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Smart Charging Alignment Europe, a new Horizon program on V2G

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Summary

Smart Charging Alignment Europe (SCALE) is a cross border project funded by the European Commission. It will enable and facilitate the mass deployment of electric vehicles and the accompanying smart charging infrastructure. SCALE brings together leading existing research & innovation initiatives and smart charging demonstration testbeds from across Europe forming a unique knowledge & collaboration platform. SCALE prepares an open smart charging & V2X eco-system that equally benefits all stakeholders. The consortium builds upon existing technologies and standards, such as OCPP and 15118, and focuses on research and developments of the missing and/or incomplete elements and links.. SCALE will initiate the Open V2X Alliance ensuring SCALE's legacy during and after the project's lifetime.

Keywords: consumer, digitalisation, regulation, smart charging, V2G

Introduction

A new European cooperation project is kicked off in June 2022. Leading European cities, universities & knowledge partners and networks as well as energy and electric vehicle industry pioneers have joined forces to explore and test smart EV charging and Vehicle-2-Everything (V2X) solutions to create a new energy eco-system of harnessing the flexibility that EVs offer in the mass deployment scenario.

The three-year EU-funded SCALE project will be a cooperation funded by the new Horizon Europe programme

SCALE contributes towards zero-emission road transport which is the vision of the *2Zero partnership* under which SCALE has been selected for funding. The uptake of EVs in the mass-deployment scenario, coupled with the flexibility that renewable energy generation offers, can form the basis of a de-centralized power system simultaneously decarbonizing both transport and energy sectors. Driven by the EU Smart Mobility strategy and EU Green Deal which aims to have 30 million electric vehicles on the roads by 2030, mass deployment of electric vehicles can be expected soon. The energy demand created by these millions of EVs on the road can only be managed by smart and digitally controlled charging systems as well as by preparing the energy network to utilize the surplus

energy stored in EV batteries through state-of-the-art V2X technologies. Mass-deployable innovations that can seamlessly integrate EVs into the power system to increase the energy efficiency and the share of renewable energy in households, neighbourhoods, industries, cities and regions can thus have a particularly high impact on reducing carbon emissions. The different V2X solutions & innovations will be systematically tested, validated and deployed across various cities in Europe in SCALE, thus being globally the first-of-its-kind attempt at this scale.

SCALE's strategic objective is to create an open system solution, deploying a user-centric approach, thus reducing the need for power grid reinforcement investments.

SCALE will aim to create momentum across Europe paving the road for Fitfor55 ambitions. SCALE works across pilot sites and makes use of an integrated approach and has identified four prioritised Innovation Clusters in which smart charging and V2X is either already playing a significant role or will become a necessity in the next years. SCALE will test and validate a variety of smart charging and V2X solutions and services in 13 use cases in real-life demonstrations by a set of different partners & expertise needed for real-world demonstrations (e.g., involving DSOs, public authorities, service providers), structured by its four Innovation Clusters:

The project sees charging solutions as a continuum of a) unidirectional static, b) dynamic & c) bidirectional charging with all charging concepts moving beyond state-of-the-art technology offering a systemic solution. Project results and lessons learned from pilot activities as well as gathered knowledge and best practices will be transferred across EU cities & regions and relevant e-mobility stakeholders. SCALE aims to create a system blueprint for user-centric smart charging & V2X for European cities & regions

The consortium comprises cutting-edge European e-mobility actors and is led by ElaadNL, one of the world's leading knowledge and innovation centres in the field of smart charging and charging infrastructure.

SCALE builds upon the progress and future plans of the first bi-directional region in the world, Utrecht and all twenty nine partners, covering entire smart charging & V2X value chain and represent leading OEMs and charging manufacturers (Hyundai, Renault, SONO, Polestar, VDL, ABB), DSO/TSOs (LVN, Enedis, Equigy), Flexibility Service Providers (Enervalis), CPOs and e-Mobility Service Providers (We Drive Solar, GoodMoovs, Current, EMS), public authorities (City of Utrecht), research & knowledge partners (ElaadNL, Bayern Innovativ, RISE, Trialog, CERTH, University of Utrecht, Chalmers, FIER, Rupprecht Consult), European networks & multipliers (POLIS, UEMI, AVERE), as well as consumer associations (Elbil) from eight countries are working together for three years to exploit the untapped potential EVs and renewable energy offer to the power systems and the energy ecosystem in this sector. Multiple SCALE consortium partners are directly involved in EC's European Alternative Fuels Observatory & other important European e-mobility initiatives (STF, Clean Bus Europe). SCALE creates a critical mass to develop the technological, regulatory, organisational and legal readiness that is needed for a mass-market.

