INCIT-EV

Large demonstratioN of user Centric urban and long-range charging solutions to boosT an engaging deployment of Electric Vehicles in Europe

02 EDITION
MARCH 2022

NEWSLETTER

The INCIT-EV project has just passed its 3rd general assembly. After two years of work in a context disrupted by the COVID 19 pandemic, the project was able to maintain its activities and follow its agenda. Today INCIT-EV project presents its first concrete results. today we present the technological brick of the impact on the electrical network, one of the deployment tools and one of the important dissemination activities on synergy.

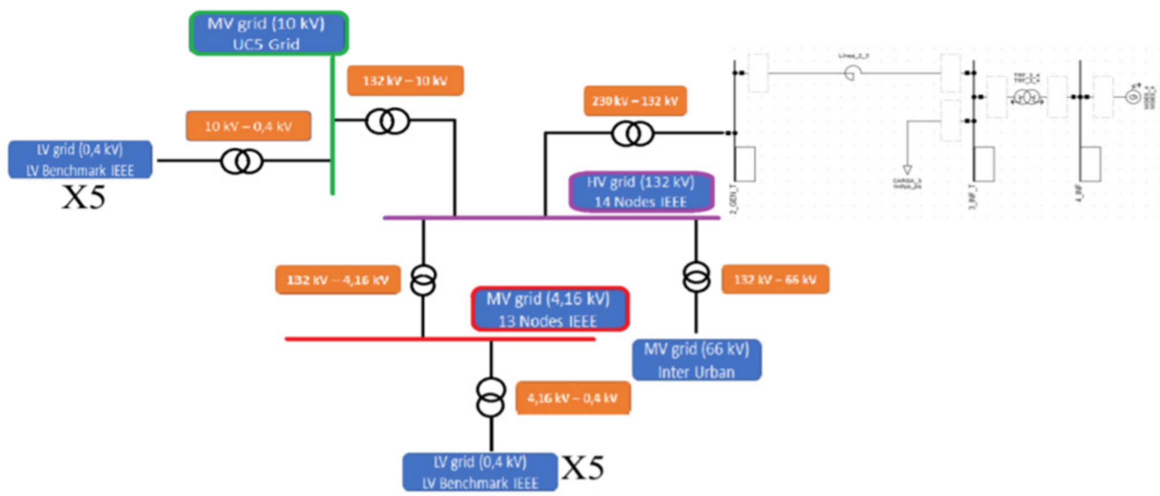
Technology brick: Grid Requirements for Charging Systems Deployment

The main objective of the project has been **analysing the most important grid requirements to face a wide deployment of electric vehicles**. To achieve this objective, a theoretical analysis of the technological and practical requirements of a large implementation of EVs has been done.

Along the project, it has been analysed the **impact that a wide deployment of EV charging stations** could have along electric systems, analysing the overall effect on high, medium, and low voltage. The simulations done throughout the project analyse grid impact in terms of congestions, losses, and voltage deviations. The effect of grid impact reduction techniques, such as solar generation, battery storage or demand management has also been analysed.

During the project it was also studied **the support that a big amount of EV/charging stations** could provide to the system operators in terms of frequency regulation.

To make the simulations as REAL as possible a tool has been developed for obtaining expected demand profiles of EVs, according to its charging distribution and considering different battery capacities and charging power. The grid used for the analysis consist of 10 low voltage (0.4kV) grids, connected to three different medium voltage grids (4.16kV; 10kV and 66 kV) that are also connected to one high voltage grid (132kV), as seen in FIGURE XX.



With the grid already built, **4 different scenarios were decided** to analyse grid impact. In the first one 60% of all CS were connected in low voltage and the other 40% in medium voltage. In the second one 60% were in medium voltage and 40% in low voltage. The third scenario had all the CS connected to the high voltage grid in the last one it was spread equally, 1/3 in each voltage grid. These 4 scenarios were studied 3 times each one of the, with 20; 40 and 60% of grid peak demand power EVs penetration.

