

Flexible demand as a counterpart to variable output renewables

*Based on work in task 17 within the IEA/DSM program
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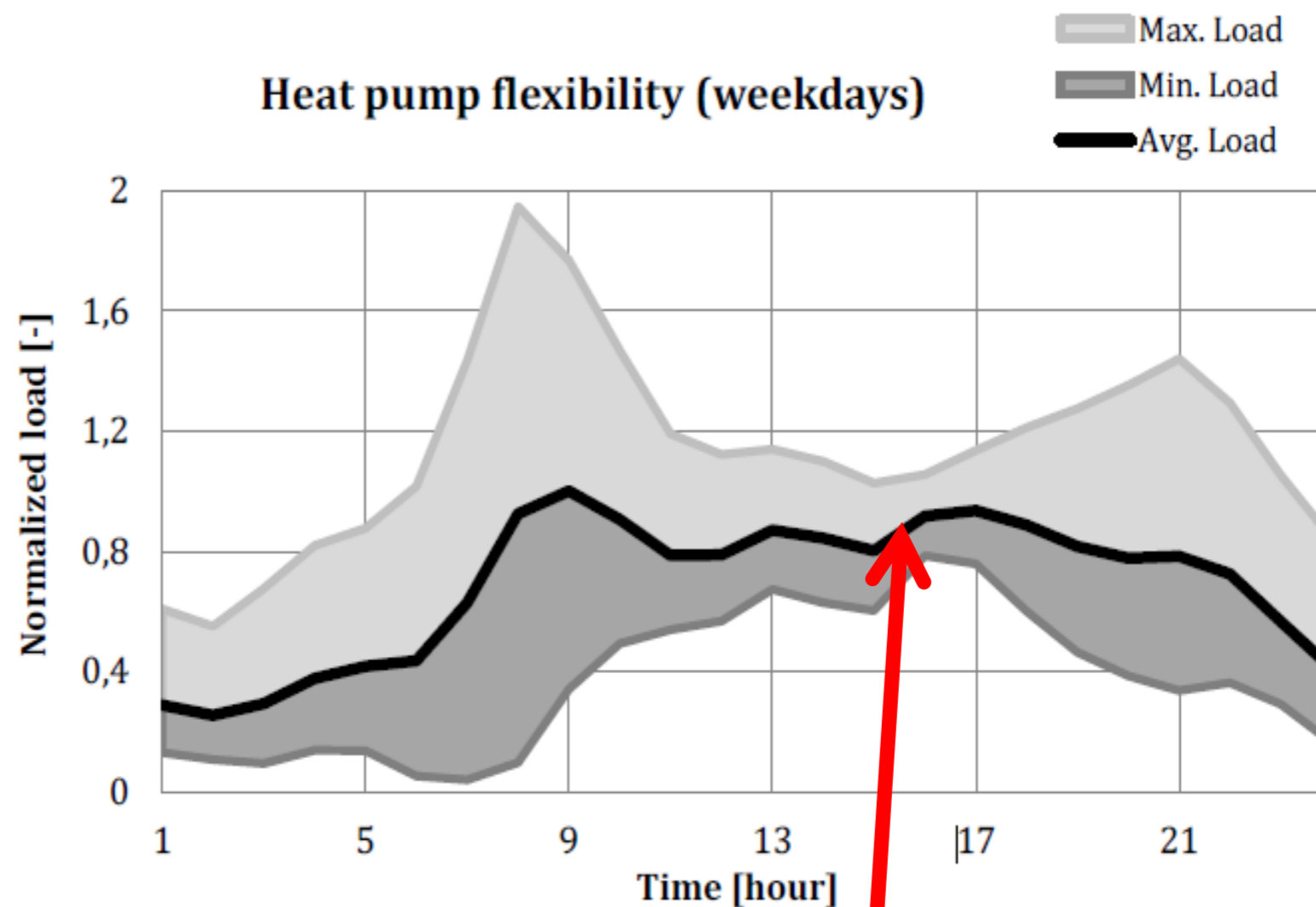
Brussels 13-10-2016 The Role of DSM to Provide Flexibility to provide flexibility in electricity systems

What comes out of IEA-DSM task 17

- What are the suppliers and consumers of flexibility
 - How should they be deployed
 - When should they be deployed
- Synergy between flexibility and energy efficiency
- Transition to 100 % renewables
- How is a new market design able to uncover flexibility at:
 - Right time
 - Right place
 - Right benefits

