GREEN POWERED FUTURE
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# Pillar 2

## System Flexibility and Market Design

*Factsheet P2-02*



# Flexibility from electric vehicles

According to the IEA, electric vehicles (EV) are the key technology to decarbonise road transport, a sector that accounts for over 15% of global energy-related emissions, and the global electric vehicle fleet is set to grow twelve-fold by 2035 under stated policies. Therefore, electromobility will significantly influence power demand, its patterns and distribution.

This factsheet shares key case studies from GPFM members' projects assessing EV grid impact and flexibility potential, how it could be exploited by smart charging and Vehicle-to-Grid (V2G) solutions, and planning strategies for the deployment of the charging infrastructure, ensuring that the power system can support EV uptake and exploit its flexibility potential to support variable renewable integration.

## GPFM Innovation Priorities in scope:

- **IP 2.5.4** - Demand response, EV services and grid impact assessment
- **IP 2.5.5** - Tools for optimal smart charging and V2G management
- **IP 2.6.5** - EV charging infrastructure planning and deployment

**6** Case studies reported in this factsheet

**29** Projects covering these IPs are included in the GPFM National Pilots report

**National Pilots Report**

For further details on **GPFM Innovation Priorities (IPs):**

**GPFM Roadmap** **Action Plan 2022-2024**

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# Case studies

## Case Study #1 Flexibility From Electric Vehicles: V2G and Smart Charging

The transition to electric vehicles (EVs) is revolutionizing the landscape of public transportation, offering a cleaner, more sustainable alternative to traditional fossil fuel-powered buses and trains. The Project aims to develop at a very high maturity level an effective and efficient tool to enable a positive interaction between Charging Stations for all kinds of EVs (cars, trucks, busses…) making them a primary source of Demand Response services to optimize the Rome's distribution grid operation. The pilot will also exploit the "Areti Smart Park", the Areti's laboratory for Electromobility equipped with RES generation, storage and advanced control system of charging stations for the Areti's EV fleet, to test specific Smart Charge and V2G technologies.

*Link to case study's detailed description*

**Areti**

## Case Study #2 NS Power - Smart Grid Nova Scotia Project

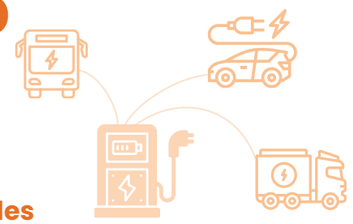
Nova Scotia Power's project focused on integrating and managing distributed energy resources (DERs). The project included testing a distributed energy resource management system (DERMS) and various DERs such as electric vehicle (EV) smart chargers, residential managed EV charging via telematics, bi-directional (vehicle-to-grid) EV chargers, and other residential, commercial and industrial loads. The project demonstrated the value of DERMS in delivering customer and grid benefits including affordability, reliability and environmental sustainability. NS Power aims to manage 150 MW of flexible load by 2030.

*Link to case study's detailed description*

**Canada**

**Circulating EV in 2035 globally according to the IEA APS scenario**

**1015** Million



**EV global sales share in 2035 according to the IEA APS scenario**

**66%**

Source: *IEA*

## Case Study #3 Grid Integration and Control of Large-Scale EVs

The project targets China's electric vehicles (EVs) growth challenges, focusing on: 1) Analyzing individual-user charging demand and proposing a cloud-edge collaboration strategies, 2) utilizing a big data platform for real-time battery, vehicle, and charging pile monitoring with early warning systems, 3) exploring data-driven EV flexibility predictions and intelligent vehicle-grid interaction controls, 4) developing risk mitigation for large-scale vehicle-grid integration and secure terminals, 5) developing a "grid-operator dual-level" control system, researching business models and policies, and showcasing advancements across scenarios.

