Capacity Subscription

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Capacity Subscription

- Before actual consumption, consumers pay for a fuse that limits demand to fuse size in kW
- Fuses are centrally controlled and become Load Limiting Devices
- LLDs are activated only when there is a capacity shortage
Characteristics

- Every consumer must have a Load Limiting Device
- Consumers must assess
  - Own demand for capacity during system-peak
  - Own preference for unlimited supply
- Consumers purchase capacity based on
  - market price for capacity
  - own preferences
- Normally, the fuse is inactive
- Under capacity shortage conditions, the LLDs are activated by the System Operator, and demand is limited
LLD Realisation

Smart Load Controller

fuse: x kW

from main fuse

reset button

high priority demand < x kW

boiler

air conditioning 1

air conditioning 2

low priority demand
Capacity Market

- Consumers demand capacity, based on preference for unlimited supply
- Producers can offer their expected available capacity
- Demand for and supply of capacity form the basis for the creation of a Capacity Market
- Crucial difference with existing Capacity Markets (PJM etc):

  Demand for capacity is based on consumers’ preferences for unlimited supply and the price of capacity instead of experts’ estimates based on the assumed need for reliability
Surplus situation

- Consumers subscribe to their expected maximum demand
- Fuse price is zero or very low
- Fuses never activated
- Market not affected
- No investment in peaking capacity
Deficit situation

- If consumers prefer the present (high) level of security, the capacity price will increase
- This leads to investment in new capacity
- If consumers accept to occasionally limit demand, prices will remain low …
- … but there is a legitimate and acceptable way to limit demand to available supply
Market Structure

- Capacity Subscription can in principle be implemented in various market structures
- The Capacity Market can have annual, monthly and maybe continuous auctions
- System Operator must know the sum of the fuse sizes
- System Operator keeps track of demand and decides upon fuse activation
  - before clearing of the 24-hour ahead market
    - market participants will then know this when bidding
  - or in real time
    - e.g. in the case of unexpected events
- Real time metering not necessary!
<table>
<thead>
<tr>
<th>Stage/cycle</th>
<th>System operator</th>
<th>Market operator</th>
<th>Producer</th>
<th>Retailer and Trader</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly</td>
<td>Calculation of tariffs</td>
<td>ROM bids</td>
<td>Price forecast</td>
<td>Operating strategy</td>
<td>Price forecast</td>
</tr>
<tr>
<td>Monthly/weekly</td>
<td>ROM-options</td>
<td>Capacity contracts</td>
<td>Operating strategy</td>
<td>Operating strategy</td>
<td>Selling capacity</td>
</tr>
<tr>
<td>Load forecast</td>
<td>Price forecast</td>
<td>Trading capacity</td>
<td></td>
<td>Selling energy</td>
<td>Buying capacity</td>
</tr>
<tr>
<td>Price area definition</td>
<td>Risk analysis</td>
<td>Risk analysis</td>
<td></td>
<td>Risk management</td>
<td>Buying energy</td>
</tr>
<tr>
<td>Load forecast LLD activation warning</td>
<td>Risk management</td>
<td>Risk management</td>
<td></td>
<td>Risk management</td>
<td>Preliminary schedules</td>
</tr>
<tr>
<td>Spot stage</td>
<td>CFD</td>
<td>Demand forecast</td>
<td></td>
<td>Spot market price calculation</td>
<td>Elbas bids</td>
</tr>
<tr>
<td>Daily</td>
<td>Spot market price calculation</td>
<td>Elbas bids</td>
<td>Elbas bids</td>
<td>Elbas bids</td>
<td>Elbas bids</td>
</tr>
<tr>
<td>Pre-operational stage</td>
<td>BM, merit order price list</td>
<td>Balancing bids</td>
<td>Final schedules</td>
<td>Balancing bids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overview on schedules and reserves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational stage</td>
<td>Deviation from plan</td>
<td>Clearing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BM activation</td>
<td>LLD activation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post operational stage</td>
<td>Accounting</td>
<td>Invoicing</td>
<td>Invoicing and paying</td>
<td>Invoicing and paying</td>
<td>Paying</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Capacity Market

Activation Evaluation

LLD Activation

Settlement
Challenges

 Complexity / customer accept
  - but: in Norway a two-price capacity tariff was dominating until the mid-eighties
  - Education

 How to estimate one’s need for capacity
  - Internet-based demand calculator

 What happens when subscribed limit is exceeded during fuse activation
  - manual reduction – doubtful
  - advanced electronic load control
  - alternative: two-price system with very high violation penalty (1-2 Euro/kWh?)

 Infrastructure cost
Demand Calculator - Result

![Graph showing the relationship between subscribed capacity (kW) and the number of LLD activations for different winter conditions.](image-url)

- **Mild winter**
- **Normal winter**
- **Cold winter**

The graph indicates that as the subscribed capacity increases, the number of LLD activations decreases significantly, especially under cold winter conditions.
Demand Calculator – Cost Estimate

![Graph showing annual cost (NOK) against subscribed capacity (kW) for different winter conditions: mild, normal, and cold winter. The graph includes lines for each condition, with different markers and line styles to distinguish between them. The x-axis represents subscribed capacity (kW), ranging from 0 to 8, and the y-axis represents annual cost (NOK), ranging from 6000 to 12000.]
Advantages

- Consumers choose their preferred reliability level
- System reliability ensured
- Reliability (adequacy) becomes private (as opposed to public) good
- Enables creation of capacity market
- Motivates technological change (dynamic efficiency)
  - Smart demand-side solutions vs generation capacity
- Hourly metering not necessary
Disadvantages

- Initially complicated for consumers
  - → "default" solution?

- Most customers must be willing to limit demand occasionally
  - If no customers at all are willing ever to have demand limited, the total need for capacity is the sum of their individual maximum demand

- Requires new infrastructure
  - Communication
  - Control

- Considerable initial investment
Further research

- Comparison with other "dynamic" solutions, e.g.
  - Spot pricing
  - Reliability contracts
  - PJM, new version (flexible demand for capacity)
- Try-outs
  - Technology
  - Consumer communication and acceptance
- Market simulation
Conclusions

- Capacity Subscription basis for two-sided Capacity Market
- Investment in supply based on capacity prices
- Generation capacity will be based on real consumer preferences instead of hypothetical questions
- (A part of) security of supply becomes a private instead of a public good
- Motivates technological innovation (dynamic efficiency)
- Initially complicated and expensive
- May be a realistic alternative to full spot pricing