What are the sources of end-user flexibility

- Thermostatically controlled loads
 - Heat pumps
 - Micro-CHP

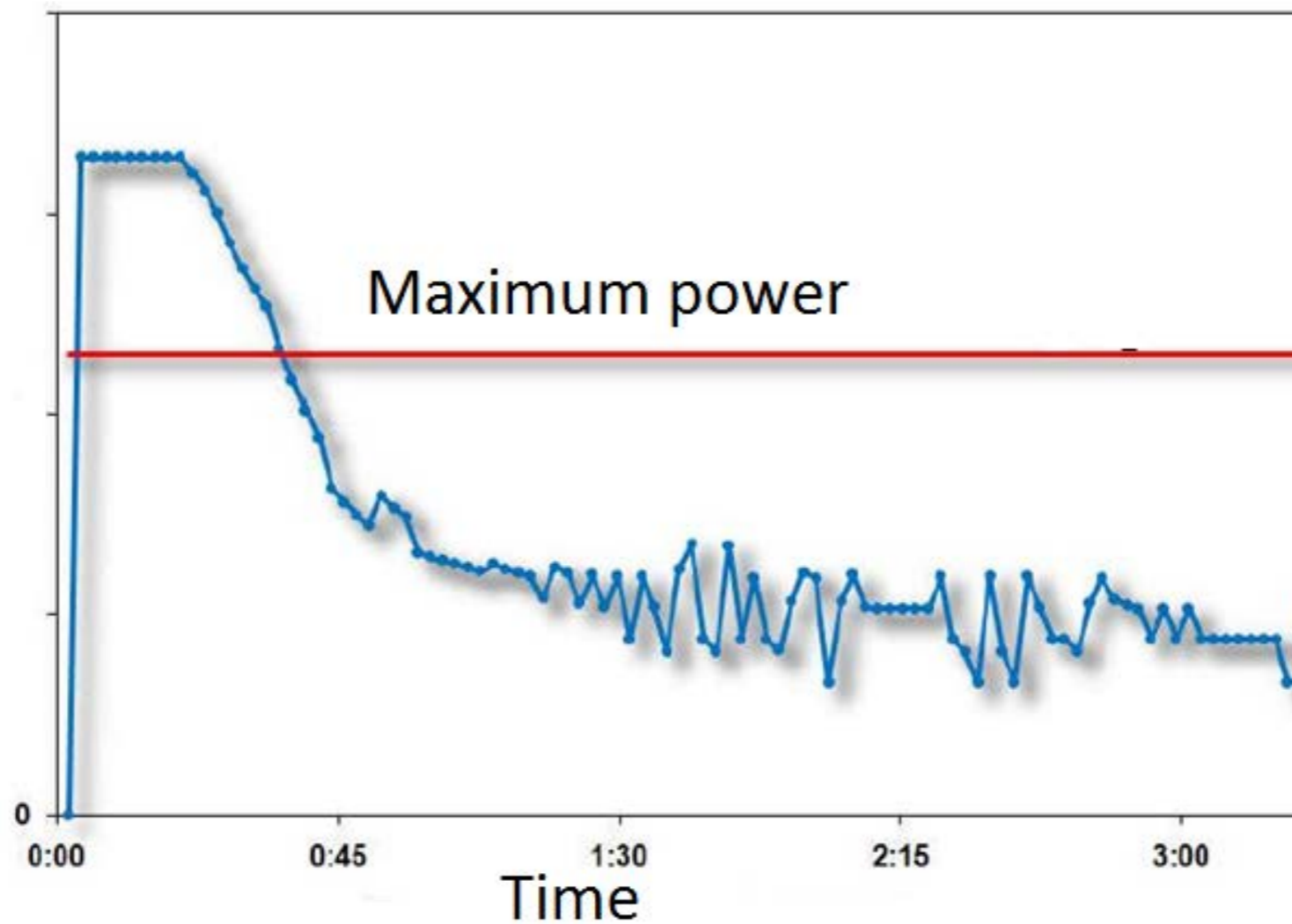


PowerMatchingCity II Hoogkerk

Constrained by comfort limit

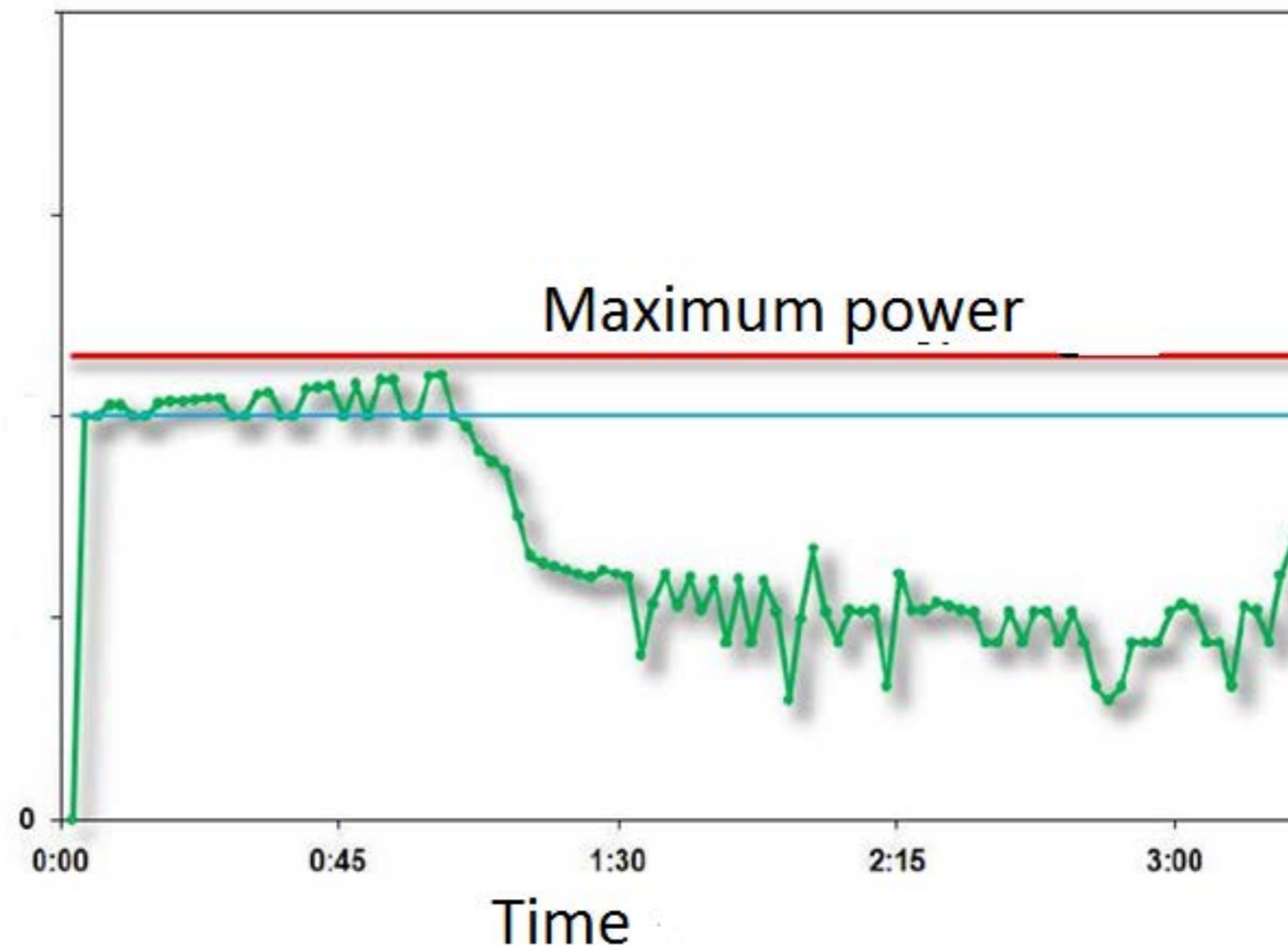
What are the sources of end-user flexibility and how to automate them

- Heat pumps in a residential area after blackout
 - without automated coordination



What are the sources of end-user flexibility and how to automate them

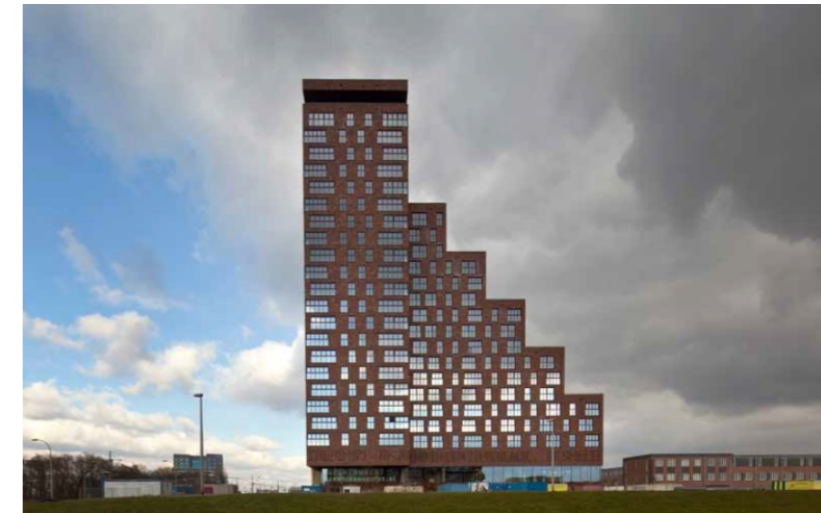
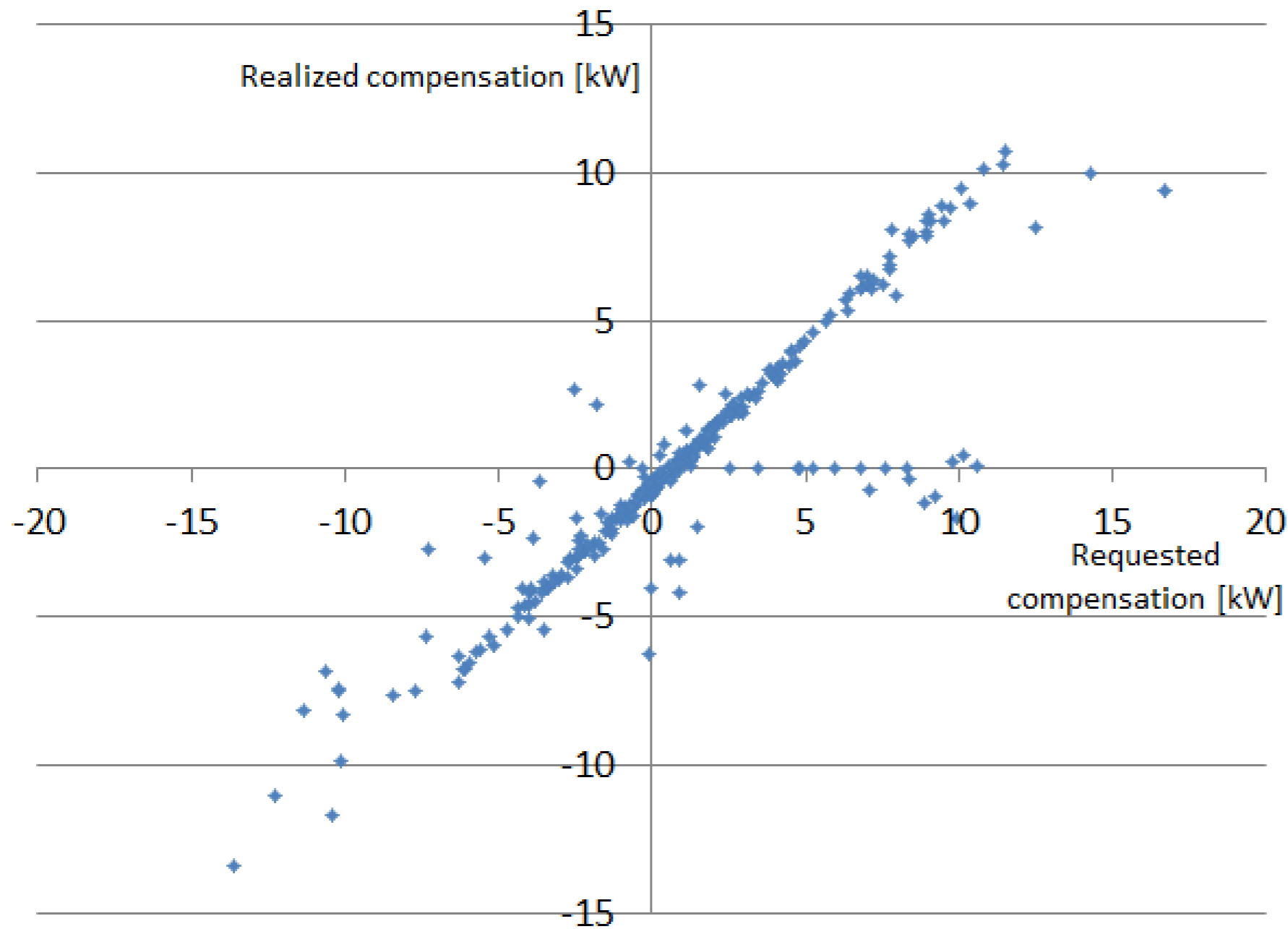
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What are the sources of end-user flexibility

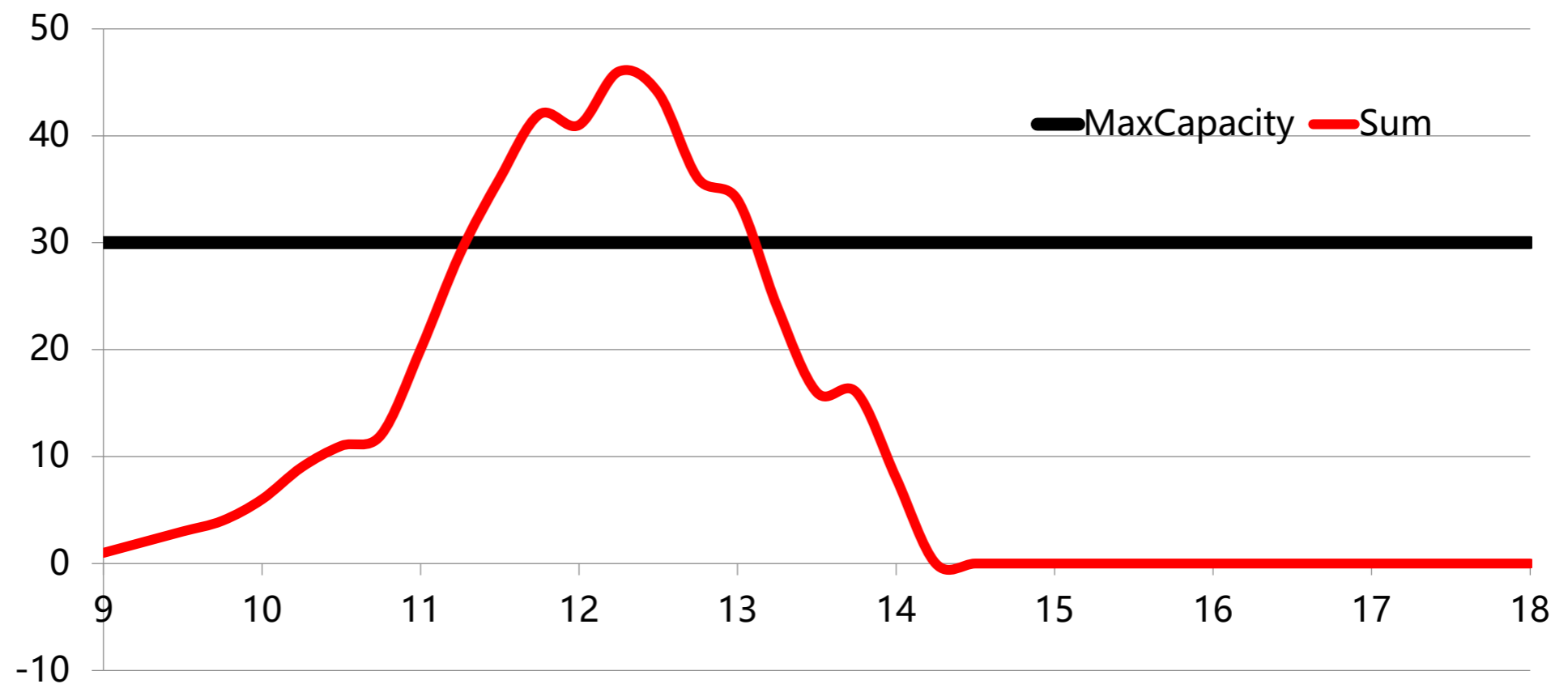
Aggregated deployment of heat pumps commercially

