EU 2020: 20% of all electricity demand to be met by renewable generation.

EU 2030+: Largely Decarbonised Electricity System, with incorporating segments of transport and heat sectors in order to reduce CO2 emissions by 80% by 2050.

Context: EU Response to Climate Change Challenge 2050 Road Map:

- EU wide or member state centric approach?

Wind resource

Solar resource

North is Windy & South is Sunny

2050 Road Map:

- EU wide or member state centric approach?

EU wide or member state centric approach?

80% by 2050

Reduce CO2 emissions by 80% by 2050

Heat sectors in order to reduce CO2 emissions by 80% by 2050

Largely Decarbonised Electricity System, with incorporating segments of transport and heat sectors in order to reduce CO2 emissions by 80% by 2050.

Electricity demand to be met by renewable generation.

EU 2020: 20% of all...
Key concern with Business as Usual approach to decarbonising electricity system – massive degradation in asset utilisation approach to decarbonising electricity system.

<table>
<thead>
<tr>
<th>Utilisation</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;25%</td>
<td>2030+</td>
</tr>
<tr>
<td>35%</td>
<td>2020</td>
</tr>
<tr>
<td>55%</td>
<td>2010</td>
</tr>
</tbody>
</table>

- 2020: Wind generation will displace energy produced by conventional plant but its ability to displace capacity will be limited.
- 2030+: Electrification of segments of transport and heat: increase in peak demand disproportional higher than 10% load factor.
- Key concern with Business as Usual: massive degradation in asset utilisation.
System / market integration challenge

Yesterday

Conventional Generation
Transmission
MV Distribution
HV Distribution
Demand
Unresponsive

Markets
Technology
Aging assets
Climate change
Energy Security

Energy

Tomorrow

Low carbon Generation
Transmission
HV Distribution
MV Distribution
LV Distribution

Responsive demand

DG
100 MW
DG
10 MW
DG
<1 MW

Large Wind
100 MW

DG

Oil and Gas Market
Heat market
Transport Sector
CARBON Market

Elec. Cars
Smart Home
Storage
HVAC
HP
Integrating distributed energy resources: From the Grid to Consumers
<table>
<thead>
<tr>
<th>Generation Mix Flexibility</th>
<th>CO₂ Savings KG/SD/year</th>
<th>Cost Savings £/SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>100-250</td>
<td>&gt;50</td>
</tr>
<tr>
<td>High</td>
<td>75-15</td>
<td>3-15</td>
</tr>
</tbody>
</table>

Wind... Demand response in action: demand to follow.

- Water Heater
- Air Conditioner
- Refrigerator
- Washing Machine & Tumble Drier
- Smart Dishwasher
1. DG and DR provide limited or no support to system management.

2. TSO/DNO try to mitigate impact by forecasting DG and managing DG connections growth.

3. As DG connections grow, security of the system is compromised & operating costs increase.

4. Value of energy < Value of flexibility.

5. Inefficiencies between energy investments, DG displacing energy not capacity.

6. Inefficiencies in infrastructure investments.

7. Disconnection between wholesale market (real time) and retail market (tariff based).

Present market structure and limitations:

- Power flow
- Market-based contracts, metering & settlement information
- DG and DR provide limited or no support to system management.
- TSO/DNO try to mitigate impact by forecasting DG and managing DG connections growth.
- Value of energy < Value of flexibility.
- Inefficiencies between energy investments, DG displacing energy not capacity.
- Inefficiencies in infrastructure investments.
- Disconnection between wholesale market (real time) and retail market (tariff based).
Distributed Energy Marketplace

The marketplace is the framework to realise the cost effective & sustainable future system...

Linking all market participants in a single real-time marketplace

System operator can access all resources suitable for system management activities

Identifying the value of end user response and location (unlock demand)

Developing role of suppliers/aggregators as a gateway to market for small end users

Market coupling of energy and related markets

The market place is the sustainable future...
Discussion

• Smart grid based integration of DER likely to bring significant savings
  • Understanding the flexibility?
  • Business case? Split benefits?
• Strategic or incremental investment in distribution network infrastructure and intelligence? Uncertainty?
• Coordinated or Market based approach?