- Results from the SCALE project demonstrations. SCALE has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101056874.
- Tender experiences from the Netherlands in deploying public charging infrastructure.
- Results from European Testlab for Emobility at ElaadNL

- Feedback received from a broad range of European stakeholders including Charge Point Manufacturers, Charge Point Operators, Mobility Service Providers, Distribution System Operators, Energy Suppliers, Flexibility Service Providers, EV Manufacturers, Software companies, City Authorities, Research and Knowledge institutions and Consulting companies.

The final version of this document is made available on the ElaadNL website, see (https://elaad.nl/en/requirements-smart-and-bidirectional-charging-infrastructure/). When using this document, always check this website for updated versions.

This document will be shared with the EU Smart Energy Expert Group as input to assist the European Commission with the preparation of delegated - and implementing acts.

For the context of the Netherlands, this document is the successor of the smart charging requirements from the NAL published in 2021. This document is offered as input to NKL as part of updating the "Basisset AC charging infrastructure", which is scheduled by the beginning of 2025.

Generic requirements - all charge points

The following generic requirements are applicable to all charge points (public, semi-public and private, AC as well as DC) and both for Smart Charging and Bidirectional Charging.

ID	Requirement	Explanation
1	The requirements listed below are applicable for all new and to be refurbished charging points.	
2	Compliance to all mentioned standards, protocols and requirements needs to be proven via an independent conformity certificate. In case this is not available, compliance needs to be proven via a certification program or test cases made available by the applicable standardization organization.	Conformity assessment must be in line with ISO/IEC 17065:2012. For IEC standards, Accredited National Certification Bodies (NCBs) can be found at: https://www.iecee.org/members/national-certification-bodies. Disclaimer, a reference for possible independent test labs are provided for information purposes only. It is up to the contractor to identify current independent test labs for each standard, protocol and requirement mentioned.
3	New official published versions of all mentioned standards, protocols and requirements need to be implemented free of charge and complied to, within the following period: • Larger structural changes (normally indicated by a shift in the first number of a version, for example from v1.0 to v2.0 or a newer edition) will be implemented within 18 months after availability of independent test certification in at least the first 5 years after the purchase of hardware. • Smaller incremental changes (normally indicated by a shift in the second number of a version, for example from v1.0 to v1.1 or	To secure charging points are up to date within acceptable timeframe and acceptable budget for all stakeholders. Both larger structural changes and smaller incremental changes need to be to be proven via an independent conformity updated conformity certificate. If hardware refurbishment is necessary for updates, implementation should occur after the hardware has reached the end of its technical lifetime.

	a correction or amendments document) will be implemented within 6 months after availability of independent test certification in the total technical lifetime of the hardware.	
4	All components of the operational charging infrastructure must demonstrably meet all requirements under real operating conditions, to be proven by a periodic (sample) field audit process.	The detailing of the periodic field (sample) audit process is up to negotiation between client and contractor.

Smart Charging requirements - all charge points

Requirements are applicable to all charge points (Public, Semi-public and Private) and both Smart Charging and Bidirectional Charging. Most requirements in this section are relevant for AC and DC chargers. It is mentioned if a recommendation is only applicable to AC or DC charging.

ID	Requirement	Explanation
4	All charging points, regardless of power, must be remotely controllable in near realtime.	European regulations in the field of the European internal energy market state that an end customer must be enabled to become "active" in the energy market. There is an essential role for the end customer in realizing more flexibility in the electricity system, for example through its EV. For a private charger, remotely controlled also refers a connection to a Customer Energy Management System. The method to prove compliance to this requirement is up to negotiation between client and contractor.
5	All Charging Stations, Charging Points must have access to a telecommunication module and be connected with the Backend of the Charge Point Operator or an Energy Management System at least 98% of the time.	This is essential to send and receive Smart Charging signals. The method to prove compliance to this requirement is up to negotiation between client and contractor.
6	All Charging Stations, Charging Points must operate in compliance with at least ENCS EV-311 Security requirements from IEC 62443 for procuring EV charging stations - 2025 v1.0.[1]	The requirements in this document are based on "IEC 62443-4-1 - Secure product development lifecycle" and "IEC 62443-4-2 - Technical security requirements for IACS components". The requirements can be found on https://elaad.nl/publicaties/ and https://encs.eu/resources/security-requirements/ To prove compliance, the manufacturer can show two IECEE certificates: one for 62443-4-1