Eneco Imbalance response November 1-14, 2013



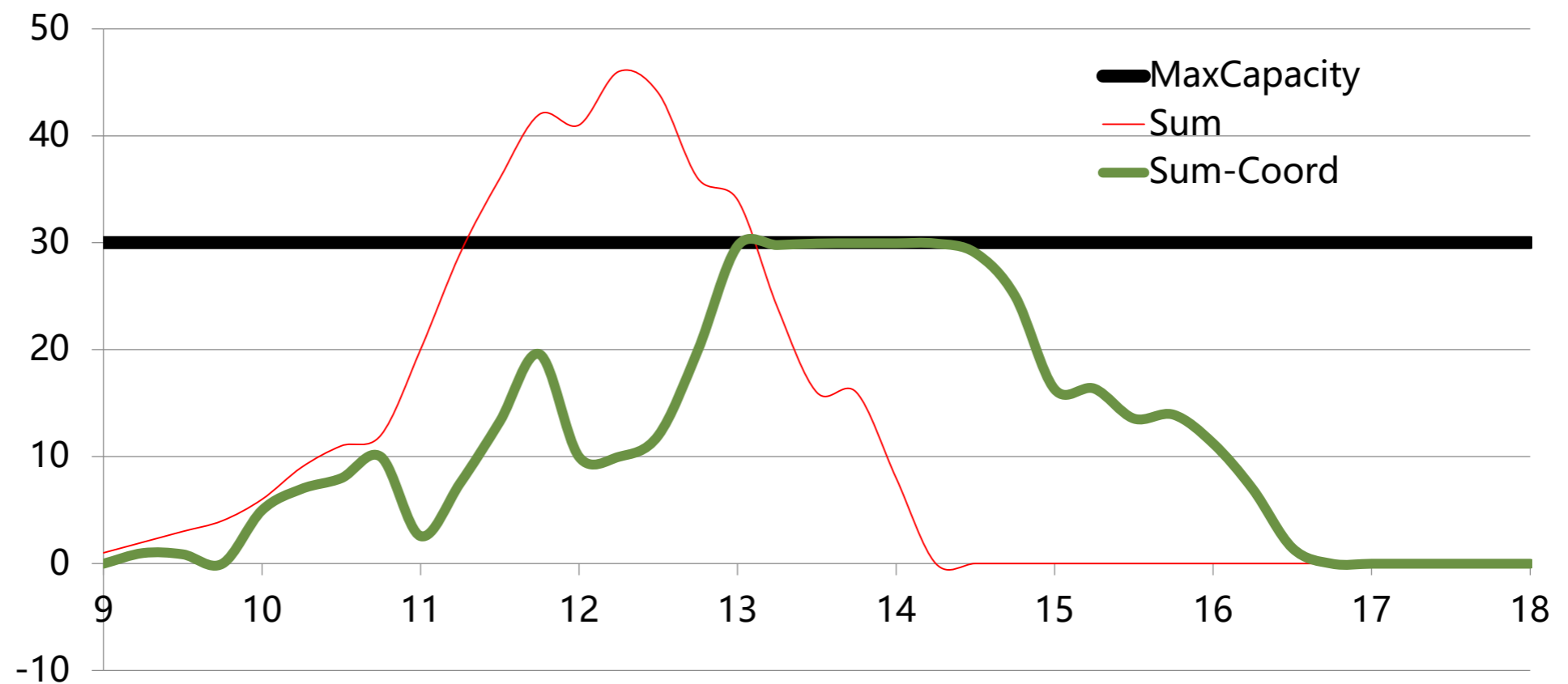
What are the sources of end-user flexibility and how to automate them

- Thermostatically controlled loads
 - Heat pumps
 - Micro-CHP
- **EV chargers (uncoordinated)**



What are the sources of end-user flexibility and how to automate them

- Thermostatically controlled loads
 - Heat pumps
 - Micro-CHP
- **EV chargers (coordination via automation)**

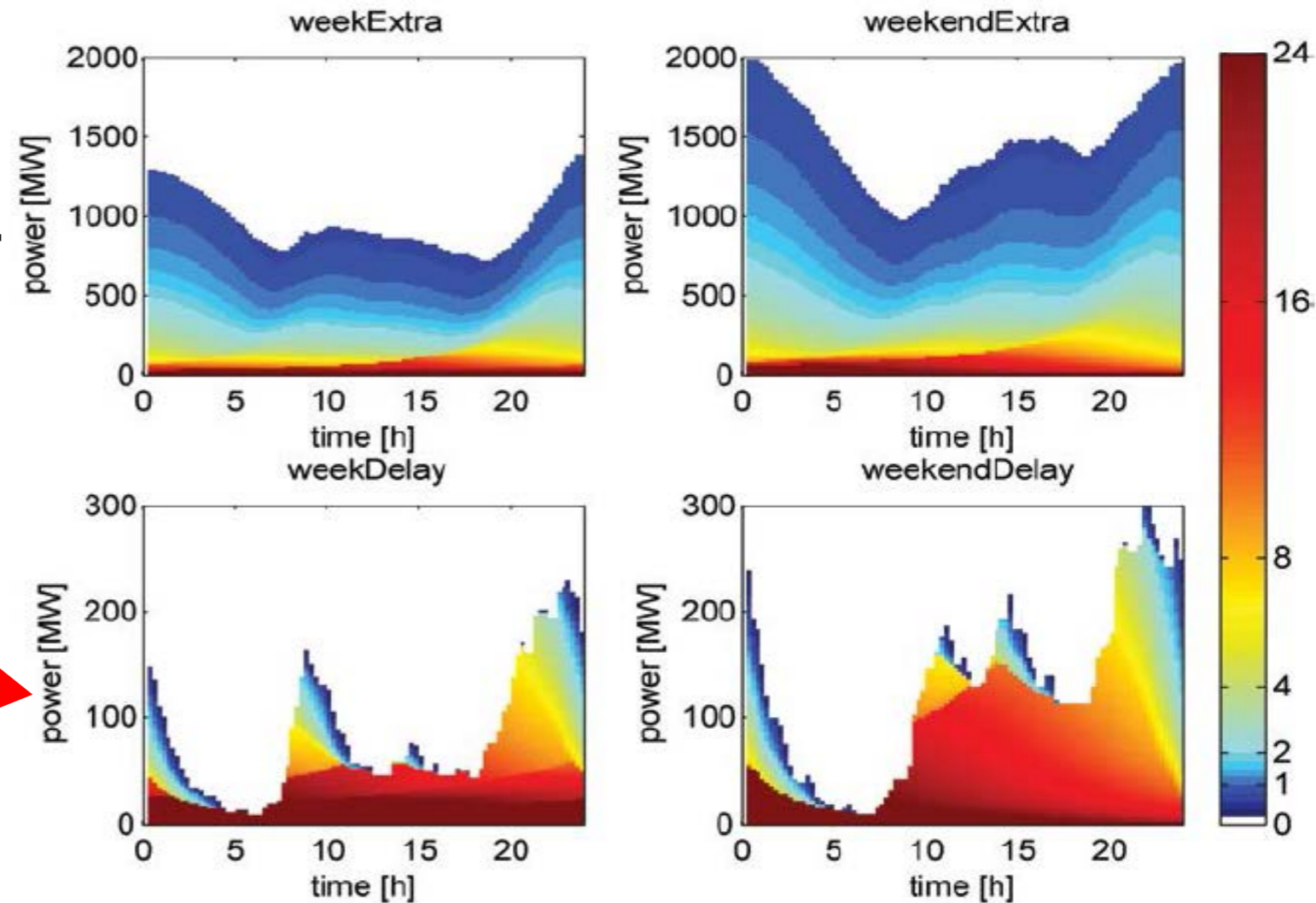


What are the sources of end-user flexibility and how to automate them

- Thermostatically controlled loads
 - Heat pumps
 - Micro-CHP
- EV chargers
- **Wet appliances**
 - Linear project (B)
 - Dish, laundry washer

