Role of the smart technology in the energy efficiency improvement

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Agenda

- General rules of the customer behaviour changing
- Areas of the possible improvement of energy efficiency
  - on the customer side
  - on the operator side
  - on the supplier side
- Available tools/signals for behaviour changing of the market participants
- Smart grid as a solution
General rules of the customer behaviour changing

- Objects
- Competence to change the behaviour
- Signal for the change available just in time
- Motivation for the change
- Simplicity of the settlement as the effect of the change
General rules of the customer behaviour changing

Objects:

- Total energy consumption:
  - Heating:
    - Building efficiency
    - Behavioural scheme (open windows, $25^\circ\text{C}$ vs $18^\circ\text{C}$ in-home temperature, etc.)
  - Transport
    - The level of needs
    - Type of vehicle
  - Electric equipment
    - In-home equipment saturation
    - The use of the equipment
General rules of the customer behaviour changing

- Object – electricity:
  - Energy consumption level
  - Load curve shape (Power consumption shape)
General rules of the customer behaviour changing

- Competence to change the object
  - customer independent
  - customer dependent:
    - time related
    - cost related

<table>
<thead>
<tr>
<th>Kind of solutions matrix</th>
<th>Cost</th>
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<tbody>
<tr>
<td></td>
<td>low</td>
</tr>
<tr>
<td>Time to effect</td>
<td>short</td>
</tr>
<tr>
<td>long</td>
<td></td>
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- high efficient
- medium efficient
- low efficient
General rules of the customer behaviour changing

Motivation to the change:
- economic (costs or income perspective)
- non-economic (ambition, comparison to the neighbours, welfare vision etc.)
- perspectives of new useful services
General rules of the customer behaviour changing

Signal for the change available just in time

- Signal 1 (needs)
- Comparison, analysis and command
- Observation of previous value
- Observation of effect
- Changed value
- Original value
- Signal 2 (measure)
- Signal 3 (measure)
- Signal 4 (command)

**Original value**

**Changed value**

**Comparison, analysis and command**

**Observation of previous value**

**Observation of effect**

**Signal 1 (needs)**

**Signal 2 (measure)**

**Signal 3 (measure)**

**Signal 4 (command)**
General rules of the customer behaviour changing

- Simplicity of the settlement as the effect of the change
  - direct effects (e.g.: costs reduction)
    - short time loop of answer
    - long time loop of answer
  - indirect effects (e.g.: satisfaction)
    - soft correlation
Areas of the possible improvement of energy efficiency

- On the customer side:
  - Energy consumption reduction by soft change of behaviour
  - Power consumption reduction by soft change of behaviour
  - Energy and/or power consumption reduction by the replacement of equipment (hard change)
Areas of the possible improvement of energy efficiency

- Energy consumption reduction by soft change of behaviour
  
  e.g.: iron use style:
  - to prepare the huge part of laundry without breaks or
  - to switch on the iron for each shirt separately, or to make many breaks during the work
Areas of the possible improvement of energy efficiency

- Power consumption reduction by soft change of behaviour

Typical shape of load curve of household group:

![Graph showing typical load curve of household group with a peak during the day and a low during the night.](image-url)
Areas of the possible improvement of energy efficiency

- Power consumption reduction by soft change of behaviour

Individual shape of household consumer:

![Stochastic 2 hour load profile](image)
Areas of the possible improvement of energy efficiency

Power consumption reduction by soft change of behaviour

Individual shape of household consumer:

- Refrigerator: 2 kW
- Dishwasher: 2 kW
- Washing machine: 2 kW
- Water boiler: 2 kW
- Iron: 2 kW
- TV: 0.3 kW
- Computer: 0.4 kW
- Lighting full: 1.5 kW
Areas of the possible improvement of energy efficiency

Power consumption reduction by soft change of behaviour

Individual shape of household consumer:

- Refrigerator: 2 kW
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- Lightning reduced: 1.5 kW