[1] In the feedback received, a limited number of stakeholders have expressed concerns about the requirements regarding cybersecurity. However, a large group of stakeholders have expressed concerns about an inadequate level of cybersecurity in relation to Charging Infrastructure in general and Smart – and Bidirectional Charging in particular. Given the fact that Charging infrastructure is marked as a sector of High Criticality in the NIS2 Directive, in this document is chosen to include strict requirements for cybersecurity.

		and one for 62443-4-2 compliance related to the requirements (and guidance for implementation) mentioned in “EV-311 Security requirements from IEC 62443 for procuring EV charging stations - 2025 v1.0".
7	All Charging Stations & Charging Points must operate in compliance with at least IEC 61851-1:2017.	Basic standard for Charging points. At least support modes: - Mode 3 (AC) - Mode 4 (DC)

ID	Requirement	Explanation
8	For DC only: All Charging Stations & Charging Points must operate in compliance with at least IEC 61851-23:2014, ISO 15118-2:2014 and DIN SPEC 70121.	This requirement is applicable for DC only. These standards specify the communication between the electric vehicle (EV) and the Charging Station or Charging Point. List of conformance test labs can be found on CharIN website, see https://www.charin.global/technology/charin-conformance-testing/
9	All Charging Stations, Charging Points, and the backend of the Charge Point Operator must operate in compliance with at least IEC 63584:2024 (OCPP 2.0.1).[2]	The communication between charge point and backend is in conformity of the Open Charge Point Protocol. Mandatory use of the highest security profile. At least support modules: Core, Advanced security, Smart charging, ISO15118 support List of Independent test labs can be found on Open Charge Alliance website, see https://openchargealliance.org/testing-laboratories/.
10	The backend of the Charge Point Operator must operate in compliance with at least OCPI 2.2.1.[3]	To enable data sharing with other market parties and -roles. At least support modules: ChargingProfiles module List of Independent test labs can be found on EVRoaming Foundation website, see https://evroaming.org/evroaming-test-tool/.
11	The backend of the Charge Point Operator must operate in compliance with at least IEC 62746-10:2018 (OpenADR 2.0) or IEC 61850.	These standards are a recommendation for communication between DSO and CPO to enable Smart Charging based on actual grid load. It is up to each DSO to decide whether to follow this recommendation. A contractor must

[2] In the feedback received, a limited number of stakeholders have expressed concerns about the required version for OCPP. After careful consideration in this document is chosen for version OCPP 2.0.1 as this version has been published already in 2020 and is the first and only formal IEC standard for OCPP.

[3] In the feedback received, a limited number of stakeholders have expressed concerns about the required version for OCPI. After careful consideration in this document is chosen for OCPI 2.2.1 as this version has been published already in 2021 and older versions of OCPI are not supported anymore. Furthermore the choice of OCPI 2.2.1. is in line with CEN Workshop Agreement (CWA) 18090 published in April 2024.

	Alternatively the Charging Stations, Charging Points may also be connected to a DSO device which is able to receive remote signals and control the charging power.	contact the applicable DSO to agree on required protocol for communication with DSO. For public charge points in Member State the Netherlands a subset of OpenADR 3.0 is agreed. Documentation and compliance information is available via ElaadNL. List of Independent test labs can be found on OpenADR website, see https://www.openadr.org/certification-process#testhouses.

Smart Charging requirements – private charge points only

Requirements are applicable to Private charge points only. The requirements in this section are relevant for both AC and DC chargers.