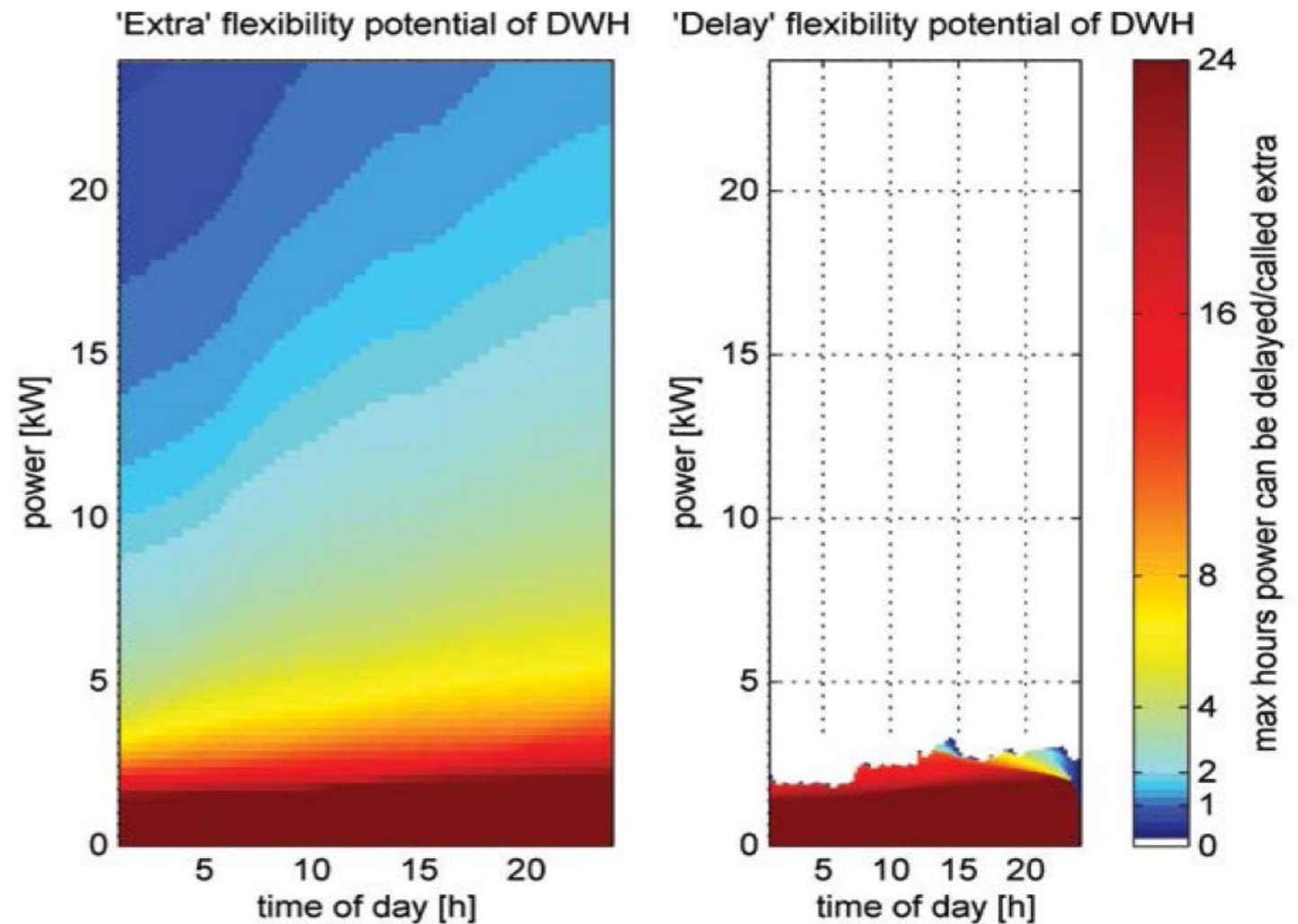
Pre-empt

Delay

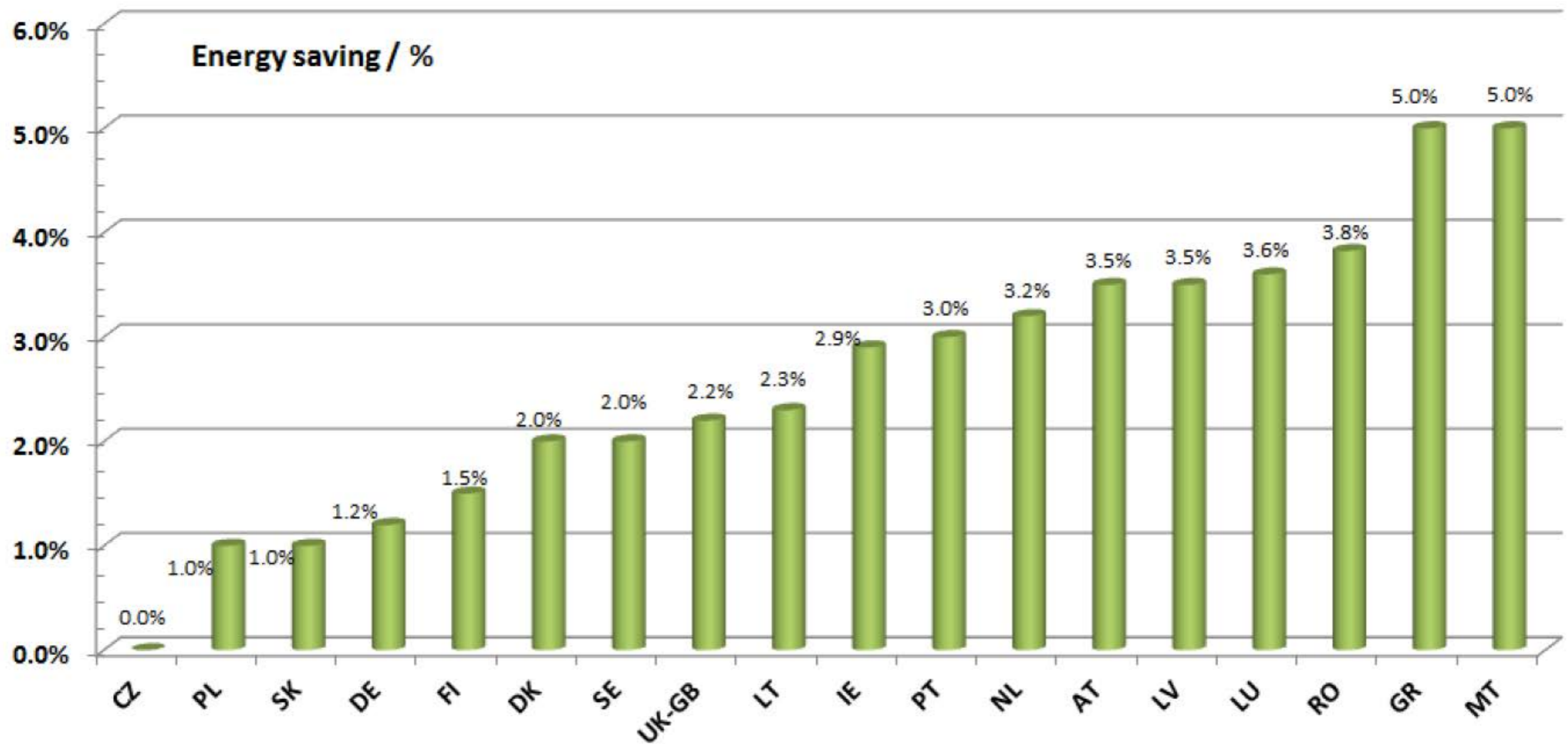


What are the sources of end-user flexibility and how to automate them

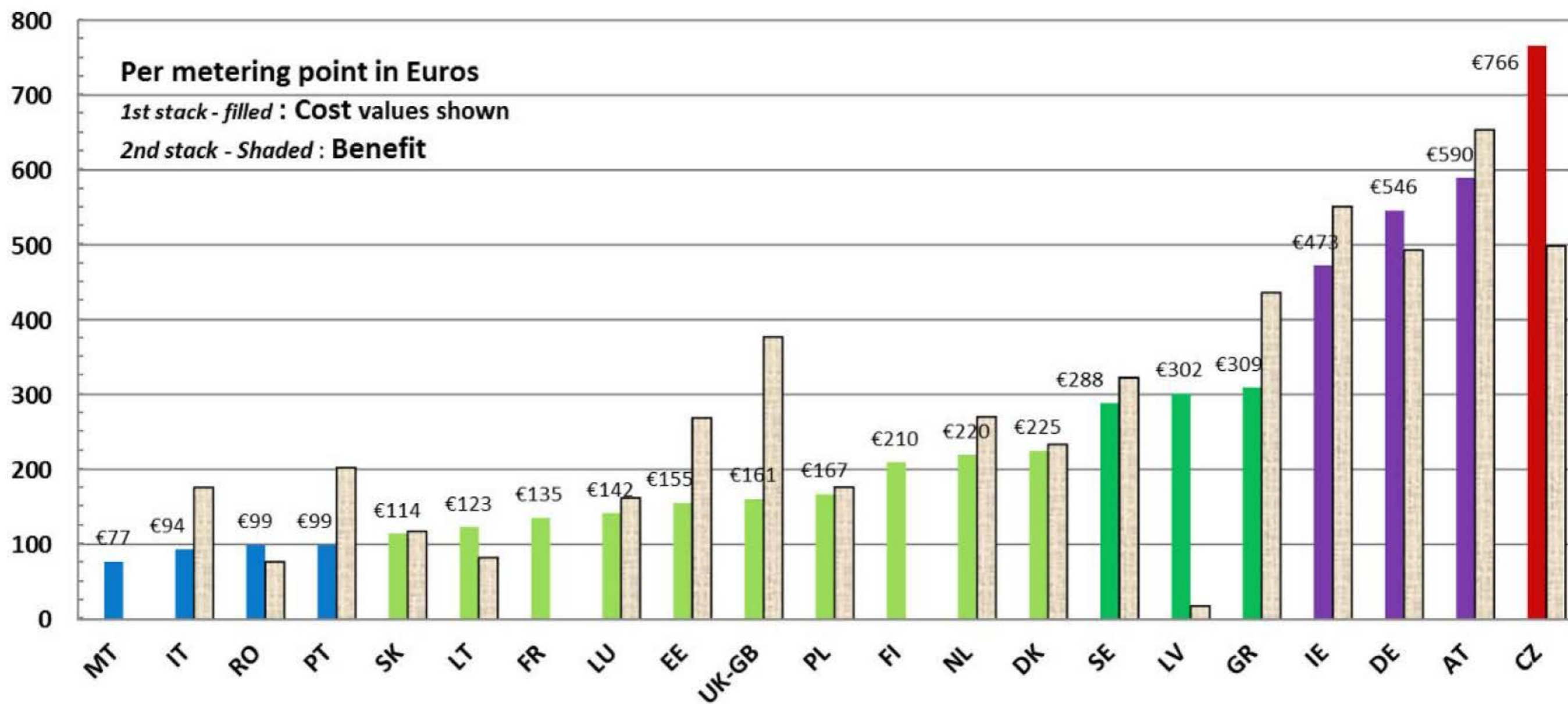
- Thermostatically controlled loads
 - Heat pumps
 - Micro-CHP
- EV chargers
- Wet appliances
 - Dish, laundry washer
- **Domestic hot water**



