EV related Demonstration Projects by NEDO

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History of EV

■ The First Stage of EV boom
  • 1990: GM showed EV in Motor Show in LA, as one of countermeasure of air pollution.
  • 1997: GM released EV1 in the Market.
  • 1999: GM released NiMH battery version EV.
  • 2003: GM stopped EV release and all of EV in the market were recovered.
History of EV

• The Second stage of EV boom

The second EV boom was came, because many people recognized EV will be important element on Smart Grid. Also, people knew there is a potential needs of EV in China due to non-reliability of gasoline supply.

2015 May  Cumulative sold number of Nissan Leaf become larger than 170 thousands.

IEC admitted 4 DC charging standard (CHAdeMO, SAE Combo, EU-Combo and Chinese standard).

• 2014 - : CHAdeMO, Combo dual charger became usual in Market
Current Discussion EV related

- UK and France announced that all of sales vehicle will be turned EV by year 2040.
- Norway decided all of sales car will be zero emission car by 2025.
- Many Europe car manufactures announced the shift of car movement from gasoline engine to Electric.
- Many new companies such as home appliance manufacture or home appliance retail company announced to participate in EV market.
- In Asia, India, China and Bhutan announced EV shift as a countermeasure of PM 2.5.
- Tesla invested Mega Factory of battery looking future EV market.
- Gogoro in Taiwan started battery drive motor bike.
NEDO International Demonstration Projects

- **Niedersachsen, Germany**: Battery storage application.
- **Lisbon, Portugal**: Demand Response using Air conditioner.
- **Northern Poland**: System Stabilizing Technology on the transmission level.
- **California, USA**: Utility owns Battery Storage demonstration.
- **Ontario, Canada**: PV with Battery demonstration.
- **New Mexico, USA**: Smart Grid, Smart House and Smart Building demonstration.
- **Hawaii, USA**: Demand Response by EV and Smart inverter demonstration.
- **Suryacipta, Indonesia**: Power quality Management for Industrial Park.
- **Speyer, Germany**: Self consumption HEMS demonstration.
- **Manchester, UK**: Demand Controllable HP demonstration.
- **Lyon, France**: Positive Energy Building and Energy monitoring demonstration.
- **Malaga, Spain**: Inner city QC demonstration project.
- **Slovenia**: Distribution system DMS.
- **Haryana, India**: Smart Meter and AMI demonstration.
- **Putrajaya, Malaysia**: EV bus demonstration.
Maui island is the place where installed renewable energy exceeded more than 50% of peak load of grid system. NEDO asked more than 500 drivers of EV to participated to DR demonstration of EV charging management, and also asked volunteers to participated to smart inverter demonstration for residential PV.
Maui Demonstration system figure

NEDO demonstrated EV demand response and smart inverter by constructing figure’s communication structure.
Integrated DMS which manages charging, can create tomorrow’s schedule of EV charging based on tomorrow’s generation forecast of PV and demand forecast. Then DMS send signal to start charge by looking for connecting status and desired ending time of charging.

Each participant can check how he contributed renewable energy consumption by portal site.
By charging management, the peak of charging was shifted to 10 - 11 pm as off-peak period of power system. This shows charging management is effective to reduce peak of electric demand.
V2X demonstration in Maui

Participants must install PV–PCS which enable to discharge electricity from EV at his house or office. PCS is preset as charging in midnight or noontime when PV is generating, and discharging electricity in evening when demand peak is coming.

Also this function is available as emergence condition such as shortage of supply capacity is happened when rapid ramping down is happened. Those charging and discharging timing were prescheduled by Integrated DMS.
The Result of V2G

From the Peak demand period (6pm–9pm) to midnight EV charging is shifted. Also, demand peak period (6pm–9pm) some EV discharge electricity to the grid.
In Lyon, France, there was a smart community demonstration conducted as a joint project with Japan from 2011 to 2016, focusing on the construction of a future-oriented city where advanced energy technologies are utilized to achieve Europe’s aggressive environmental target. Technical demonstrations were implemented as achieved in the following four tasks such as, Task 1: Positive Energy Building (PEB). Task 2: EV Car Sharing and Charging Management, Task 3: Home Energy Consumption Visualization, Task 4: Community Management System (CMS).
Task 2 covered the EV car sharing service aimed at addressing common urban transport issues of traffic congestion and lack of parking. It also addressed the development and operation of a system that optimizes the charging schedule of EVs used in EV car sharing service with the objective of absorbing any fluctuations of renewable energy.
Method of Charging Management