ID	Requirement	Explanation
12	All Charging Stations & Charging Points can communicate with the meter in the Grid Connection if this meter supports local connection possibilities.	For communication between EVSE and Power Grid Management System. On European and Member State level there is no harmonization yet for one standard or protocol.
13	All Charging Stations & Charging Points can communicate with an Energy Management System (EMS) via an open protocol.	For communication between EVSE and Energy Management System. On European and Member State level there is no harmonization yet for one standard or protocol. Energy Management System (EMS) means a set of interrelated or interacting elements of a plan which sets an energy efficiency objective and a strategy to achieve that objective (Energy Efficiency Directive (EED) – Directive 2012/27/EU)
14	All Charging Stations, Charging Points, and the backend of the Charge Point Operator must additionally comply with additional applicable national technical standards and grid-integration protocols regarding smart charging, dynamic load management, cybersecurity, and interoperability with grid operators.	For member state the Netherlands specifically, this refers to compliance with NTA 8043:2024, addressing national requirements on grid integration, smart charging functionality, data exchange, and cybersecurity. Note: The requirement of IEC 63584:2024 (OCPP 2.0.1) in this document prevails above the requirement of OCPP 1.6 as mentioned in NTA 8043:2024.
15	When maximum charge speed information is received via multiple sources, the lowest value prevails.	Making sure all limitations are taken into account and for safety reasons.

Bidirectional Charging

Requirements are applicable to all charge points Public, Semi-public and Private. The requirements in this section are relevant for both AC and DC chargers. The requirements below are in anticipation of upcoming regulation and can be used by clients who want to lead the way to bidirectional charging.

ID	Requirement	Explanation
16	All requirements for Smart Charging are also applicable for Bidirectional Charging.	In this section only the additional requirements for bidirectional charging are mentioned. All requirements for Smart Charging are also required for Bidirectional Charging.
17	At/on charge point it is clearly visible that the charge point is suitable for bidirectional charging.	So that the driver knows whether bidirectional charging is possible at the charge point
18	The status indicator of the charge point provides an indication when the vehicle (via the charge point) supplies energy to the grid. This indication can be clearly distinguished from the regular indicators.	So that the charge points' status is visible for safety reasons.
19	All Charging Stations & Charging Points must operate in compliance with at least NEN-EN-ISO 15118-20:2022. Note: In the EC proposed Delegated Acts for AFIR is stated that From January 1, 2027 all new and refurbished public charging points and new private charging points must support ISO 15118-20.	This standard specifies the communication between the electric vehicle (EV) and the electric vehicle supply equipment (EVSE). Comply to the complete standard and also amendment 1 (when released) in particular AC DER service and improved security concept. List of conformance test labs can be found on CharIN website, see https://www.charin.global/technology/charin-conformance-testing/
20	All Charging Stations, Charging Points and the backend of the Charge Point Operator must operate in compliance with at least OCPP 2.1.	The communication between charge point and backend is in conformity of the Open Charge Point Protocol. Mandatory use of the highest security profile. At least support modules: core, advanced security, smart charging, ISO15118 support, Bidirectional power transfer, DER control (grid code support) List of Independent test labs can be found on Open Charge Alliance website, see https://openchargealliance.org/testing-laboratories/.
21	All Charging Stations & Charging Points must operate in compliance with at least NEN-EN 50549-1 (including anti-islanding and interface protection).	The system is equipped with a mechanism that automatically disconnects the charge point from the grid in case of power failure (anti-islanding). It is allowed to use the relay for this disconnection. Additionally, the system shall include interface protection (under- and overvoltage, under-

		and overfrequency protection) as part of the broader grid code handling requirements.
22	All Charging Stations, Charging Points and the backend of the Charge Point Operator must operate in compliance with national Grid Codes.	For UK see Engineering Recommendation G98 and Engineering Recommendation G99

Annex: Legislation for Smart and Bidirectional Charging

The information below is added for information purposes only. The contractor needs to comply to all applicable EU regulations. Once new regulations are in place, charge points must comply to these new regulation within the timeframe stated by the EC.