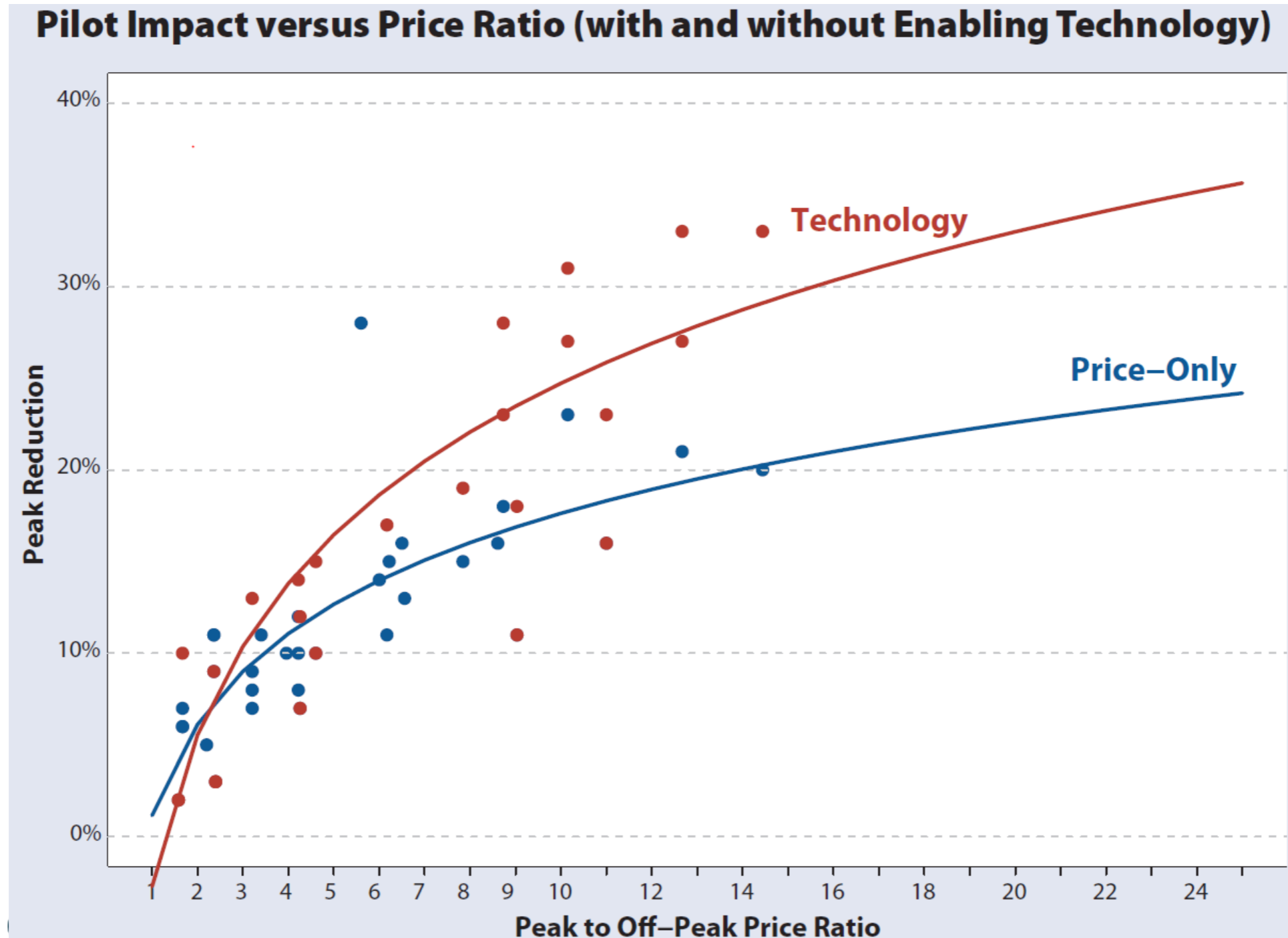
Flexibility and energy efficiency; smart meter baseline potential