Once the scenarios had been defined, the grid impact simulations were done, first with only the CS connected to the grid, as base case scenarios, and latter adding grid impact reduction technologies to compare the results. In TABLE XX all impact reduction simulations done in the project can be seen.

A total of 16 simulations were carried out implementing photovoltic generation, battery storage, demand management or a combiantion of technologies to see how the grid impact could be reduced using these technologies.

When the technologies were combined, it was the simulation with PV asnd battery storage the one that has the most reduction in overloaded lines, mainly because it is possible for the user to control when the battery is charged and discharged using the storage energy when the peak demand occurs.

With a higher penetration of EVs the number of undervoltages increases, althoug these undervoltages appear only in LV grids. If PV is implemented in all the CS spread out through the grid, overvoltages increase a lot. On the other hand, storage, demand management and combined technologies are the ones where undervoltages reductions are greater, but only storage and demand management are able to achieve this reduction without raising the number of overvoltages.

If a deeper study of storage and PV is done and both are properly sized and, in battery case, the usage profile is better adapted to PV generation and CS demand most of the problems could be solved leaving the demand management technology for exceptional cases where demand excess the expected one and where PV and battery are not able to solve all grid problems.

For achieve underfrequency or overfrequency correction with EV charging stations, they must have a frequency control installed.

In underfrequency simulations, the higher the number of EVs installed, the higher the active power supply to the grid, which leads to higher frequency error correction. **At high and low voltage, it is not necessary to transport the power long distances along the electric grid**. This is since, at high voltage, the EVs charging stations are close to where the frequency event occurs.

In low voltage, the EVs charging stations are close to the consumers and feed them directly. Therefore, the power losses are lower, and the frequency correction is higher. Moving to overfrequency event simulations, the most power absorption takes place in the low voltage grid, since power must be transported further through the grid (from where the frequency event occurs), leading to higher losses. **So, considering the losses in the power transport and the EVs power absorption, placing the EVs charging stations at low voltage is the best solution for overfrequency cases**. The worst case is when the power absorption is more distributed in the electric grid.

Deployment tools: Reference City Definition and KPI Specification

A methodology and a set of KPIs have been proposed, developed, and tested to characterize cities based on their readiness for a widespread of electric vehicles and related infrastructure. This methodology is based on the selection of a representative set of KPIs and their grouping in vectors that allow to compare and classify cities based on measurable data.

This KPIs have been divided into groups or vectors of a concrete topic:

1. **Civil and Social.** Analysing the quality of life and other social aspects.
2. **Transport.** Characterize cities transport infrastructure.
3. **EV census.** Characterize the number of electric vehicles in the city.
4. **EV charging infrastructure.** Characterize EV charging infrastructure in the city.
5. **EV charging services economics.** Characterize EV charging prices in the city.
6. **Smart Charge / ICT system.** Characterize city infrastructure possibilities to provide smart charge services reducing grid impact and promoting the use of renewable energies.
7. **Environmental impact.** Characterize the environmental impact of the electric energy provided to EVs in the city

Vectors 1 to 2 are used to set the main characteristics of the city and vectors 3 to 7 measure values related to EV.

As KPIs values vary wildly between them a normalization process has been used so all values are set from 0 to 100, where the higher the value the best each city is doing regarding that KPI.

By stablishing a set of KPIs, 80 European cities form EU-28 countries have been parametrised according to its characteristics. Using the K-Means clustering methodology 5 reference cities has been obtained, each with some unique characteristics. This reference cities represents how a city is doing regarding EVs implementation and its related characteristics.

