Business Potential

How Will V2G Play a Role on Distribution System Level

Seyedmostafa Hashemi Toghroljerdi
Center for Electric Power and Energy
DTU Elektro
• What distribution system services (DSSs) can be expected?
• Can money be earned of it?
• How will the collaboration between services work?
• Which services can be expected from EVs?

Almost all services that are provided now by other ancillary service providers.
Services provided by EVs to power systems

- Smooth grid integration
- Intermittence reduction
- Energy curtailment reduction

- Frequency regulation
- Spinning reserves
- Congestion management
- Black start provision

- Congestion management
- Load shifting
- Peak shaving
- Valley filling
- Voltage drop

TSO

DSO

EV Services

RES
Services Provided by EVs to Distribution System Operators

- **Active power support**
  - Congestion management
  - Load shifting
  - Peak shaving
  - Voltage control

- **Reactive power support**
The Maturity in the EV-DSS Implementation

- Congestion management
- Loss minimization
- Load shifting
- Peak shaving/valley filling
- Voltage regulation by active power control
- Reactive power compensation
- Voltage regulation by reactive power control

Frequency controlled normal reserve (FNR) for TSOs

EV services

Time horizon [years]

0 - 2
Short-term

2 - 5
Medium-term

> 5
Long-term

Base case
Here and now

02-01-2017
02-11-2018

EVs + RES coordination

06-11-2017 - 02-03-2018
Short-term

02-03-2018 - 26-06-2018
Medium-term

26-06-2018 - 20-10-2018
Long-term

[58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [19], [69], [70], [71], [72], [73], [74], [81], [84], [96], [107], [111], [75], [76], [77], [78], [79], [80], [82], [83], [84], [85], [86], [87], [88], [89], [90], [91], [92], [93], [94], [95], [96], [97], [110], [9], [10], [78], [96], [97], [107], [109], [121], [122], [123], [124]
• Can money be earned of it?

Yes,

How much? it is very case sensitive.
Potential Business Solutions

• Postpone/eliminate DSO investments for the grid upgrade
• Minimize power losses in the network
• Extra earning through new market for reactive power provision in renewable-based power systems
Few Examples of Potential Earnings

Flexibility provision: the potential monthly revenue by providing flexibility to a DSO MV/LV transformer can be up to 700 DKK/month. (study done by Insero)

Reactive power provision: with efficient chargers, EVs are able to minimize the grid losses. (around 1000 DKK/month)

Reactive power provision: increase EV penetration from 100 to 150 EVs (30% penetration), 50% more EVs in the grid, without DSO new investment.
• How will the collaboration between services work?

A DSS can be provided individually, in combination with other DSSs, or in combination with the transmission system services.
### Assessment of the Stackability of DSS

<table>
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<th>Category</th>
<th>Active power</th>
<th>Reactive power</th>
<th>RES integration</th>
<th>FCR-N</th>
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H - High level, M - Medium level, L - Low level.
Stacked Services: Reactive Power and FCR-N Provision

Market services

Frequency Regulation

Reactive Power

TSO

DSO

Active and reactive power set points
Stacked Services: Reactive Power and FCR-N Provision

Market services
- Frequency regulation
- Reactive provision

New service requested by DSO request

Goal: voltage control

Measurement signal
Control signal

F - Frequency
U_1 - Voltage level
P_1 - Active power flow
Q_1 - Reactive power flow
• Stacking distribution and transmission system services can provide extra benefits to the both DSOs and customers.
• Improving the controllability and efficiency of charges can potentially help commercialization of distribution system services.

**More Information:**

- **Journal Paper:** Distribution System Services Provided by Electric Vehicles: Recent Status, Challenges, and Future Prospects, under review.
Thanks for your attention

Questions?

Email: shtog@elektro.dtu.dk