1 Objectives and ambition

1.1 Open system architecture

Scale will develop an open system architecture by 2023 for smart charging & V2X which ensures interoperability, connectivity, openness of the system and fair market conditions. An architecture resulting in at least 30 innovations already during the project (number of new technologies, products, standards, protocols, software and services being developed). The SCALE Open Architecture for smart charging and V2X will support the deployment of several regulations in place, i.e., directives on deployment of alternative fuels infrastructure (2014/94/EU), on building energy management (2010/31/EU), renewable energy (2018/2001) and on common rules for the internal market for electricity (2019/944/EU; plus regulation 2019/943/EU). SCALE will support the implementation of the state-of-the-art open standard ISO/DIS 15118-20 - which enables bidirectional charging in communication between vehicles and charging points from 2022 on – to actively avoid the use of lock-in proprietary protocols.

1.2 User-centric approach

To create solutions for a pan-European market for smart charging and V2X, SCALE will build a user evidence-base to develop and test holistic and scalable solutions for smart charging and V2X. SCALE will deploy a user-centric approach, systematically collecting knowledge, removing existing acceptance barriers and developing solutions in line with 800 users directly involved in SCALE pilots. SCALE will build a unique EV user knowledge base surveying 15.000 EV users (and non-users) from 10 European countries. SCALE has identified four prioritised Innovation Clusters (based on sites/ specific user groups). For each of these, a range of solutions and services will be tested in real-life demonstrations in 7 different European contexts. In total, SCALE will demonstrate 13 use case pilots, testing a total of 20 innovative charging concepts & solutions within the four Innovation Clusters that have been validated with the involvement of 800 pilot users. Thus, SCALE serves as a the first-of-its-kind knowledge platform & database, systematically collecting validated knowledge and lessons learnt for these four smart charging & V2X priority areas.

1.3 Reduce the need for grid reinforcement

SCALE caters to the need for more flexibility in the grid by preparing a European rollout of smart charging and V2X, which can align time, speed and way of charging to efficiently distribute the power demand in the grid. SCALE sees V2X as an integral means to manage the energy transition. The holistic SCALE smart charging and V2X solutions will support European cities and regions to manage the energy transition smartly and efficiently, thereby reducing infrastructure costs for the society due to an 88% reduced need for grid strengthening while still ensuring system stability. To reach for the full potential of smart charging and V2X solutions, SCALE will move a step further, streamlining renewable energy communities based on V2X allowing for citizens to become energy prosumers.

Finally, SCALE will develop a system blueprint for user-centric smart charging & V2X for European cities & regions, ensuring the integrated planning for the energy and mobility transition towards smart charging and V2G pursuing sustainable mobility and energy goals.

1.4 Prepare a mass-market and eco-system for smart charging & V2X

SCALE connects important European frontrunners and testbeds for smart charging and V2X in the top-5 countries in charger roll-out, and builds upon existing technologies, infrastructure, open standards & protocols, partnerships, and funded projects. Thus, SCALE creates a critical mass to develop the technological, regulatory, organizational and legal readiness that is needed to for a mass-market and eco-system. SCALE will establish the missing research and innovation links to enable a mass-deployment of smart charging and V2X in Europe. In SCALE, the City of Utrecht will become a worldwide showcase and testbed for large-scale adoption of V2G, becoming the first region in the world with a bidirectional ecosystem. In SCALE, 500 V2G enabled cars and 3000 V2X charging points will be demonstrated as part of a city-wide flexibility experiment.

1.5 Innovations

Throughout the project SCALE will work on developing (business)-innovations, recommendations for partnerships in the sector as well as for regulations and will work in the consortium, its alliance and extended network, to achieve acceptance and prepare for EU-wide implementation.

1.5.1 Testing infrastructure

State-of-the-art test-labs for smart charging and V2X and intense cooperation between the Enedis, Elaad and the EC's JRC testlabs. The test labs exchange test-teams, vehicles, charging equipment, and software (e.g., CPO-, aggregation-, fleet management solutions). Aligning and standardising testing methods across the test-labs; defining and implementing joint testing methodologies across the SCALE test-labs.

1.5.2 Crowd Balancing Platform

The Equigy Crowd Balancing Platform already facilitates the exchange of information between aggregators and TSOs for several ancillary services across Europe, the TSO-DSO coordination is currently under development. Enable independent, third-party validation of flexibility transaction to ensure a fair market and maintain the stability of the grid.