Flexibility and energy efficiency; smart meter valuation

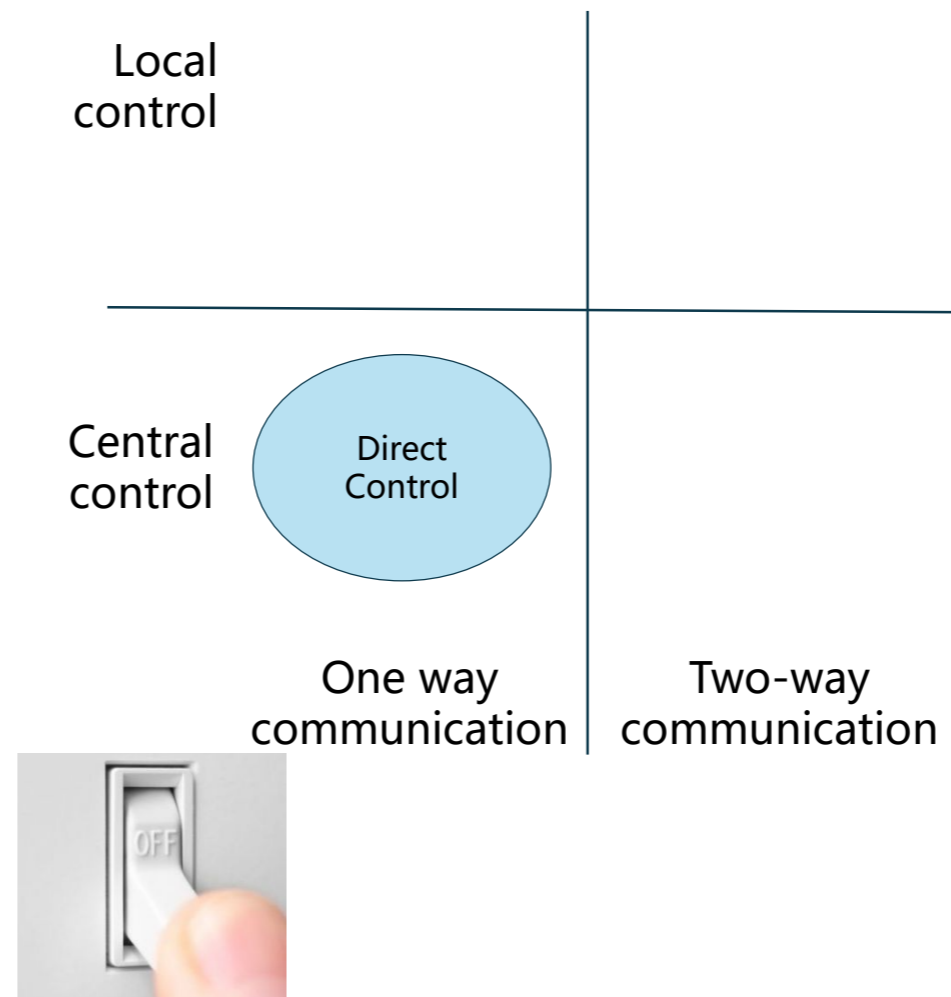


Flexibility; flexible tariffs and automation invocation potential



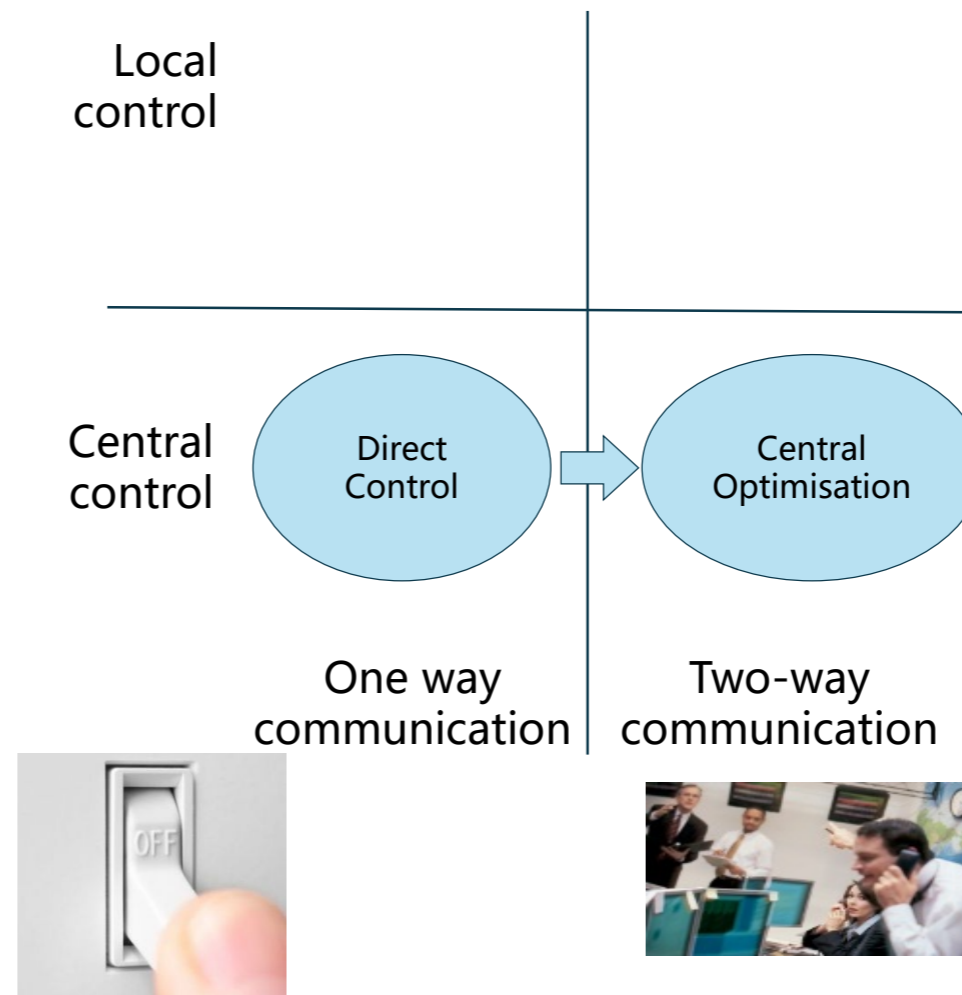
Invocation and reconciliation of flexibility : Classic DSM

- Direct (Top-Down) Control
 - Top-level Actor switches devices
 - No local information used



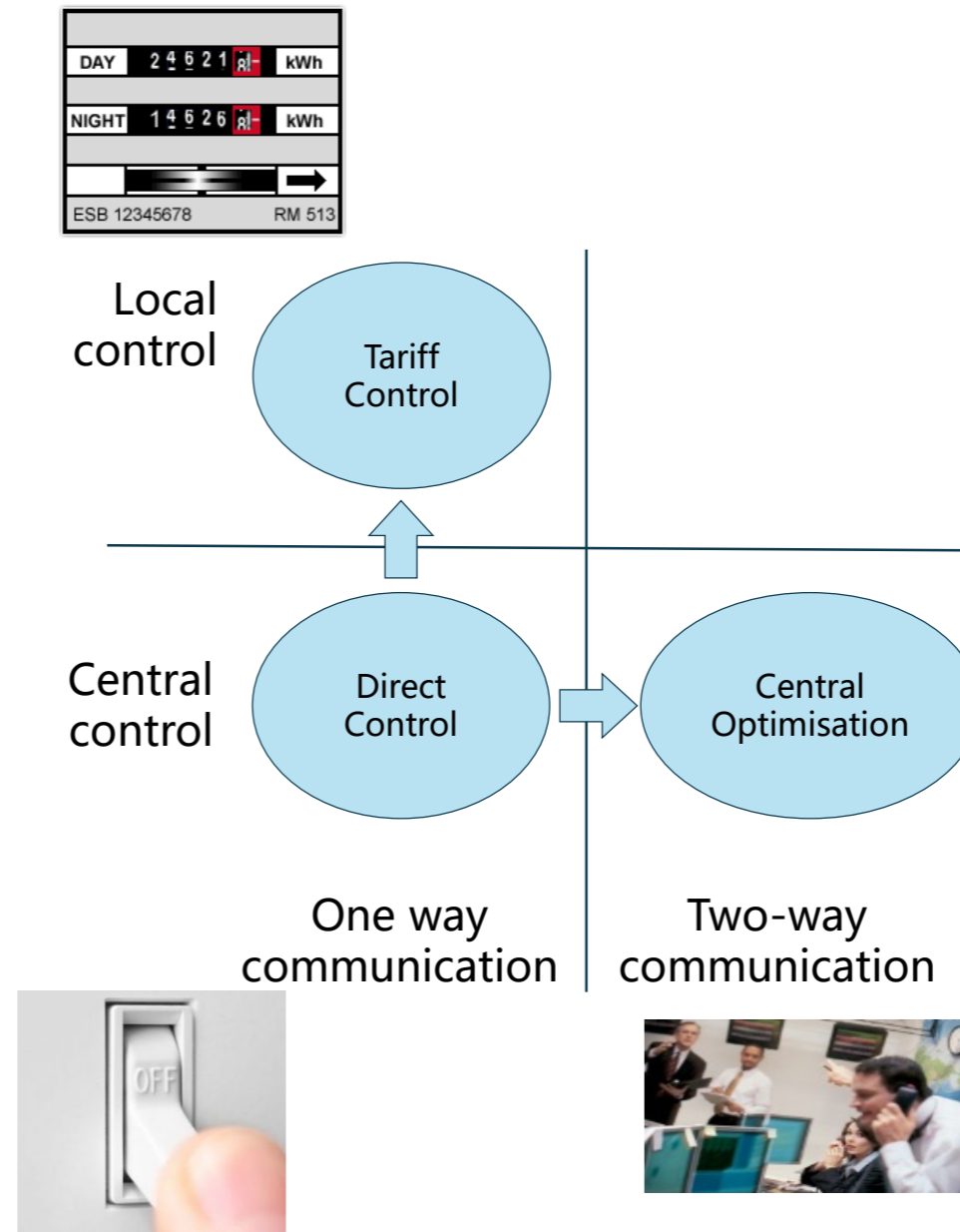
Invocation and reconciliation of flexibility : Central control

- **Direct (Top-Down) Control**
 - Top-level Actor switches devices
 - No local information used
- **Central Control and Optimization**
 - Optimisation and control from a central point
 - Relevant local information has to be communicated to a central point



Invocation and reconciliation of flexibility : More refined mechanisms are needed

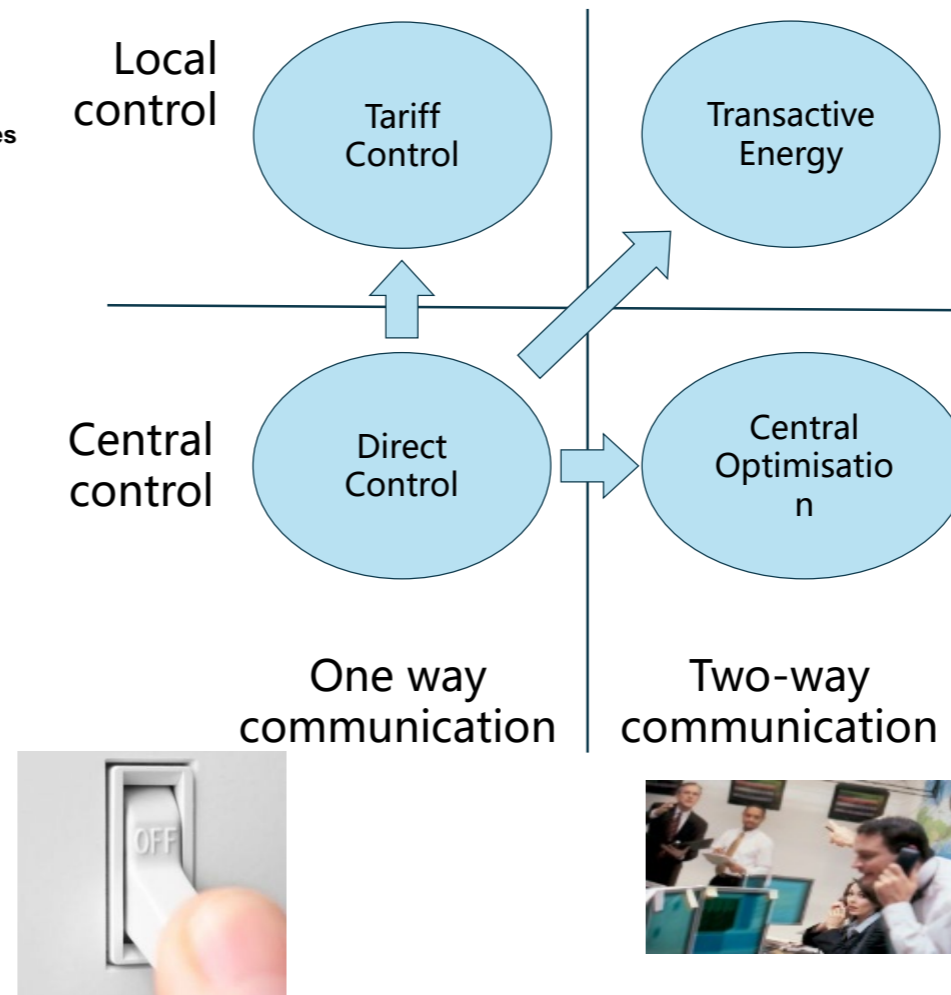
- Direct (Top-Down) Control
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- Tariff Reaction for control
 - Prices are transmitted to customers and/or their automated devices
 - No local information is communicated