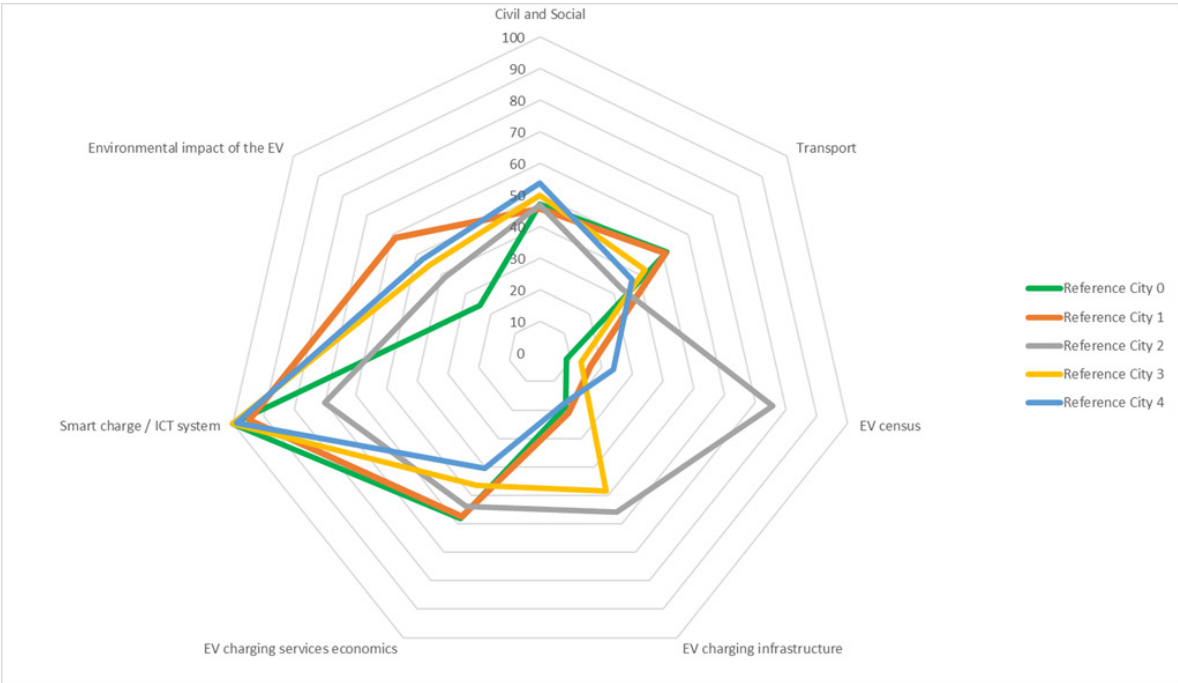
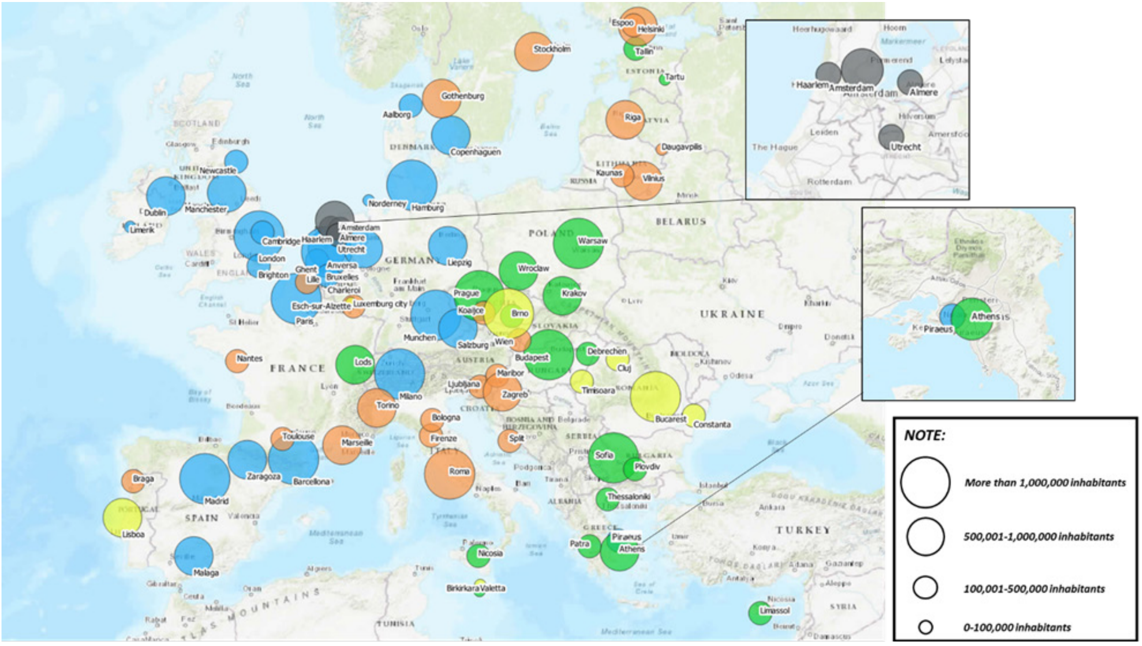


