Electric Vehicles Charging and Energy Management

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Schneider Electric – the global specialist in energy management

24 billion € sales in 2012

41% of sales in new economies

140,000 people in 100+ countries

4–5% of sales devoted to R&D

Balanced geographies – FY 2012 sales

North America 25%
Western Europe 30%
Asia Pacific 27%
Rest of World 18%

Diversified end markets – FY 2012 sales

Utilities & Infrastructure 25%
Industrial & machines 22%
Data centres 15%
Non-residential buildings 29%
Residential 9%
We provide Energy Management Solutions

Energy production & transmission
- Wind energy
- Solar energy
- Hydro
- Biofuels
- Hydrocarbons
- Nuclear

Energy Management
- Making energy...
  - Safe
  - Reliable
  - Efficient
  - Productive
  - Green

Energy Usage
- Appliances
- Climate control
- Security
- Lighting
- Machines
- IT servers

...with 30-70% savings everywhere
Charging EVs: a grid nightmare?

One can hear some nightmarish predictions…

- « EV charge will create black out… »
- « … or force to use massively fossil electricity »
- « Need to build many new power plants to charge the millions of EVs »
- « massive investment is necessary to build the infrastructure »
- « domestic installations will not support electric vehicle… »
Electric energy is available

- Production capacity in a few key countries for EV

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual production TWh</th>
<th>Installed power GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>4 200 TWh</td>
<td>1 140 GW</td>
</tr>
<tr>
<td>China</td>
<td>3 500 TWh</td>
<td>900 GW</td>
</tr>
<tr>
<td>Germany</td>
<td>600 TWh</td>
<td>140 GW</td>
</tr>
<tr>
<td>France</td>
<td>500 TWh</td>
<td>100 GW</td>
</tr>
</tbody>
</table>

- EVs energy needs

<table>
<thead>
<tr>
<th></th>
<th>Annual consumption</th>
<th>Peak power (theoretical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 VE</td>
<td>~ 2.5 - 3 MWh</td>
<td>3 - 43 kW</td>
</tr>
<tr>
<td>2 M VE</td>
<td>5-6 TWh</td>
<td>6 - 80 GW</td>
</tr>
</tbody>
</table>

- Energy for 2 M VE: about 1% of total in France, less than 1% for USA
- But peak power need may exceed grid capacity if charge is not managed efficiently
  - Simultaneous charge of 2 M EVs at 3 kW create an extra peak of 6 GW (6% for France)
But power not available all time

- Key issue is to manage peak consumption: most of charge must occur at low consumption periods.
- This peak is multi scale: Grid level, local, building / home.
EV can and should massively use renewables

- Most countries massively develop renewables (wind and solar notably)

<table>
<thead>
<tr>
<th></th>
<th>Production 2020 TWh</th>
<th>Power 2020 GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA (wind 2011)</td>
<td>250 TWh</td>
<td>&gt; 100 GW</td>
</tr>
<tr>
<td>China (wind)</td>
<td>350 TWh</td>
<td>150 GW</td>
</tr>
<tr>
<td>Germany (wind + PV)</td>
<td>125 + 40 TWh</td>
<td>50 + 35 GW</td>
</tr>
<tr>
<td>France (wind + PV)</td>
<td>59 + 6 TWh</td>
<td>25 + 5 GW</td>
</tr>
</tbody>
</table>

- A part of this production may be lost, because of low demand at some times of peak renewable production
- Consequence: need to profit of night overproduction to charge in priority
  - Case of France: 50 à 100 nights of high production over demand by 2020
  - Energy surplus: 3 to 8 TWh, compared with a need of 5-6 TWh for 2 M EV
- Local generation and autoconsumption will contribute to use of renewable
- Conclusion: optimize charge to maximize use of renewables
  - True zero CO2
  - Increase windmills ROI
  - Charge flexibility is key for optimization
How to do it? EV in Smart Grid

- Centralised production
- Residential
- Transmission
- Distribution
- Renewable > 1MW
- Decentralized and intermittent generation
- Distributed local generation <1MW
- Commercial, industrial & local authorities
- Local authorities
- Industries
- Buildings
- Homes
- Active end users

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Managed charging is the answer

- Managed charge will limit peak demand and open new services for very efficient energy management. It is a breakthrough innovation for the grid.
A roadmap for smart charge till 2020

● Phase 1: Avoid peak by charge modulation
  ● Immediately available with mode 3 or 4
  ● EV does not create additional stress on the Grid or installation

● Phase 2: Move charge to maximize renewable use
  ● Anticipate availability 12 hours ahead to plan for night charge

● Phase 3: active contribution with V2G (Véhicule to grid)
  ● Use battery as storage to power the home or send energy back to the grid and possibly keep maximum storage capacity available for next night
  ● These services will be monetized (high economic value over battery life time)
As a conclusion

- Grid can support EVs in the initial years.
- It is essential to start immediately with load management, to have the capability to avoid increase of peaks demand.
- EV Energy management must be part of home and building energy management, for highest effectiveness.
- As EV number grows, grid will get a « no new cost », flexible storage capacity for Demand / Response management, with grid services that are monetized.
- Storage, and later V2G, will help increase Renewable on the grid.
- Smart charge is an important part of future EVs business model.