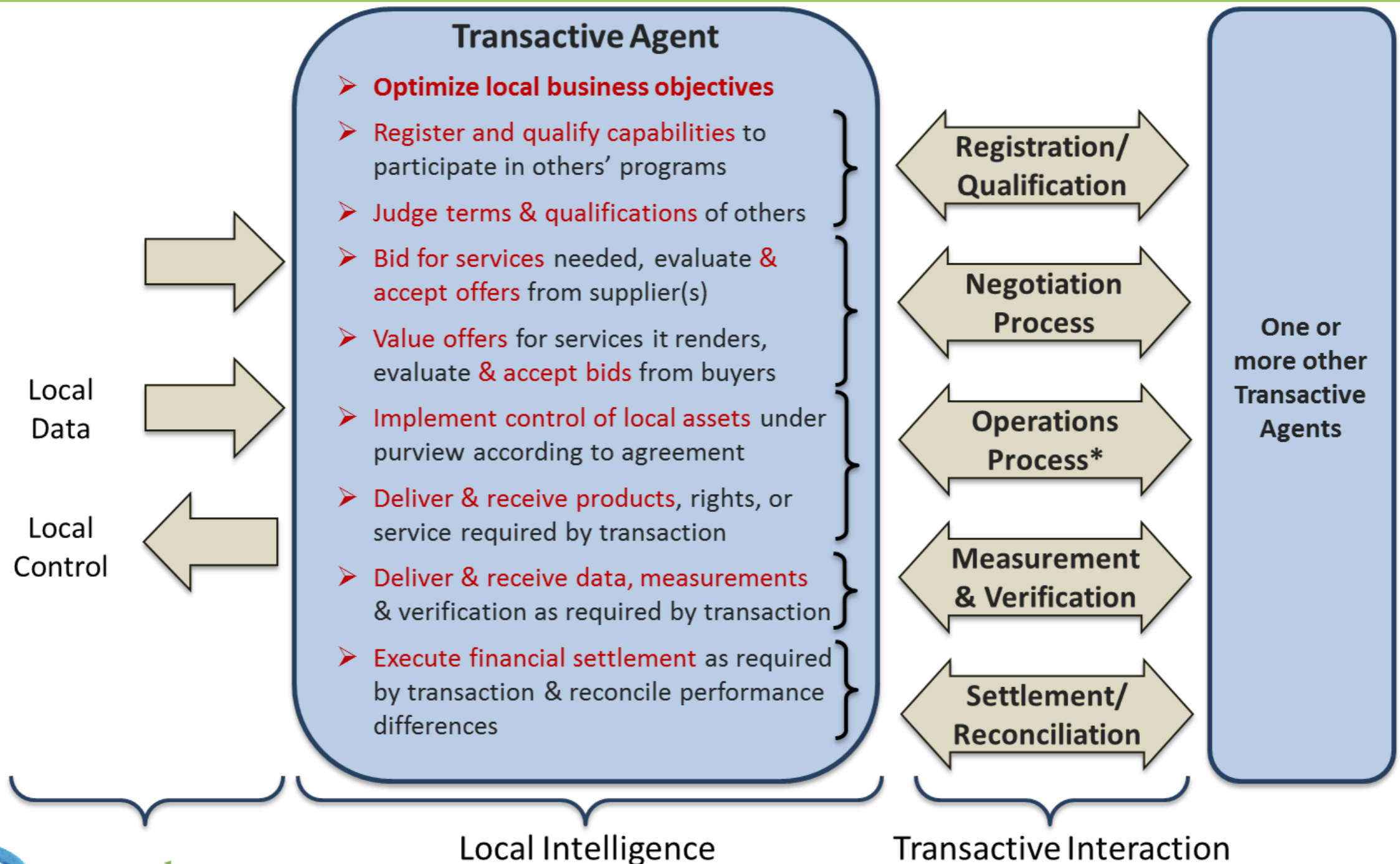
Invocation and reconciliation of flexibility : More refined mechanisms are needed

- **Direct (Top-Down) Control**
 - Top-level Actor switches devices
 - No local information used
- **Central Control and Optimization**
 - Optimisation and control from a central point
 - Relevant local information has to be communicated to a central point
- **Tariff Reaction for control**
 - Prices are transmitted to customers and/or their automated devices
 - No local information is communicated
- **Transactive Energy (TE)**
 - Automated devices are participating in market interactions
 - Information exchange on the basis of quantity (e.g., kW and kWh) and price

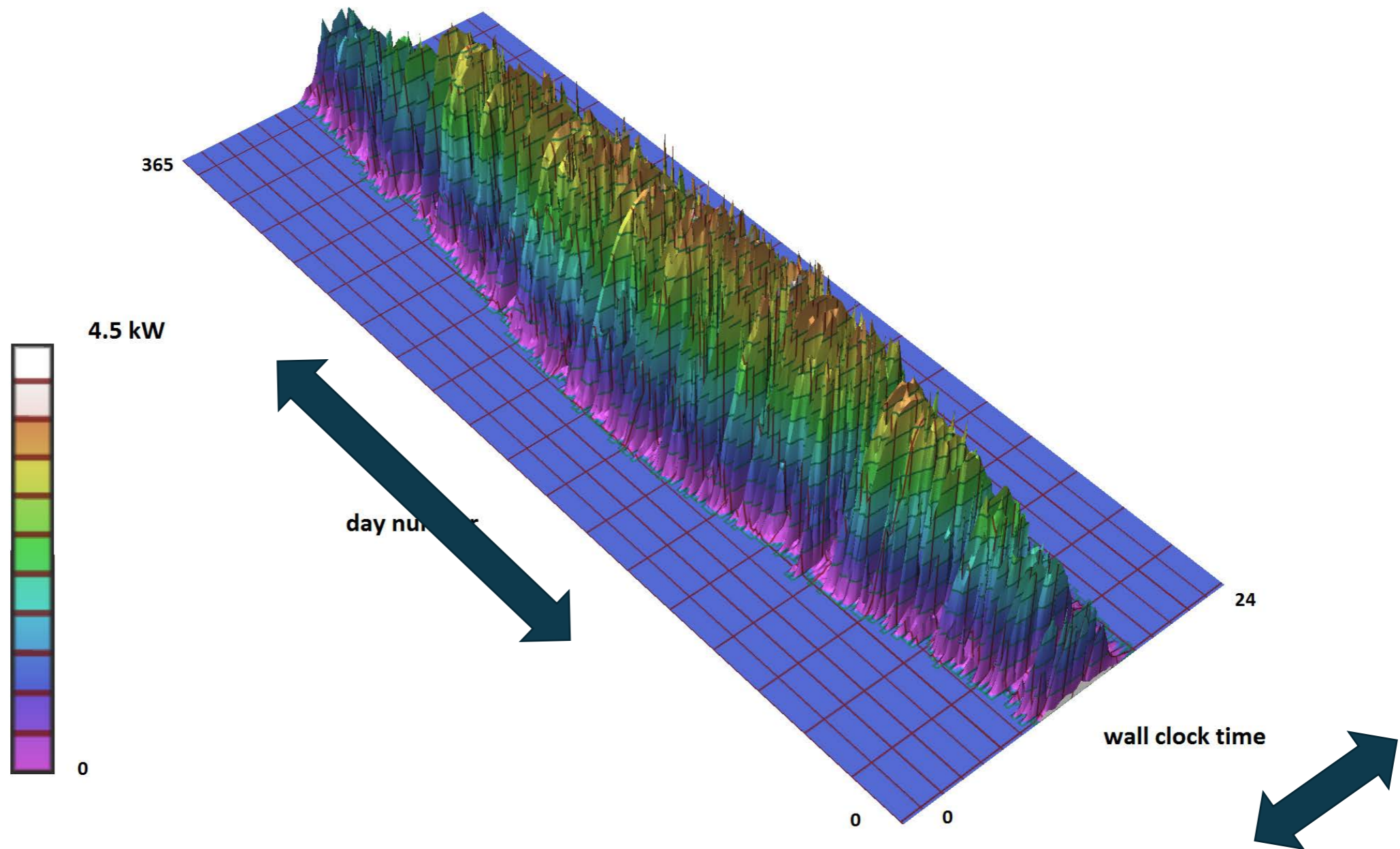
DAY	2	4	6	2	1	kWh
NIGHT	1	4	6	2	6	kWh
ESB 12345678						RM 513