Tided 2 hour load profile with reduction of consumption

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
Areas of the possible improvement of energy efficiency

- Power consumption reduction by soft change of behaviour

Individual shape of household consumer:

![Graph showing peak load shift and reduction by soft change of behaviour]
Areas of the possible improvement of energy efficiency

On the operator side
- current technical losses optimization
- maintenance costs optimization
- investment optimization
Areas of the possible improvement of energy efficiency

- On the supplier side
  - mainly, the supplier is motivated to maximise of the sale
  - but
  - in certain conditions he has interest to reduce demand level
Available tools/signals for behaviour changing of the market participants

For the customer:
- energy price (just) time related
- energy price whole market energy price related
- energy price current system situation related
- power price customer localisation related
- educational campaign
- neighbour relationship („competition”)
- income perspective (e.g. prosumer’s)
- non-energy added value
Available tools/signals for behaviour changing of the market actors

For the DSO:

- Proper current observation of customer behaviour
- Proper current observation of network state
- Proper current observation of distributed generation state
Available tools/signals for behaviour changing of the market actors

For the supplier:

- Wholesale market price dynamics
- Current demand dynamics
- Price flexibility of demand of certain groups of customers
- Current network state (risk of damages) and congestions management range
Smart grid as a solution

- What is the „Smart Grid” (from point of view of this approach)?
- Who and why is a „target” of SG solutions?
- SG as a tool for direct observation of customer behaviour
- SG as a communication platform
- SG as a tool for distributed generation development
- SG as a tool for self-observation of customer
What is the „Smart Grid” (from point of view of this approach)?

- the source of information for all market participants
- the communication platform for all signals (information and commands)
- the friendly platform for distributed generation (additional income source)
- the friendly platform for non-energy added value for customers
Smart grid as a solution

Who and why is a „target” of SG solutions?

Who:

- Distributed and disseminated (scattered) customers (less them 40kW of power demand, and even less them 1 MWh/year of energy consumption)
- The rest of customers („by the way”)
- Network operators
**Smart grid as a solution**

Who and why is a „target“ of SG solutions?

**Why:**

- This segment of the market (25% of total consumption) is response on the highest level of load curve
  - the load shift of this one kind of demand is the most important
  - the load shift of this one kind of demand is very difficult because of logistical reasons, but it could be more efficient than the industrial demand shift (from certain customer point of view)

- Distributed investment on the RES is more effective than centralised
  - because of local heat market, important for all CHP
  - because of limited scale of renewable primary energy resources
Smart grid as a solution

- SG as a tool for direct observation of customer behaviour

- Measurement device:
  - with current position register
  - with broader measurements range
  - with „semi - on line” transfer of information to the market partners (one time per day instead of one time per few month to the market partners, one time per every 15 min to the customer)

- It means current observation of customer reactions, practically
Smart grid as a solution

- SG as a communication platform

- The levels of information exchange:
  - supplier
  - DSO (TSO)
  - End user’s (customer’s) Measurement device
  - HAN devices
  - another (non electricity) functionalities

- Efficient links between all a.m. levels
Smart grid as a solution

- SG as a tool for distributed generation development
- Direct communication tool to each end-user
- Indication and measurement of reverse flow of energy (if occurs) from each of end-user
- No additional technical barriers for agreement of connection conditions for new small energy source located inside customer property
Smart grid as a solution

- SG as a tool for self-observation of customer

- Closed loop of information between certain behaviour and its effect

- Possibility of current observations of effects of certain modes of using of certain HAN devices – the open way to learn more effective behaviour

- Possibility of limited automation of reactions on the market signals – free of permanent meaning solutions
Conclusions

- It is true, that is possible to improve energy efficiency without SG solutions, but:

- SG implementation is a crucial condition for EE improvement much easier and much effective because:
  - SG infrastructure could be a source of all important signals,
  - SG infrastructure could be an efficient platform for all important information exchange.
Thank You for Your Attention!

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