1.5.3 Bi-directional charger, controller, and back-office

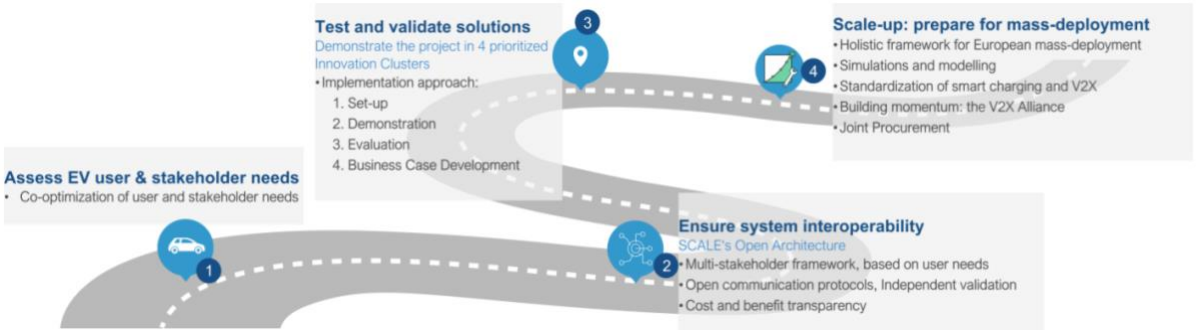
The project partners involved will create in marketable products (TRL: 9), to secure a swift uptake of smart charging and V2X. The actors involved will continue to adhere to the newest standards and protocols (also after project end) to keep the innovations at TRL 9.

1.5.4 Procurement guidelines & Planning tool for charging infrastructure rollout &

In SCALE, a joint procurement program will be constructed. This will enable collective procurement for all charging related tenders. Joint procurement is believed to bring down costs dramatically and streamline tendering procedures. Public authorities use separate models: demographic prognosis models for charging infrastructure rollout; socio & techno-economic models to develop district energy transition plans (towards fossil-free systems). DSOs use their own prognosis models including growth of EVs, electrical heating for dwellings and RES generation for their grid planning. Currently these planning processes are only loosely coupled and mostly independent. A model and process that better aligns the planning processes of public authorities (EV charging infrastructure, RES uptake, district energy systems) and DSOs (grid planning). Based on quantitative parametric and probabilistic scenario models of EV penetration, V2G penetration, EVCI rollout level and RES generation in urban environment, the Peak Shaving capabilities of V2G EVs are assessed on societal costs and benefits.

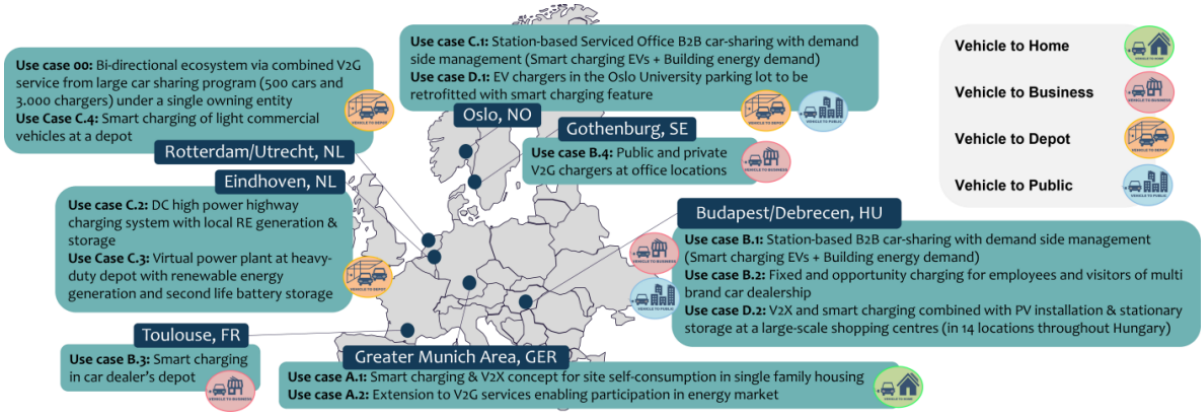
2 Methodology

The overall methodology of SCALE will maximize the exploitation potential of the proposed innovative solutions for smart charging and V2X, preparing them for a mass European adoption. The structure of the project methodology follows a clear and logical step, starting with the assessment of (1) EV users and stakeholder needs. As a next step, the project ensures, that the identified multi-actor environment can operate together (2). To achieve this, an Open Architecture is developed, following the design principles of openness and transparency, which ensures interoperability in the system. Once the architecture is ready, the viability of the system is demonstrated, via the testing of innovative V2X solutions, within the framework of SCALE's 4 Innovation Clusters (3). After use case implementation & validation the project prepares the mass-deployment across Europe (4).