All Charging Stations & Charging Points must operate in compliance with Directive 2022/2555, also known as NIS2. The NIS2 Directive establishes a unified legal framework to uphold cybersecurity in 18 critical sectors across the EU. Charging infrastructure is marked as a sector of High Criticality. The directive mandates that each Member State adopt a national cybersecurity strategy, which includes policies for supply chain security, vulnerability management, and cybersecurity education and awareness. In Member State the Netherlands, the "Cybersecurity Act", the national translation of the NIS2, will enter into force in Q3 2025. For more information see NIS2 Directive: new rules on cybersecurity of network and information systems | Shaping Europe's digital future.
At the time of publication of this document, a procedure for amending regulations for Network Code regarding requirements for demand connection (recommendations made by ACER) is in progress at the EC.
At the time of publication of this document, the commission adoption procedure for amending regulations for Measuring instruments (MID) including EVSE (COM(2024)561 - Amendment of Directive 2014/32/EU) is in progress at the EC.
At the time of publication of this document, a procedure for amending regulations for Network Code regarding Requirements for Generators (RfG) is underway at the EC.

Annex 2: Smart and Bidirectional charging as part of charging infrastructure procurement

Smart and Bidirectional charging as part of charging infrastructure procurement

Proposed annex to
Guidelines for Tender Procedure for Deployment of Public Electric Recharging Infrastructure for Passenger Cars and Vans

Version: March 28, 2025

Bart van der Ree (Utrecht Sustainability Institute)

Gertjan Geurts (City of Utrecht)

Contents

Introduction

In 2020, the Sustainable Transport Forum (STF) expert group published the first version of the handbook 'Recommendations for public authorities for procuring, awarding concessions, licences and/or granting support for electric recharging infrastructure for passenger cars and vans'[4]. An update of this handbook has recently been published by the European Commission[5].

[4] See https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/how-design-tenders-e-charging-infrastructure-new-handbook-public-authorities-2021-03-03_en

[5] See https://op.europa.eu/en/publication-detail/-/publication/0cf64e65-f4d3-11ef-b7db-01aa75ed71a1/language-en

In the past years, smart charging as well as bidirectional charging (also often called Vehicle-to-grid or V2G charging) has received increasing attention from public authorities in Europe. There have been several pilots and experiments, and several parties have quantified the benefits of these charging methods. These benefits include positive effects on the power grid (including reduced grid congestion and imbalance problems), lower charging costs for end users and charging infrastructure exploiters, optimised use of renewable energy, and less need for power grid reinforcements. While the STF "Guidelines for tender procedure for deployment of public electric recharging infrastructure for cars and vans" included some aspects related to future-proofing of charging infrastructure, such as digital connectivity and smart recharging capabilities, this document did not focus on solutions such as bidirectional charging, as it is mostly aimed at public authorities in the early stages of their EV charging deployment procedures.

In the European project SCALE – Smart Charging Alignment for Europe[6], 28 partners leading in this subject throughout the EC are cooperating to advance smart charging and bidirectional charging infrastructure and facilitate the mass deployment of electric vehicles. One of the specific tasks that this project is developing is a joint procurement initiative for smart and bidirectional charging infrastructure amongst public authorities. This has been discussed in a series of Bidirectional Cities Events and elaborated based on the best practices available at this moment. Complementing these events and exchanges, SCALE has updated a list of requirements for future-proof, smart and bidirectional EV chargers.

As several of the SCALE consortium partners are active members of the STF sub-group on public authorities (namely ElaadNL, POLIS, and E-Mobility Europe) the project approached the European Commission in view of contributing to the "Guidelines for tender procedure for deployment of public electric recharging infrastructure for cars and vans" and address that missing gap.

These actions have led to this proposal for a new Annex, to be included in a future update of the STF Handbook. It contains experiences, best practices and practical tips for public authorities on how to include smart and bidirectional charging in public charging procurement actions.

The actual requirements are being distributed as a separate annex in this version; in a later version they may be included.

Smart and bidirectional charging: why bother?

