Demand response: a powerful flexibility resource

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Major points today

- What is demand response (DR)?
- Why should we care about DR?
- How is DR doing in the US? And in Europe?
- How to get DR?
1 What is demand response?
DR has a time dimension

Types of programmes: another classification

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
Why should we care about DR?

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

... and reliable

Demand response (in aggregate) to ISO-NE orders to reduce load:

- 653 out of 669 MW (98%) responded, June 2010
- 855 out of 939 MW (91%) responded, July 2011

Response of generators to ISO-NE dispatch orders in Sept 2010 was far from reliable

- 393 out of 986 MW (40%) of 90 online units
- 673 out of 936 MW (72%) of the 56 start-ups
... it lowers wholesale power costs to ALL consumers
... It reduces the need for backup and balancing generation

<table>
<thead>
<tr>
<th>Pathways</th>
<th>DR</th>
<th>Additional transmission</th>
<th>Back-up and balancing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline¹</td>
<td>0%</td>
<td>2</td>
<td>120</td>
</tr>
<tr>
<td>80% RES 10% CCS 10% nuclear</td>
<td>0%</td>
<td>165</td>
<td>255</td>
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<td>60% RES 20% CCS 20% nuclear</td>
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<td>40% RES 30% CCS 30% nuclear</td>
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<td>20%</td>
<td>50</td>
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Reduction due to 20% responsive demand, in GW of investment needed

Source: Roadmap 2050: A practical guide to a prosperous, low-carbon Europe (European Climate Foundation, 2010)
… it improves reliability

Baseline Load

Actual Load

Load Reduction

Obligation

Source: ERCOT, 2011 Emergency interruptable load service deployment, Quality Scheduling Entity Manager Working Group, 2012
... and is not necessarily high tech
DR 1.0 versus DR 2.0

Source: Brattle Group, The Hidden Battery, 2016
Resulting in very different net benefits

Cost benefits have been substantial

- 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
How is DR doing in the US? And in Europe?
“Level Playing Field” created for DR

FERC Directives (2007-2011):

- Demand treated as equal to supply
- Aggregators allowed
- Same payment for same service
- Pay reflecting operational capabilities (speed, precision)
FERC: up to 20% reduction in peak demand

DR available to system operators (2017)

Source: FERC, Demand Response and Advanced Metering Staff Report, 2018
US markets

Source: FERC at https://www.ferc.gov/market-oversight/mkt-electric/overview.asp
Sources of DR revenues in PJM

Source: PJM Demand Response Strategy, June 2017
DR in PJM: a major system resource

Source: Brattle Group, Second Assessment of PJM Capacity Market, 2012
There is potential in Europe

Share of theoretical potential for DR at system peak load

<table>
<thead>
<tr>
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<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>
<td>25</td>
<td>14%</td>
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<tr>
<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>France</th>
<th>Germany</th>
<th>UK</th>
<th>Other EU</th>
<th>US CAISO</th>
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- Large player in the market
- Market presence established
- Not active

Source: Smart Energy Demand Coalition (SEDC), 2017

Source: IEA WEO, 2018
Poland after August 2015

Source: Forum Energii based on PSE
DR products

Elastic product: TSO decides about delivery period

Interruptible product: the participant decides about the concrete hours within the delivery period

Fixed product: the participant decides about delivery period

Source: Forum Energii based on PSE
## Tender results

<table>
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<tr>
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<th>2017/18</th>
<th>2018/19</th>
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<tbody>
<tr>
<td>Deployment (EUR/MWh)</td>
<td>3.2</td>
<td>3.2</td>
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<tr>
<td>Capacity (EUR/MW –h)</td>
<td>20.9</td>
<td>21.6</td>
</tr>
<tr>
<td>Capacity (EUR/MW –h)</td>
<td>30.9</td>
<td>32</td>
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4 How to drive DR?

Barriers and enablers
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 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 EU Member States, 2016
Consumers respond to prices

Source: RAP, Faruqui et al. *Time-Varying and Dynamic Rate Design, 2012*
Risk-rewards trade-off

Source: RAP, Faruqui et al. *Time-Varying and Dynamic Rate Design*, 2012
Reduce 5 to 8 p.m.

Time-of-Day Rates are here

Manage your bill by reducing electricity use between 5 p.m. - 8 p.m., Monday - Friday

Source: Sacramento Municipal Utility District
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 charges are popular

% of fixed fee in network charge

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

Data as of 2013
5 Conclusions
DR 2.0: flexibility 24/7

- 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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