

## Integration of Electric Vehicles in the Power Grid

### Vision

#### Drivers of Change

Nations worldwide all share concerns on the world's dwindling reserves of oil and gas and the environmental impact that the use of fossil fuels has on the world.

The efforts and initiatives currently being undertaken to counteract these challenges can be divided into two categories.

- (1) Finding clean and renewable technologies.
- (2) Improving the intelligence of the power grids.

The introduction of electric vehicles in the future power grid can both increase the utilization of renewable energy and help optimize power production and consumption on the power grid.

The Edison project offers a unique possibility of creating an innovative and dynamic power system that supports active integration of distributed energy resources (DERs) such as electric vehicles (EVs).

#### Project Benefits

#### National Level



- Support an environment-friendly development
- Optimize power production and consumption
- Enable energy independence

#### Grid Level



- Maintain security of supply
- Actively integrate distributed energy resources

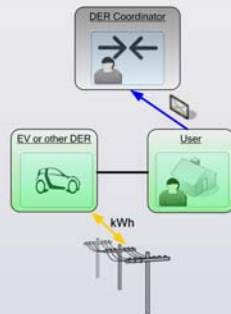
#### User Level



- Get an economic incentive to contribute to CO<sub>2</sub> reduction
- Automatic procedure for connecting to the grid.

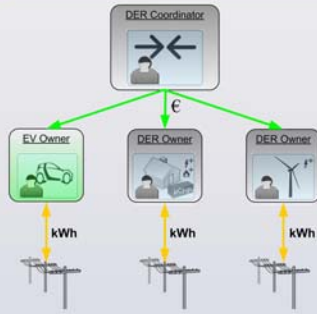
### Initial Scenarios

#### 1: Choice of Coordinator



When an EV is connected to the **powergrid**, related user **information** is sent to a DER coordinator which uses the Work Package 3 (WP3) developed IT solution that supports a broad range of different EVs and other DERs.

#### 2: Manage Win-Win



The DER coordinator broadcasts **price** information to influence the EV's behavior. The EVs can be given a price to contribute with short voltage bursts to balance the grid or to be kept informed of the realtime prices for charging the battery.

#### 3: Support Roaming



This system will allow an EV to connect to the grid at any location on a national level. This active integration benefits the user and reinforces the grid to which the connection is made.

### WP3: Developing the IT Solution

#### Purpose

The Work Package will support the Vision in the:

"Development of a technical system for intelligent system integration of distributed EVs connected in private homes, company parking lots, and at charging stations."  
(From WP3 project description)

#### Designing the IT Solution

The first task is to analyze and evaluate different software designs and technologies that can be used in the prototype solution. The prototype should be based on well-documented standards and offer a high degree of interoperability.

#### Test Lab Validation

The next task will be to implement the software solution on a server. The server will be connected to a number of clients that represents the participants in a distributed scheme.

#### Island Demonstration

The solution can contribute to a large-scale demonstration on the island of Bornholm. This island is well suited as a test-site for actively integrating EVs into the power grid.

### Cooperation between IBM and DTU

#### IBM/DTU Cooperation

Both IBM and DTU have resources and experience related to the field of distributed energy resources and intelligent grids. The combined knowledge and assets of the participants represent a promising starting point to achieve the goals of WP3 and the EDISON project in general.

#### IBM GridWise Project

IBM has participated in the GridWise project. In this project information technology and communication were used to create a real-time energy market for DERs. In the project, the energy consumption of 112 single-family homes were influenced using energy price information.

#### DTU VPP Assets

DTU has done a lot of research into the Virtual Power Plant (VPP) concept. In a VPP the production of several small DERs are combined. The VPP acts as a traditional power plant when seen from the market. Thus it is a virtual power plant. Internally, the VPP monitors and coordinates the individual resources.

#### IBM Blade Servers

Two IBM Blade Servers will facilitate the prototype implementation and tests defined in the WP3 description. Both IBM and DTU will control and manage such a server. These servers will increase the consortium partners' ability to cooperate and share results.