Smart charging is rapidly gaining attention as charging infrastructure is being rolled out in Europe. Bidirectional charging (or Vehicle-to-grid, V2G) is being developed in several cities in the EU. The goal is that electric vehicles not only charge but can also temporarily discharge to the grid. Smart and bidirectional (charging technologies offer significant benefits for municipalities and local authorities:

1. Enhancing Grid Efficiency and Stability

With relatively small effort and often with existing hardware, smart charging can reduce local power grid congestion and contribute to the power grid balance. Bidirectional charging increases the potential of smart charging to reduce strain on the power grid. By integrating V2G technology, EVs become active participants in the energy system, capable of discharging electricity back into

[6] See www.scale-horizon.eu

the grid during peak hours. This helps local (grid) authorities maintain energy stability and mitigate the need for expensive infrastructure upgrades.

2. Supporting Renewable Energy Integration

Smart and V2G charging enable municipalities to optimize the use of renewable energy sources, such as solar and wind. EVs can store surplus renewable energy and discharge it when production is low, helping cities towards achieving Europe's climate targets and contributing to cleaner air and lower carbon footprints.

3. Reducing Energy Costs

Smart charging can already lower charging costs considerably because it can be used to avoid moments when electricity prices are high. In cases where dynamic electricity pricing is used, V2G technology allows EV owners to monetize the energy stored in EV batteries by selling it back to the grid during peak demand. This can result in largely reduced charging costs, which can result in more attractive pricing for operation of EV fleets (such as car sharing schemes), and with this in realisation of cleaner mobility targets in cities. Other mechanisms for reimbursing the EV owner for V2G operation, such as reimbursement for contribution to power grid congestion or for participation in a local energy management system, are in development in several European countries.

4. Enhancing Urban Resilience

Smart charging and V2G technology provide a more decentralized energy storage solution, making cities more resilient to power outages and energy crises. In emergencies, batteries of V2G vehicles could serve as part of back-up systems to power critical infrastructure, such as hospitals, communication systems, or public transportation.

5. Promoting Sustainable Mobility

Smart and V2G charging will facilitate the further transition to EVs, an essential component of sustainable urban transport strategies. Local authorities can incentivize EV adoption by promoting V2G technology in car sharing schemes, fostering cleaner transportation options while meeting EU emissions reduction targets.

6. Boosting Local Economies

Smart and V2G technology support the development of local energy markets, encouraging innovation and fostering public-private partnerships.

7. Encouraging Citizen Engagement

V2G charging can be made part of local energy hubs or energy communities, empowering citizens to participate in the energy transition by making EV ownership more economical and rewarding.

8. Facilitating Compliance with EU Directives

Smart and V2G charging align with EU regulations such as the Renewable Energy Directive (RED II) and the Alternative Fuels Infrastructure Regulation (AFIR). Local authorities can leverage these technologies to meet policy requirements, secure EU funding, and demonstrate leadership in sustainable urban development.

By integrating smart and V2G charging into their strategies, municipalities in the EU can advance energy sustainability, improve public services, and achieve economic and environmental objectives, ultimately fostering smarter and greener cities for future generations.

At the moment, the number of EV charging products that support V2G is quickly growing. A set of open standards and protocols to serve as a base for communication between the different devices and actors (such as ISO15118-20, OCPP and OCPI) supporting V2G in an interoperable way, is reaching maturity and broad market acceptance. This open ecosystem blueprint can be found in the document '*Requirements for purchasing and operating Smart – and Bidirectional Charging*'.

AC and DC bidirectional charging

V2G charging in the public context is mainly useful for low and medium power charging points both roadside and at offices and enterprises. Fast charging infrastructure is typically used for fast charging where there will be objections against delayed, paused or bidirectional charging.

Low and medium power charging is mostly AC. The number of commercially available cars that support AC V2G is currently limited but growing fast. AC bidirectional charging infrastructure requires the cars to have AC bidirectional charging hardware on board. The extra hardware in the chargers is limited, which makes AC bidirectional chargers relatively cheap. AC bidirectional chargers are fully compatible with conventional charging, i.e. they can charge any car with the usual Type 2 plug. This compatibility means that AC V2G chargers can be quickly rolled out as public or semi-public chargers. Also, all AC V2G chargers can do smart charging.