A Figure above shows a simple example where there was an EV rental reservation from a user for the 7:00-9:00 slot. First, the charging timing to make maximum use of PV output is calculated by $\mu$EMS to be 10:00-12:00 and 15:00-17:00. Next, the power consumed by the use of EV is calculated by charging optimization engine and the charging time is estimated to be four hours.
Spain Malaga Inner-city EV driving and charging management demonstration

Under the MOU signed between NEDO and Malaga City in 2012, a total of six private companies from Spain and Japan established a consortium (ZEM2ALL) and participated in the demonstration. The project had important implications for the process of building smart community infrastructure and implementing EV power demand management, etc. which were designed for the further spread of EV.

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In the Integrated ICT Platform constructed in the demonstration, it was possible to collect and manage the data from quick chargers in addition to EV probe data, and to combine them with external information such as weather and membership data to conduct various analyses. EV Management Center is the application in the Integrated ICT Platform and capable of providing EV users and EV infrastructure operators with the information using the collected data.
Where is needs of DC Quick Charger

A certain percent of driver have a needs of quick charging due to shortage of remain energy.

Quick charger got good evaluation from users. The point of improvement by drivers recommendation was Charging time length.

<table>
<thead>
<tr>
<th>Period</th>
<th>May 1, 2013 – December 31, 2015</th>
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<tbody>
<tr>
<td>No. of EV</td>
<td>209</td>
</tr>
<tr>
<td>EV model</td>
<td>i-MiEV:163, LEAF:43, Other:3</td>
</tr>
<tr>
<td>Private/Business</td>
<td>Private : 64, Business 145 (general corporation: 70, Public institutions: 45, Car sharing/rental car company:30)</td>
</tr>
</tbody>
</table>
Location of DC quick charger and usage result

Needs of DC quick charger locates rather inter-city driving than inner-city driving.

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Timing when Quick charger is applied

Half of quick charger user were drivers on the way to work and back. SO, Charging peak appears in the morning, around noon and evening.
Demand response by DC charging

DR using quick charger was conducted with the objective of examining the price effect of “how much change will be produced in the usage rate of quick charger depending on the price?” for all hours and place, specifically, switching control of demand increase/decrease was conducted once every other hour (to allow the monitor to get cheaper charging fee if he/she waits or hurries for a while). The evaluation of DR effect was conducted by making comparison of the charging results between the period without valuable points (Jun. – Nov. 2014) and the period with valuable points (Jun. – Nov. 2015). Result of DR demonstration using quick charger is shown on the table. Business users did not show DR effect in the demonstration, but private users, when given valuable points, tended to perform DR to get the valuable points.

### Table: DR Effect Comparison

<table>
<thead>
<tr>
<th></th>
<th>Private user</th>
<th>Business user</th>
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<tbody>
<tr>
<td>DOWN DR</td>
<td>−16.2%</td>
<td>+14.2%</td>
</tr>
<tr>
<td>(DR to curb demand)</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>UP DR</td>
<td>+16.2%</td>
<td>−14.2%</td>
</tr>
<tr>
<td>(DR to stimulate demand)</td>
<td>○</td>
<td>×</td>
</tr>
</tbody>
</table>

Note: The marks ○ and × represent as follows:
○: It was considered that there was difference in selection probability with a certain level of significance (10%), indicating there was demand stimulating/curbing effect. ×: No demand stimulating/curbing effect identified in the demonstration.
Northern California Inter City Quick Charging effect demonstration

In Northern California, USA, NEDO has just started inter city EV charging infrastructure and new connected car services based on Malaga experiences.
In Putrajaya Malaysia, NEDO has just started EV Bus and charging systems demonstrations. This quick charger hired pantograph type and, it is larger than quick charger for ordinary vehicles, and referred by designers of future larger quick chargers.
THANK YOU FOR YOUR ATTENTION