*Link to case study's detailed description*

**China**

## Case Study #4 Aggregated flexibility from company EV charging

Electric Vehicle (EV) charging points at workplaces presents interesting opportunities for the integration of EVs with the power system. Moreover, the highly predictable charging schedules gives huge potential for adoption of charging mechanisms like V1G and V2G to support grid flexible operation.
In this case study, a communication architecture based on the OCPP protocol was developed, allowing estimation of the flexibility potential according to EV charging needs and employee habits and constraints. The architecture developed allows a remote operator to forward smart charging signals to charging points from different manufacturer in order to optimize the overall charging program.

*Link to case study's detailed description*

**Italy**

## Case Study #5 Strategic transport and energy demand modelling for Vehicle to Grid (V2G)

This innovation project provides understanding of V2G's potential to reduce peak demand on the network and facilitate network planning, and can be used by infrastructure planners, EV Charging businesses, ESOs, TOs and DNOs.
Realising the potential of V2G will depend on many factors including consumer behaviour, developments in charge point technology, and understanding battery degradation. This project developed a series of models to study the impacts of V2G and smart charging across the GB system and to understand the impact of V2G on future electricity demand profiles under various decarbonisation scenarios.

*Link to case study's detailed description*

**National Grid**

## Case Study #6 Energy System Innovation programme: ESI E-Mobility Project

Terna launched an Innovation program named "Energy System Innovation" (ESI). ESI is the new system framework to set experimental initiatives with the objective to increase the technology readiness of new energy resources to provide flexibility services to the electricity grid. The first project, named ESI E-Mobility, aims to experiment and characterize the EVs and EVSEs resource performances to provide flexibility to the grid, solve interoperability issues, advocate for communication protocol standardization, etc. To do so, Terna's E-mobility Lab, serves as reference experimental facility for the testing phase of the project. 10 partners have already participated (EVs and EVSEs) and tests are ongoing.

*Link to case study's detailed description*

**Terna**

## Key metrics

The EU decision makers effort towards EVs is paving the way for massive deployment of electric cars, commercial vehicles and buses.

**E-mobility is considered a powerful resource to provide flexibility services to the energy system.**

**EV grid integration can support higher shares of RES, reshaping the energy demand curve and reducing system costs.**

https://www.entsoe.eu/news/2021/04/02/electric-vehicle-integration-into-power-grids/

# Key findings

These case studies underline that the transition to electric mobility is revolutionizing the transport landscape, offering a cleaner and more sustainable alternative to traditional fossil fuel powered vehicles. Smart charging and Vehicle-to-Grid (V2G) tools offer innovative solutions to optimize grid operations while ensuring efficient and cheaper charging processes both for private and public transportation. To make this happen, ICT infrastructure and platforms for monitoring and controlling the EV charging need to be deployed. Moreover, the adoption of standardised communication protocols is essential to foster the adoption of smart charging schemes. Results from case studies assessing the behavior of different EVs shows that their potential as flexible resources is more in line with the requirements of long-time ancillary services. In particular, home charging implying long times could provide a good opportunity for flexibility through smart charging or V2G. A relevant issue addressed by the case studies is the potential concern about battery capacity loss due to V2G. In this view, the understanding of the factors leading to battery degradation would help to design schemes that avoid excessive battery aging, for example due to high temperatures or long durations at high states of charge.

- V2G will play a role in the decarbonisation of grids, if there is proper infrastructure investment and if suitable price schemes for cost reduction will be adopted
- Smart charging and V2G could foster grid operation optimization and pave the way for a more sustainable and resilient urban infrastructure
- Algorithms, platforms and well-suited communication protocols for monitoring and controlling the EV charging are needed to support the adoption of smart charging

# About GPFM

The Green Powered Future Mission (GPFM), launched within the second phase of the global initiative Mission Innovation (MI2.0), is a public-private partnership with members from MI countries, private sector companies and international organisations. It aims to demonstrate that by 2030, power systems in different geographies and climates can effectively integrate up to 100% variable renewable energies, like wind and solar, in their generation mix, and maintain a cost-efficient, secure and resilient system.

https://explore.mission-innovation.net/mission/green-powered-future/


**GPFM Coalition**