DC bidirectional charging does not typically put hardware requirements on the vehicle. However, most recent electric vehicles on the market have limited or disabled bidirectional charging on their DC ports. In the charging infrastructure, more hardware is required. DC bidirectional chargers are therefore typically significantly more expensive than AC bidirectional chargers. DC V2G has significant potential, for example for depot charging, as heavy-duty trucks are typically charged via DC.

GOOD PRACTICE EXAMPLE: Utrecht - Bidirectional Charging and Shared EVs

Utrecht is pioneering the integration of bidirectional charging with shared electric vehicles (EVs). In collaboration with Renault Group, We Drive Solar, MyWheels, and the City of Utrecht, Europe's first bidirectional car-sharing service has been launched. In 2025, hundreds of AC V2G-capable Renault 5 and Renault 4 EVs will join the fleet of MyWheels, integrating with bidirectional public chargers of We Drive Solar. These shared EVs can supply power back to the grid, reducing grid congestion and maximizing renewable energy use. Utrecht sets a replicable example for cities worldwide.
By aligning mobility with energy transition, the city proves that smart and sustainable solutions can be implemented on a scale.

Options for including smart and bidirectional charging in procurement of charging infrastructure

This document is designed to support public authorities and relevant competent authorities at all governance levels in designing, deploying, and overseeing smart charging and V2G charging as part of tenders for the deployment of public charging infrastructure for light duty vehicles on their territories. Tenders are a commonly used procedure for setting a contract to organise the deployment of recharging points while aiming at ensuring an open and competitive market for EV recharging services.

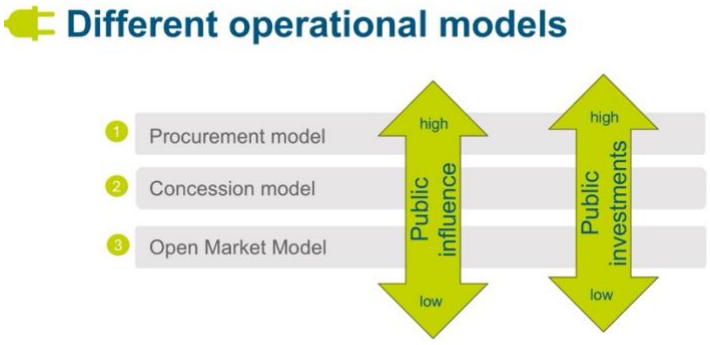
In the STF “Guidelines for tender procedure for deployment of public electric recharging infrastructure for cars and vans”, procurement strategies for charging infrastructure have been laid out and these already include smart charging. Tenders for all public recharging points built or renovated after 13 April 2024 will be obliged to require smart charging (AFIR, Recital 30).

To facilitate or stimulate bidirectional charging in these strategies, some additional requirements need be incorporated in local tenders and concessions.

The actual extra effort for a local authority to include smart and V2G charging in the procurement of charging infrastructure in cities is limited. But at the time of writing, developments in the field of V2G and bidirectional charging are not yet fully market ready. The amount of suppliers is still limited and certification programs for bidirectional capability of chargers are still in development. It is therefore wise to survey the current state of market development at the time of tendering, to avoid overdemanding the market. Some risk measures to be considered are:

- Not demanding bidirectional functionality as a requirement but as award criteria;
- Phrasing requirements to come into force later, for instance at a certain time after the finalization of certification procedures.

For smart charging equipment, the concession tendering model as described in the STF Guidelines is often used. But municipalities can use the three operational models below next to each other as well. For example, the tender model for general public charge points, the procurement model for publicly accessible charge points in municipality owned parking garages and the open market model for chargers destined for shared EV’s. Stimulating EV sharing operators to use bidirectional EVs in their shared EV fleet, can be a relatively easy entry into starting a bidirectional charging network.