Figure 1. Reference Cities

A spider graph has been selected for representing the Reference Cities as can be seen in Figure 1.

- **Reference City 0** represents cities the usually have a high energy generation rate from fossils fuels that make electricity price lower while generating a great negative impact on the environment.
- **Reference City 2** represents cities with high EV penetration and developed charging infrastructure.
- **Reference City 3** represents cities with low EV penetration but an advanced charging infrastructure, having the capability to increase the EV implementation.
- **Reference City 1** (orange) and Reference City 4 (blue): These two reference cities are the average ones, European cities that do not have some differentiated characteristics from the rest.



As the selected 80 cities are all around Europe the 5 reference cities could be described as the 5 types of cities regarding the EV implementation. With this data new cities could be characterized in one of this clusters to see how the city is doing in EV implementation. With this idea a tool is crated that, giving as input the KPIs from a new city and the definitive set of reference cities gives the user the belonging cluster of the city. With this tool is possible to characterise any European city between the 5 obtain reference cities once the KPIs has been calculated.

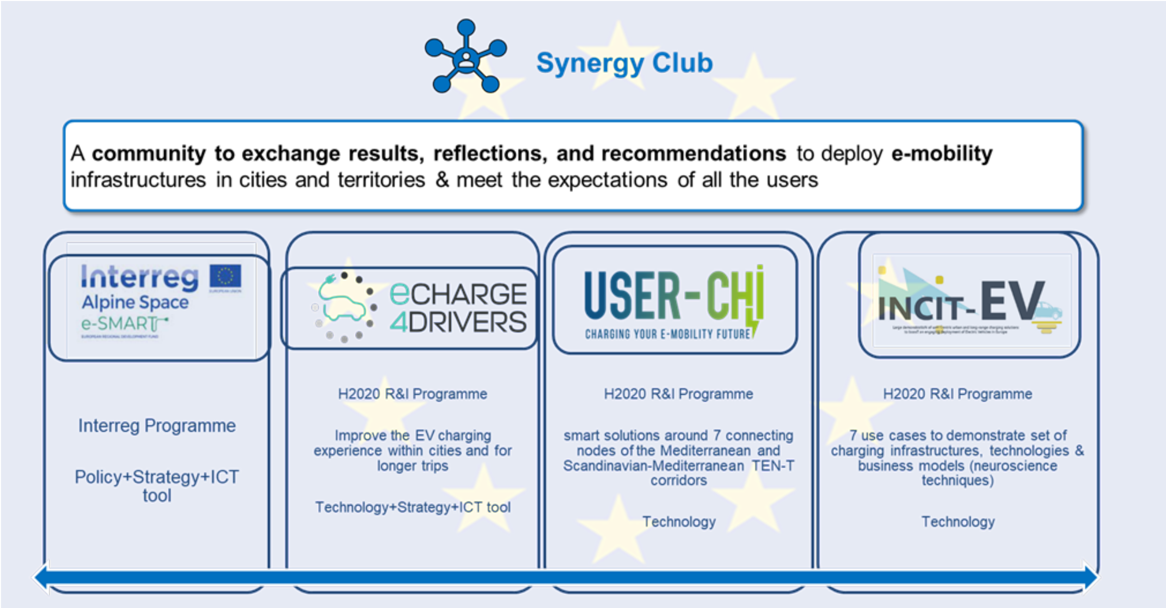
Dissemination activity: Interaction and exploitation of synergies with other projects and initiatives

The stimulation of strategic cooperation between stakeholders involved and the encouragement of the synergies among European related projects should represent a priority for Research and Innovation European programs. Interaction and synergies between various types of stakeholders, organizations and projects must be promoted and the projects themselves should generate synergies in accordance with the expected impact of the topic of INCIT-EV.

