Demand response in the US and Europe

REKK Energy Futures

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Major points today

• What is demand response (DR)?
• Why should we care about DR?
• How DR is doing in the US? And in Europe?
• How to get DR?
1 What is demand response?
Peak Clipping

Conservation

Load Building

Valley Filling

Flexible Load Shape

Load Shifting

SOURCE: Tata Power
DR has a time dimension

Price-based Demand Response

- Time-of-use prices
- Day ahead hourly pricing
- Real time pricing/Critical Peak Pricing

Load commitment timescales

- Year(s)/Months ahead
- Day ahead (D-1)
- Day of dispatch/use

Real time

Incentive-based Demand Response

- Capacity markets
- Energy market 'demand bidding'
- Reserves/Balancing markets
- Direct load control

Anyone can provide DR

PERCENT OF NOMINATED CAPACITY (MW) - PJM 2015/2016
Households
Aggregators are key actors

The aggregate response of each resource in the network is compiled to form a unified regulation response.

Source: Enbala Power Networks, 2011
2 Why should we care about DR?

DR provides needed flexibility, cost saving and improved reliability
DR is a source of system flexibility

- Grids
- ICs
- Market geography
- Market operations
- Generators
- Demand response
- Storage
- Energy & services markets
...that is cheap

Benefit-cost ratios of different flexibility options

Note: DSI = demand-side integration; IC = interconnection.

... reduces the need for backup and balancing generation

<table>
<thead>
<tr>
<th>Pathways</th>
<th>DR</th>
<th>Transmission &amp; generation capacity requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Additional transmission¹</td>
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<tr>
<td>Baseline¹</td>
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<td>80% RES 10% CCS 10% nuclear</td>
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<td>60% RES 20% CCS 20% nuclear</td>
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<td>100</td>
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<td>40% RES 30% CCS 30% nuclear</td>
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<td>20%</td>
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1 Requirements by 2050 additional to existing lines
2 In percentage of total renewable energy production

Reduction due to 20% responsive demand, in GW of investment needed

Source: Roadmap 2050: A practical guide to a prosperous, low-carbon Europe (ECF, 2010)
...and improves reliability.

Source: ERCOT, 2011 EILS Deployment, QMWG, 2012
Cost benefits have been substantial

**New England auction** (2007):
- DR won two-thirds of bids for new capacity
- Lowered clearing price to the floor

**PJM auction** (2012/2013)
- DR bids lowered clearing price by 90%
- Savings of over $1 billion

**1st UK auction** (2014)
- Limited DR access resulting in almost no DR cleared
Targeted acquisition allows DR to avoid network upgrades

Instead of a new substation...

Peak reduction by 149 MW

Competitive bidding

EE, PV, CHP, battery storage, fuel cells

$1 bn saving at a cost of $200 m
3 How is DR doing in the US? And in Europe?
“Level Playing Field” created for DR

FERC Directives (2007-2011):
• Demand treated equally to supply
• Aggregators allowed
• Same payment for same service
• Pay reflecting operational capabilities (speed, precision)
DR available to system operators (2017)

Source: FERC, Demand Response and Advanced Metering Staff Report (2018)
Sources of DR revenues in PJM

Source: PJM Demand Response Strategy (June 2017)
There is potential in Europe

Share of theoretical potential for DR at system peak load

<table>
<thead>
<tr>
<th>Country</th>
<th>Total DR (GW)</th>
<th>Peak (GW)</th>
<th>Total DR / Peak</th>
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<tbody>
<tr>
<td>France</td>
<td>11.6</td>
<td>102</td>
<td>11%</td>
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<tr>
<td>Poland</td>
<td>3.6</td>
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<td>UK</td>
<td>8.0</td>
<td>56</td>
<td>14%</td>
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Where is DR commercially active in Europe?

Source: Smart Energy Demand Coalition (SEDC), 2017
# DR aggregators

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<th>Other EU</th>
<th>US CAISO</th>
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- ✓ Large player in the market
- ✗ Market presence established
- ○ Not active

*Source: IEA WEO, 2018*
4 How to drive DR?

Barriers and enables
Three main options

- Better market design
- Improved retail pricing
- Targeted resource acquisition
Better market design

- Assess resource at the aggregated level
- Transparent baseline methodology
- Decrease minimum bid size
- Shorten call duration
- Differentiate per availability
- Allow asymmetric bidding
Better market design

• Empower aggregators!
  • Energy and flexibility are separate products
  • Independence of aggregators from BRP/supplier
  • Rules governing their relationship:
    • Compensation
    • Data exchange
The current market design barriers

- Right of DSO to refuse DR participation in the pre-qualification process (BE)
- Some ancillary services require symmetrical bidding (DK)
- Generation and demand side resources cannot be pooled (DK)
- 12-60 hours call duration for secondary reserves (DE)
- Lack of standardised role for third-party aggregators (DE)
- Individual pre-qualification (DE, IE)
- Still too large minimum bid: 10MW (DK)
- Demand side resources treated unequally in the capacity market (UK)
- Bi-laterally agreed baseline methodology (Italy)

Source: Smart Energy Demand Coalition (SEDC), 2017 and Bertolli et al: Demand Response Status of EM Member States, 2016
Consumers respond to prices

EDF Tempo Tariff

- 400,000 customers
- 45% load reduction on “red” days, 10% “white” days
- Average saving on bill: 10%

Source: RAP, *Cleaner, Smarter, Cheaper: Network tariff design for a smart future*, 2018
Rate design should make the choices the customer makes to optimize their own bill consistent with the choices they would make to minimize system costs.
Energy charges are only half the story

Average European household & small industrial bill breakdown (2015)

Source: RAP, *Cleaner, Smarter, Cheaper: Network tariff design for a smart future*, 2018
Fixed network charge is popular

Data as of 2013

% of fixed fee in network charge

Source: RAP, Cleaner, Smarter, Cheaper: Network tariff design for a smart future, 2018
Conclusions
DR 2.0

- From peak shaving to regulation response
- From averting emergency to daily flexibility
- From CM only to various markets
- From large consumers down to households
- From “sneaker” to “automated”
Key messages

1. Demand response is a highly effective way to improve system flexibility, reduce costs, and improve reliability

2. Use all three ways to tap DR
   1. Better market design
   2. Smarter retail pricing
   3. Targeted acquisition
RAP Resources

- Demand Response as a Power System Resource
- Time-varying and dynamic rate design
- Cleaner, Smarter, Cheaper: Network tariff design for a smart future
- Unleashing Demand Response with Effective Supplier Compensation
- The Market Design Initiative: Enabling Demand-Side Markets
- Effective Mechanisms to Increase the Use of Demand-Side Resources
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

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US markets

Source: FERC
Demand response in PJM capacity market

Performance standards, M&V

Utility programs
Capacity market

Annual DR
PRD

Summer PR
Extended summer

Limited ALM
Limited DR
Limited ILR
Base DR
Annual CP

Source: PJM Demand Response Operations Markets Activity Report (Nov 2018)
DR in PJM: a major system resource

Source: Brattle Group, 2nd Assessment of PJM Capacity Market (2012)
Risk-rewards trade-off