Bidirectional Charging Requirements in tender documents

The document "Requirements for purchasing and operating Smart – and Bidirectional Charging' specifies the requirements needed for V2G that should be used in tender documents, structured in the following groups:

- Generic requirements - all charge points
- Smart Charging requirements - all charge points
- Smart Charging requirements – private charge points only
- Bidirectional Charging – all bidirectional charge points

This document can also be found on the ElaadNL website, see: https://elaad.nl/en/requirements-smart-and-bidirectional-charging-infrastructure. And it will be updated when new relevant specifications for this topic become available.

Annex 3: List of participating organizations in the Bidirectional Cities events

List of participating organizations in the Bidirectional Cities events

Aalborg University	Alliander	Almada Municipality	Angstrom	Areti
Arts et Métiers - L2EP lab	Ausgrid	AVERE	BME Zero Carbon Hub Hungary	Boston Consulting Group
CERTH	CESI	CHAdeMO	CIRCE	City of Bergen
City of Edinburgh Council	City of Funchal	City of Leuven	City of Oslo	City of Oslo, Agency for Urban Environment
City of Stockholm	City of Tampere	City of Utrecht	CNET-CENTRE NEW ENERGY	Credit Agricole
cs Beratung	DataArt GmbH	DC Systems by Schneider Eletric	Deddie	Deja Blue Energy
Delta Electronics EMEA	Digital energy corporation	DREI	Drivkraft Danmark	DTU
EDP	EDSO	EFACEC Electric Mobility SA	ElaadNL	Elbil
e-mobil BW GmbH	E-Mobility Europe	Emobility Solutions Kft	eMobilityLab GmbH	EmQ Energy meets Quality
Energiacom	Energy Queensland	EnergyHubs AS	Energynautics GmbH	Engie
Enovates NV	ENSAM	ENSAM L2EP lab	ENSAM/AMVALOR	Equans
ERnext	ESB	ESB Networks	Eunice	Eunice Group
EV Consult	EVIN Nonprofit Zrt.	FGS Global	FIER SUSTAINABLE MOBILITY	Fluctis Energy
Fluvius	Flux50	Forum Virium Helsinki	gemeente den haag	GoodMoovs
Göteborg Stads Parkering AB	Gothenburg University	Greenway	HEDNO	IDIADA
IDIADA Automotive Technology	Indian Institute of Technology Roorkee	Intercontrol Oy	IREC	Iveco
Jaguar Land Rover	Jutsen innovation	Kadikoy	Kar Chargers	KEPCO
LG Innotek	Lindholmen Science Park AB	LIST	London's European Office	MIT
Mölndal Energi	Mölndals Parkerings Aktiebolag	Municipality of Kadikoy	Net Zero Engineering Solutions Pty Ltd	Next-Dimension consulting
Nissan	Nissan Technical Centre Europe	Nolet5	Norsk elbilforening	NTT data
Panasonic Industry	Petrol d.d. Ljubljana	PNO INNOVATION S.L.	POLIS	PSNM

Rai	Revupworx	Rijksdienst voor Ondernemend	RWTH Aachen University	SFC non-profit
Sigenergy	Smappee	Smart Mobility and Transport Solutions	SMART Productions Associées asbl - CENURBE asbl	SOLO
Stadtwerke Karlsruhe	Stanford	stromfahrer (Stadtwerke Kiel)	Stromfahrer GmbH i.L.	Surbana Jurong
Sustain Solutuions	Székely Family & Co. Nonprofit Ltd.	Task 53 by EV-TCP by IEA	TATA ELXSI	Tellegem
Tellegen	The Boston Consulting Group	The City of Edinburgh Council	Trondheim	TU Delft
Universiteit Utrecht	University of Exeter	University of Ljubljana, Faculty of Electrical Engineering	University of Rome	University of St. Gallen
Uppsala municipality	Uppsala University	USI	Utrecht Sustainability Institute	V2G EVSE Ltd.
V2G Liberty	Vattenfall	VDE	Volo-X	Volvia
Volvo	Volvo Cars, Vehicle Propulsion	Vrije Universiteit Brussel	Wallbox Chargers	Way to Go
WDS	We Drive Solar	Wenham Carter	Worldgrid	Zapadoslovenska energetika, a.s.