

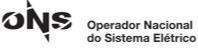


### Why a plug-in electric vehicle (pev) joint project?

The wide adoption of PEVs around the globe will have a significant impact to the operation of electricity grids worldwide. As system operators, it is our responsibility to maintain system security and stability taking into account these changes.

To be prepared for this challenge some VLPGO members have participated since 2009 in a Joint Project for the Plug-In Electric Vehicle. The Project is focused on analyzing the effects that PEVs will have on system operations and provide recommendations to manufacturers and policy makers which benefit consumers, avoid adverse effects on the security of supply and allow more efficient use of the existing electric grid infrastructures.

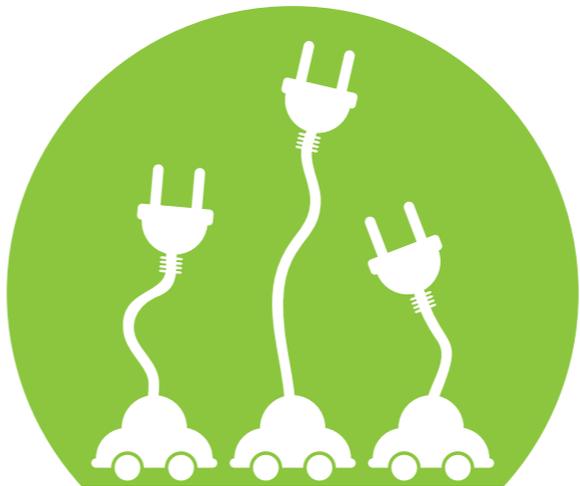
## VLPGO Very Large Power Grid Operators

 USA - <a href="http://www.midwestiso.org">www.midwestiso.org</a>	 USA - <a href="http://www.pjm.com">www.pjm.com</a>
 Spain - <a href="http://www.ree.es">www.ree.es</a>	 France - <a href="http://www.rte-france.com">www.rte-france.com</a>
 Japan - <a href="http://www.tepco.co.jp">www.tepco.co.jp</a>	 Italy - <a href="http://www.terna.it">www.terna.it</a>
 South Africa - <a href="http://www.eskom.co.za">www.eskom.co.za</a>	 South Korea - <a href="http://www.kpx.or.kr">www.kpx.or.kr</a>
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### Electric Vehicle Joint Project

## TSO answers to main questions regarding plug-in electric vehicle (PEV)



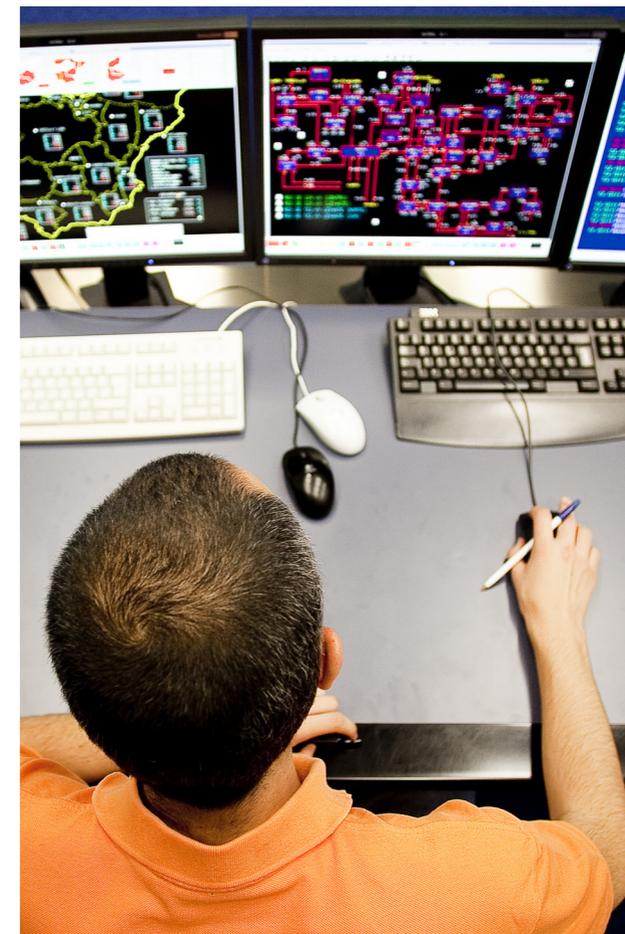
October, 2010

### What is VLPGO?

The Very Large Power Grid Operators Association (VLPGO) is a voluntary initiative of the world's largest Power Grid Operators, representing together more than 60 % of the electricity demand in the world.

The vision shared by all the participants of the VLPGO initiative is to be a leader and a catalyst in the transition of the electric power industry to the power grid of the 21st century.

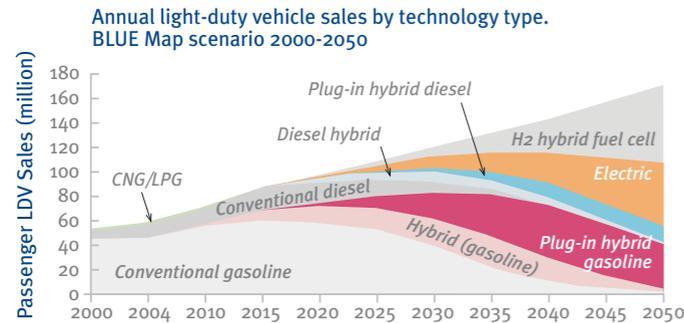
For more information visit [www.vlpgo.org](http://www.vlpgo.org)



# TSO answers to main questions regarding plug-in electric vehicle (PEV)

## How many PEVs are forecasted?

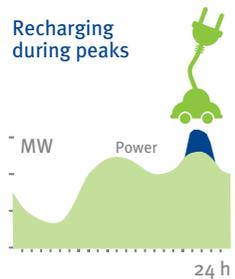
A massive development of electric vehicles is foreseen by the 2050 worldwide.



