External workshop | 20.06.2018

Aggregation models

Mario Dzamarija (DTU)
Aggregator’s role

- visibility to MO (≥ 100 kW)
- filters necessary data to MO
- balance responsibility
- activation

MO – market operator
Aggregation approaches

Aggregation approaches used for bidding in electricity markets:

• Physical (bottom-up) approach
• Traces approach
• Data driven approach
• Hybrid approach

Each of them has certain advantages: accuracy, required data, disaggregation.
• aggregating household devices
• clusters of consumers
• aggregator max. revenue, sends price-volume signal to cluster
• cluster minimizes end-users’ electricity bill
• access day-ahead and intraday markets
• P. Koponen et al., ”Toolbox for Aggregator of Flexible Demand”

- single aggregation model
- physical approach
- agg. DERs @ trans. – distr. interface, concept of VPP
- D. Pudijanto et al., ”VPP and system integration of DERs”

VPP – virtual power plant

Characteristics:
(1) Output
(2) Reserve
(3) Response
(4) Cost characteristics
Aggregation models (1)

1. Stationary EES
2. EVs
3. Variable RES
4. Others: backup (fossil fuel) generators, other dispatchable generators (biogas, hydro)
5. CHPs
6. TCLs
7. Shiftable Loads
8. Curtailable Loads

DERs activation

| 1. Atomic Loads |
| 2. CHP Units |
| 3. TCLs |
| 4. EES Units |
| 5. Curtailable Gen./Loads |

aggregate

bidding

market

equilibrium price
### Aggregation models (2)

<table>
<thead>
<tr>
<th>Model</th>
<th>Aggregation approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHP Units</td>
<td>Physical</td>
</tr>
<tr>
<td>Curtailable generation and curtailable loads</td>
<td></td>
</tr>
<tr>
<td>EES Units</td>
<td></td>
</tr>
<tr>
<td>TCLs</td>
<td></td>
</tr>
<tr>
<td>Atomic Loads</td>
<td>Traces</td>
</tr>
</tbody>
</table>

#### Physical (bottom-up) approach

The aggregator knows all parameters of DERs and its real time status.

- The disaggregation is straightforward.
- Potentially hard to implement when many heterogeneous energy resources are included.

#### Traces approach

Characterized by load profiles and the cost associated to each profile, and not by the exact physical DERs’ characteristics.

- The disaggregation is straightforward.
CHP units bidding curve

- zero corresponds to baseline power
Curt. gen. bidding curve

- zero corresponds to baseline power
Market discomfort cost

(source: Miguel Marroquin)

- valorise the benefit of a **future** activation vs. current activation
Further info

M. Dzamarija et al., “D2.1: Aggregation models” (24/05/2018)

H. Marthinsen et al., “Aggregation model for curtailable generation and sheddable loads”

J. Camargo et al., “A network flow model for price-responsive control of deferrable load profiles”

smartnet-project.eu
Mario Dzamarija

Contact Information

Affiliation: DTU
Email: madz@dtu.dk
SmartNet-Project.eu

This presentation reflects only the author’s view and the Innovation and Networks Executive Agency (INEA) is not responsible for any use that may be made of the information it contains.