Market based demand Response

DRR-seminar
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Market based DR - Main aspects

- Manual or automatic reduction of consumption on hourly basis in high price periods in the day ahead market or for balancing purposes

- Duration: One to a few hours

- Expected response should be reflected in the bids in the market (Elspot, Balancing Market (BM)) to avoid extraordinary costs for the market players.
Market based Demand Response

Market Phases
- Price hedging Phase
- Spot Phase

Control Phases
- Pre operational Phase
- Operational Phase

Option Market
- Price-dependent load reduction

Remote controlled load reduction

Elspot trade
Bilateral trade

Production scheduling
BM bidding

Price
Quantity

MW

0 2 4 6 8 10 12
0 2 4 6 8 10 12

SINTEF Energy Research
Vision

To improve Demand Side price elasticity and to create “Regulation objects” from consumption as alternatives to investments in new production

Requirements:
- Price flexibility on hourly basis
- Controllability
- Hourly metering
- Remote and/or local load control
- Improvement in data management procedures
- Improvement in End User markets

Two Way Communication (TWC)

MVDB/CIS

Market Design
Status hourly metering Norway

Presently hourly metering is available from all consumers with yearly consumption > 100 000 kWh

80 000 customers ~60-70 % of the load

Residential customers >8000 kWh/year ??
Alternative time resolution metering, collection and settlement/billing

<table>
<thead>
<tr>
<th>Time resolution Meter value handling</th>
<th>Hour</th>
<th>4 times/day</th>
<th>Day</th>
<th>Week</th>
<th>Month</th>
<th>Quarter</th>
<th>Year</th>
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<tbody>
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<td>X</td>
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<tr>
<td>Collection (Self reading or AMR)</td>
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<td>Settlement/billing</td>
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Large scale test project

Two way communication to 10 894 residential customers

AMR- Hourly metering

RLC- available for 50 % of the customers

6 technology vendors involved
Main challenges Technology

- Data quality (referred to market settlement requirements)
- Standardization of interfaces

![Bar chart showing availability metered values over weeks with highlighted test period and quality test mark.]
Customer incentives for reducing consumption

- Network tariffs
  - ToU Energy Tariff (= Fixed part + Network losses + Variable Energy part)
  - Energy part only activated in peak hours

- Supplier products
  - Spot price on hourly basis
  - Spot price on hourly basis combined with agreements for remote load control

- Criteria for load control
  - Spot price criterion
  - Reserves criterion
Test result
RLC water heaters at different hours

Buskerud, peak power response, remote load control, different hours

<table>
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<th>Time</th>
<th>18%</th>
<th>30%</th>
<th>15%</th>
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Watt

Nordic peak hour
Customer response to price signals

Buskerud household, response ToU tariff and spot price based power product

Hours [h]

P.U.

Jan+Feb
Reference
Mar+Apr
Response on spot price
Price signals and contracted RLC

Power supplier

Network owner

Household

Commercial

Spot price on Hourly basis and RLC

ToU “Energy” tariff

ToU “Power” tariff

Contract RLC

Metering/Control

Power supplier

Network owner

Household

Commercial
Flexible bidding Elspot

Elspot bids

Price [øre/kWh]

Volume [kWh]

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Value of demand side price elasticity

California: 300 MW (out of 50 000 MW) load reduction in peak load enough to avoid "rolling blackouts" (Sally Hunt 2002)
Registered reduction in consumption as response to price signals was 0.2 – 1.0 kWh/h.

0.5 kWh/h response from remote load control of electrical water heaters.

50% participation of Norwegian household customers:

⇒ 600 MW potential load reduction in peak hour.
Automatic load reduction ("Spot price criterion")
Evaluation (preliminary)

- Spot price is the cheapest product in the long run. (Financial contract as backup recommendable.)

- Automatic load reduction when price is high valuable for those who does not want to watch the spot price.

- Load reduction in peak hours gives significant system benefit

- Drawback: Only payback to the customer when price difference during daytime is high. So far only a limited number of hours/year

Interday ToU network tariff necessary to provide sufficient economical incentives?
Market based demand response (DRR Norway demonstrators 05-06)

- Demo I: Automatic load reduction when spot price exceeds predefined level

- Demo II: Remote reduction of aggregated load when called upon as "regulation object" in the balancing market

Main aspects:

- Challenge: Development of cost effective concepts for remote load control, market participation and accounting of multiple loads
- Development based on resent research and test activities
- Cooperation between two technology vendors (Elink and Powel)