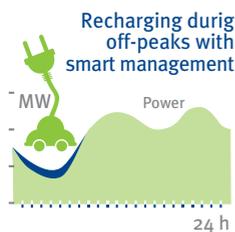
Source: EV/PHVE International Energy Agency (IEA) 2009 Roadmap.

## How can PEVs impact the electric grid?

PEV can be an opportunity to increase the system efficiency only if the charge of these vehicles is done during off peaks periods.



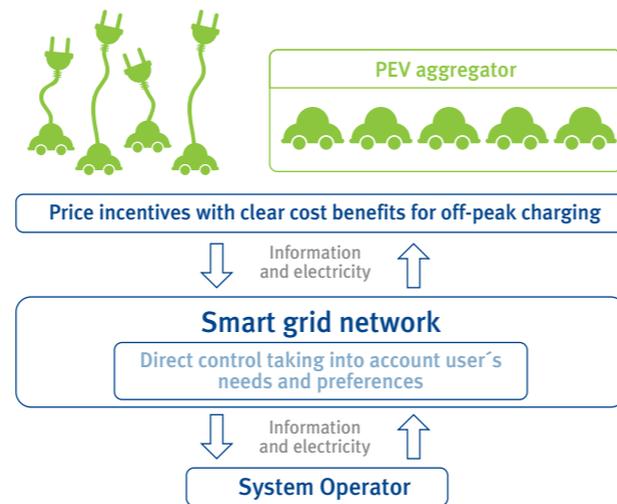
Charging PEV during peak periods will result in less efficiency of the electric system due to overloading of infrastructures during short periods, the need of more transmission and generation assets and the increase of CO<sub>2</sub> emissions...



... whereas a managed charge of PEV during off-peak periods is an opportunity to reduce the cost of mobility, increase the system efficiency and renewable integration.

## What does "smart charging" mean?

Smart charging means the management of the time and level of charging by the vehicle owner or/and by electric system inputs. There are three primary methods to match electric system needs and PEV charging timetables: predetermined rules, direct control load and price signals. The implementation of these could bring significant benefits to the electric system.



### Benefits

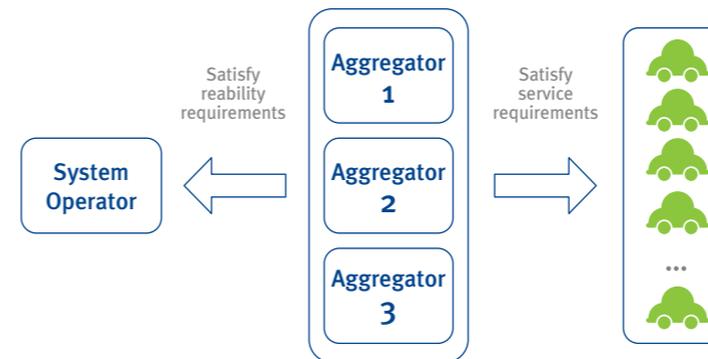
- Higher efficiency of the electric system.
- Higher integration of renewable energy.
- Green house gas emissions reduction.
- Reduce external energy dependency.

## What does "Vehicle to Grid" mean?

Vehicle to Grid (V2G) systems enable the transfer of electricity from the vehicles batteries to the electric grid. V2G provides the potential to help electric system reliability and balancing but this capability requires an enhanced communication between users and the system operator.

## What does "PEV aggregator" mean?

An aggregator is a new player that will integrate multiple PEV end users and will be engaged in communications with TSO (Transmission System Operator) in order to support reliability requirements and/or participate in energy products or SO services while satisfying service commitments to each vehicle.



## How regulation has to evolve to help the adoption of PEVs?

The regulatory framework for the promotion of PEVs has to evolve in each country in order to open the possibility of new players in electricity markets (PEV aggregators) and to create new tools for the promotion of smart charging (time of use tariffs appropriate for PEV).



## Key outputs and recommendations

- ### 1 Key outputs

Smart Grid enhances the possibility of charging PEV according to system needs: Significant capacity in the valley portion of the load curve allows accommodating significant number of electric vehicles with the existing generation and transmission facilities.

### Recommendations

To develop smart charging infrastructure to enable filling the valley period.
- ### 2

The quick response of PEV charging has a key role in the solution of emergency events of the system.

### Recommendations

To create a product for PEV load curtailment in an emergency situation.
- ### 3

The use of retail prices reflecting network system conditions is essential to the implementation of smart charging.

### Recommendations

To create a new dynamic pricing product for PEV that reflects network systems conditions.
- ### 4

Aggregators will have a key role for the implementation of smart charging taking into account system needs.

### Recommendations

To provide interfaces to aggregators that will provide services to PEV users complementary to dynamic prices strategies.