Network Evolution towards Meshgrid™

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Agenda

Vision for Network Evolution

Implications for Network / Early examples
Disruptive technologies are accelerating the Energy transformation

**Digitization** of data

- In buildings: Number of connected devices
  - 1.7bn in 2014
  - x3 in 2020

**Decentralization** of assets

- Corporate Investment
  - Over 55% of companies now have onsite generation

**Decarbonization** of grid

- Global investment in renewables:
  - $286 billion
- Global investment in fossil fuel:
  - $130 billion

Bloomberg New Energy Finance


#ESPerspectives
The Business Model of the Past

Except for deregulation, the business model of the power industry has remained largely unchanged for the past 100+ years.

Centralized Generation
Transmission & Distribution
End Use Consumption
The Business Model Today

Rise of renewables and other distributed energy resources are testing long-standing assumptions and creating new opportunities

“The current market model, pre-dating the renewables era, does not create the incentives needed to stimulate prosumers to share their flexibility.” - Engerati

Centralized Generation
Transmission & Distribution
End Use Consumption
Distributed Energy Resources
In the future, a countless number grid-enabled, responsive assets, aided by advancing tech, will be monetized and optimized in real-time.
Agenda

Vision for Network Evolution

Implications for Network / Early examples
- Grid Level: Venteeea
- End User Level: Kergrid
Implications of for Meshgrid™
The Central Role of Energy Storage

CHALLENGES

Power Shifting and Firming
Power Smoothing
Frequency Regulation

OPPORTUNITIES

Tariff Optimization
CO2 reduction
Demand Response
Active Energy Management
Renewable integration, Frequency support, Volt/Var Management, (load following, ramping support)…”

Storage
Response time < 4s
Duration 10 minutes
Venteea: An exceptional testing site in terms of storage services

Focus of the VENTEEA storage demonstration: aggregation of several services for several stakeholders (TSO, DSO and wind farm operator)
Possibility to switch between 2 connection points with a dedicated and non-dedicated feeder → a strong increase in the service offers that can be considered

<table>
<thead>
<tr>
<th>TSO</th>
<th>DSO</th>
<th>DG/RES</th>
<th>End-Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSO1: frequency control</td>
<td>DSO0: main substation UPS</td>
<td>DG1: ancillary services support</td>
<td>CUS1: peak shaving</td>
</tr>
<tr>
<td>TSO1i: frequency stability</td>
<td>DSO1: capacity support</td>
<td>DG2: fluctuation smoothing</td>
<td>CUS2: time-of-use optimization</td>
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<tr>
<td>TSO2: voltage control</td>
<td>DSO2: local voltage control</td>
<td>DG3: curtailed energy reduction</td>
<td>CUS3: unnoticed DR support</td>
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<tr>
<td>TSO3: loss minimization</td>
<td>DSO3: Contingency grid support</td>
<td>DG4: time shifting</td>
<td>CUS4: power quality (user)</td>
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<tr>
<td>TSO4: congestion relief</td>
<td>DSO4: intentional islanding</td>
<td>DG5: capacity firming</td>
<td>CUS5: end-user UPS</td>
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<tr>
<td>TSO5: angular stability</td>
<td>DSO5: reactive power support</td>
<td>DG6: micro grid balancing</td>
<td>CUS6: power quality (DSO)</td>
</tr>
<tr>
<td>Storage owner</td>
<td>DSO6: loss minimization</td>
<td>Not feasible in VENTEEA</td>
<td></td>
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<tr>
<td>ARB: energy arbitrage</td>
<td>DSO7: power quality (users)</td>
<td>Not considered in VENTEEA</td>
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<td></td>
<td>DSO8: power quality (TSO)</td>
<td>Dedicated feeder mainly</td>
<td></td>
</tr>
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<td></td>
<td>DSO9: TSO fees optimization</td>
<td>Feeder with customer mainly</td>
<td></td>
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</tbody>
</table>
End-User Level : KerGrid

- Building Management System (Automation Server)
- Energy Management & Control (Ressource Advisor)
- Energy Flexibility (Demand Side Operations)
  - Tariff Management
  - Peak Shaving - Demand Response
  - Black Out Management
  - CO2 reduction – Self consumption
Continue the Conversation…

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Energy & Sustainability Services

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BACK UP
Megatrends are driving a convergence we call Active Energy Management

- **PROCUREMENT**
  - £/$/€
  - Reduce costs

- **EFFICIENCY**
  - kWh
  - Reduce usage

- **SUSTAINABILITY**
  - CO$_2$
  - Reduce impact

- **Digitization**

- **Decarbonization**

- **Decentralization**