The monitoring of synergy actions will be implemented in early 2021 and it will be in line with the communication and dissemination strategy of the INCIT-EV project. During this census work we identified the opportunity to create a club with the projects of the same H2020 call. The synergy club was created in January 2021 between "the sister projects": USER-CHI, eC4Ds, E-smart and INCIT-EV.

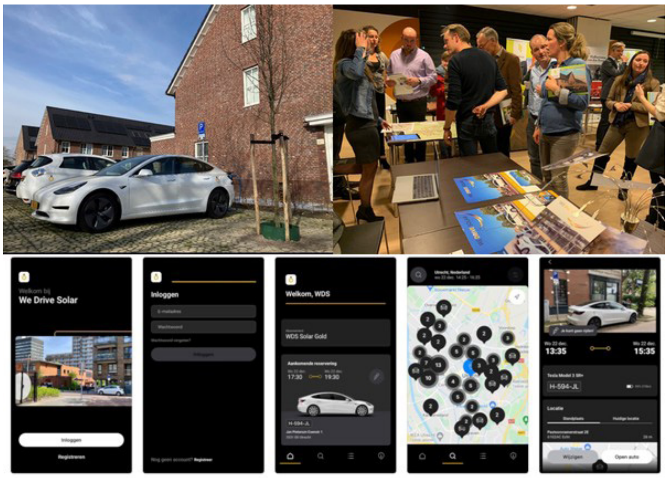
The club meets twice a year; we have identified the themes that will be discussed at these meetings:

- **exchange of project results**
- **planning for joint participation** in events such as the CIVITAS forum, the ITS world forum in 2021
- **work on common recommandations** to improve the dissemination and use project results in Europe.



ARTICLE

Use Case 1b: Community Bi-Directional Charging in Odijk, the Netherlands



In the town of Odijk, near the city of Utrecht, a local initiative is active in the recently built, and still growing, neighborhood "Het Burgje". A collaboration between the housing developers, the buyers of the houses and We Drive Solar has established three years of free subscription to the We Drive Solar (WDS) Vehicle-to-Grid e-car sharing scheme, for all citizens living in the neighborhood. This local initiative is one of the Use Cases in INCIT-EV with the goal to further develop the WDS bidirectional shared e-car proposition and software interoperability, and to research the socio-economic aspects of this offer in relation to a young neighborhood with an active local initiative.

At the location, two public, bidirectional e-car charging stations have been installed and at the time of writing, three WDS shared e-cars are in operation. Following the growth of the neighborhood and actual demand, these numbers are expected to grow to 5 bidirectional charging stations and 5 e-cars. In INCIT-EV, this Use Case extends the interoperability between the shared e-car reservation system, its users, and the smart / V2G charging operation of the e-cars. At this moment, the e-cars are smart charged, driven by the day-ahead electricity market prices. The plan is to add two new EV models into the V2G e-car sharing system. This includes the first V2G production e-car with V2G capabilities, the Hyundai IONIQ5, which is expected to be demonstrated in this Use Case by the end of 2022, thus complementing for V2G charging and discharging the ecosystem.

Already, the use of the shared e-cars and various technical and non-technical aspects are being monitored. This Use Case is expected to have high replication potential especially in the large segment of sustainable new housing districts.

Bart van der Ree

AGENDA 2022:

INCIT-EV will be speaker:

- **25-30 march** H2020RTR result from road transport in H2020 projects
- **30 May-1 June 14th** ITS European Congress Smart and Sustainable Mobility for all
- **May** Interreg Alpine Space e-SMART final event.

Next synergy club meeting : June leader “eCharge4Drivers”

READ MORE ABOUT INCIT-EV PROJECT

https://www.incit-ev.eu

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 875683.

EUROPEAN COMMISSION