SCALE works across pilot sites and makes use of an integrated approach. SCALE has identified four prioritized Innovation Clusters (based on sites/ specific user groups) for which smart charging and V2X is either already playing a significant role or will become a necessity in the next years. SCALE will test and validate a variety of smart charging and V2X solutions and services in 13 use cases in real-life demonstrations structured by the four Innovation Clusters (A: Home, B: Business / office, C: Light- and heavy duty, D: Public). Each use case comprises

of a certain combination of charger, vehicle type, and service tested. Each use case will focus on a different aspect to ensure complementarity and range. SCALE sees charging as a continuum of a) unidirectional static, b) dynamic & c) bidirectional charging. All charging concepts in SCALE will move beyond unidirectional static. SCALE use cases will be demonstrated by a team of different partners needed for live demonstrations (e.g., DSO, public authority, and service provider).



SCALE focuses on preparing smart charging and V2X for large-scale deployment throughout Europe. The knowledge acquired and solutions developed in the project will be scaled up to prepare for mass deployment. Since the smart charging and V2X eco-system consists of many different stakeholders, many distinct aspects of scalability need to be considered. These aspects are legal issues, policies, return of investment and business models, standardization besides, and effects the grid. Holistic framework for enabling European mass-deployment: SCALE will address all aspects of mass-deployment, whereas previous projects often have failed to do so. The main (non-technological) elements in scalability are legal issues, policies, return of investment and business models, standardization besides, and effects the grid. Especially important here is regulation. Laws regulating the grid differ between countries, and were not written with EVs in mind, and certainly not for vehicles that can charge at one place in the net and discharge at another location (V2G). This becomes more complicated when charging/discharging is outside your own home. The aggregated knowledge from the variety of use cases and the variety of project partners, enables SCALE to address existing challenges from a holistic perspective, covering technological, organizational, governance, business, and human factors.

To properly estimate large scale impact on European grids, modelling and power system stability studies will provide insight into smart scheduling, local distribution system impact, standards on V2G, delays, grid requirements, ancillary service requirements and frequency stability. Quantitative parametric and probabilistic models will be used for assessing the impact of progressive, massive EV penetration on the electricity system.

By design, SCALE makes use of an open science approach as it bases its work on open standards, protocols and, where applicable, open source software. The consortium will aim at making the knowledge, information and data generated by the project as exploitable and accessible as much as possible by third parties. Their disclosure will be made considering the confidentiality of some data, necessary to protect the competitiveness of the business partners and will be GDPR compliant. SCALE will publish its results in the Open Research Europe platform.

Authors

Baerte de Brey works at Stedin, a Dutch DSO on e-mobility, and is the Chief International Officer within ElaadNL. Responsible for analyzing the long-term effect of electric mobility on the electricity grids, Baerte helps building a sustainable business case around this transition. This includes vehicle2grids, EV-storage and cyber security. He graduated from Leiden University in 2001 with a law degree and received a MBA from Nyenrode Business University in 2006. On behalf of Stedin, he is one of the executive board members of ElaadNL, the knowledge and innovation centre in the field of (smart) charging infrastructure. As an expert for the International Energy Agency and the European Commission he sometimes reviews collective European programs concerning EV interoperability and smart charging. In his spare time he is an elected member of the Provincial Council of Utrecht.

Frank Geerts is Program director Smart Charging at ElaadNL and realizes innovations and solutions to facilitate and accelerate the transition to eMobility. Furthermore Frank is chairman of the Dutch national workgroup for Smart Charging.
Since 2012 Frank has played an active role in the open standardization of e-mobility at national and international level. He is regular speaker on many international conferences. He has over 20 years' experience in the energy sector, in different roles and for several energy companies in the Netherlands.
Frank is currently engaged in the development of several Smart Charging solutions and projects. Some examples: Scale-up program for Smart Charging in the Netherlands (Slim Laden voor Iedereen), scale-up project for Smart Charging and bi-directional charting in Europe (SCALE), FlexPower Amsterdam testing a new Grid Connection with flexible capacities, Smart Solar Charging based on V2G in Utrecht area and GridShield a measure of last resort to protect the grid against local power failures from unpredicted congestion based on decentralized and autonomous technology. Before, Frank was project leader of several other European projects namely Interflex, Invade and Mobi Europe.