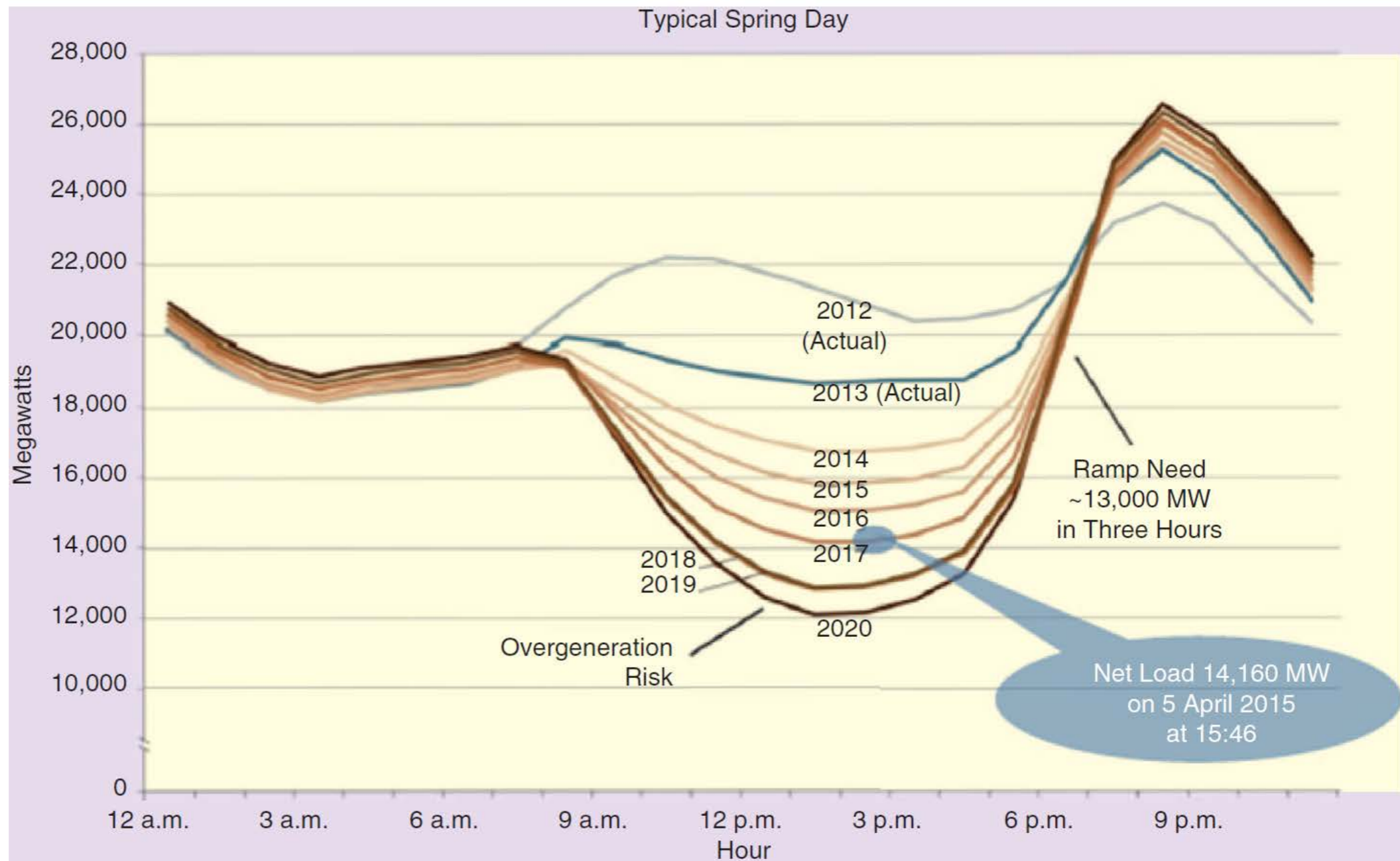
Transactive grid interactions; a more extended picture



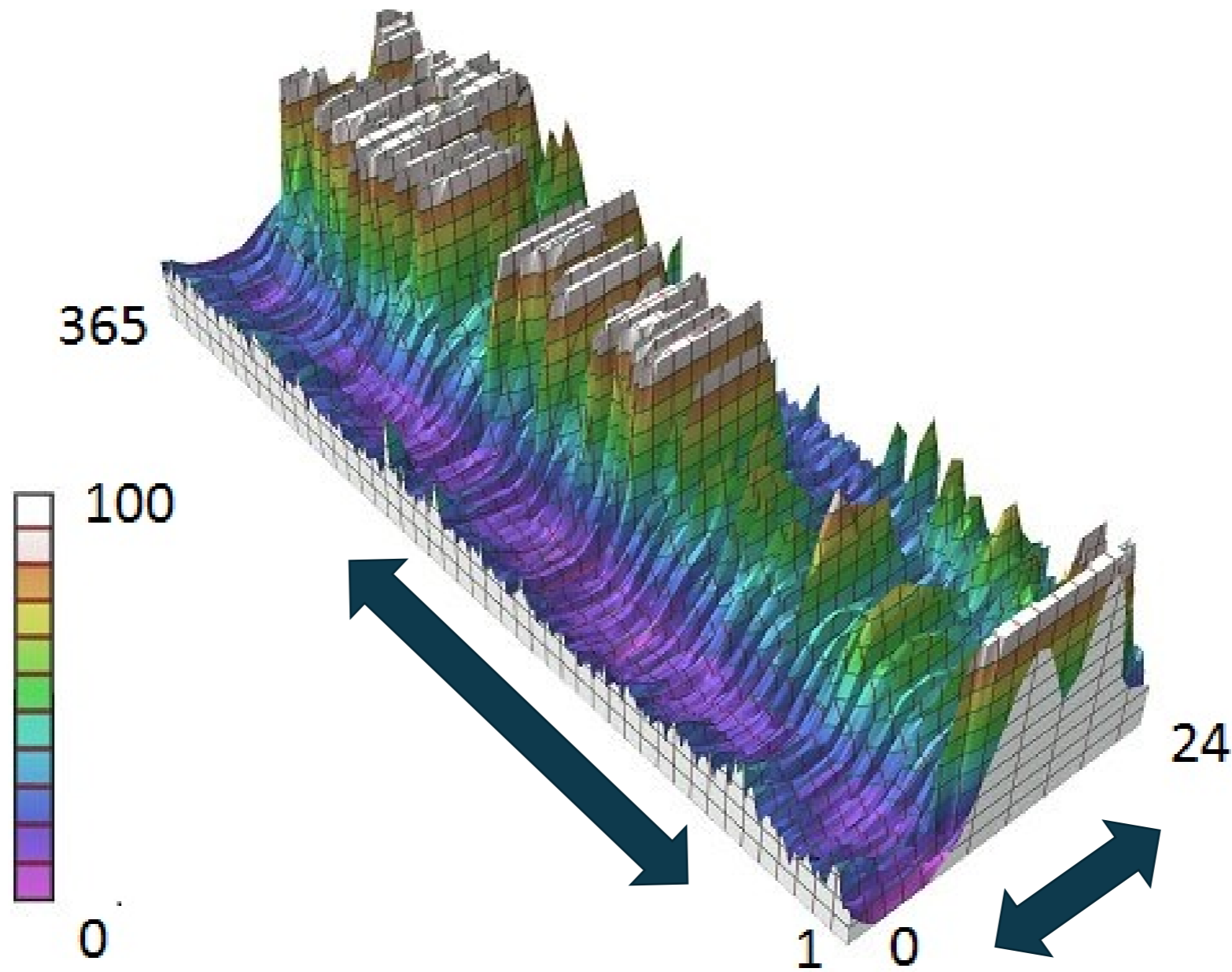
*Towards 100 % renewables (Prosumer)
End user production is becoming a flexibility
consumer*



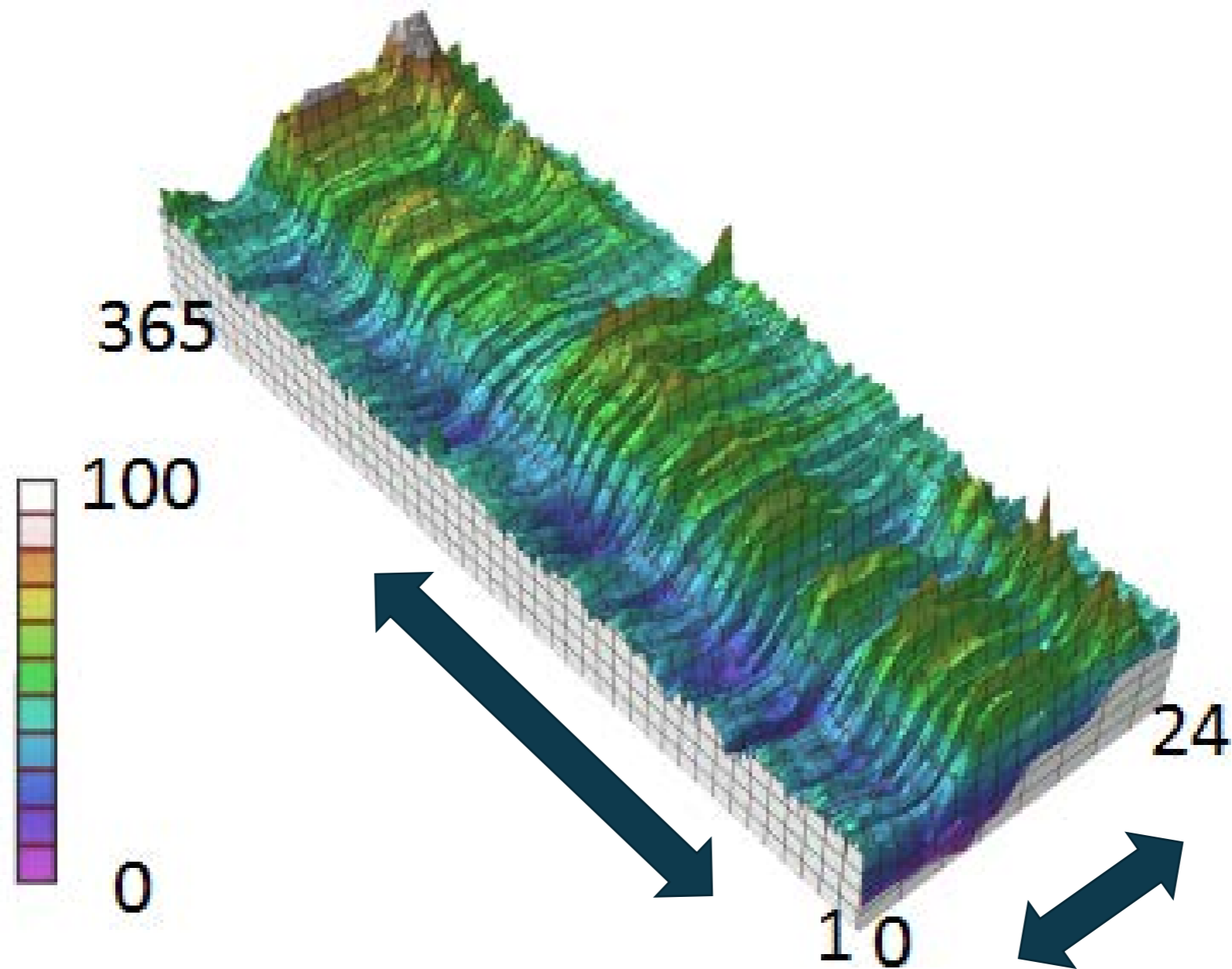
*Towards 100 % flexibility
This also has an effect on the system (e.g.
California)*



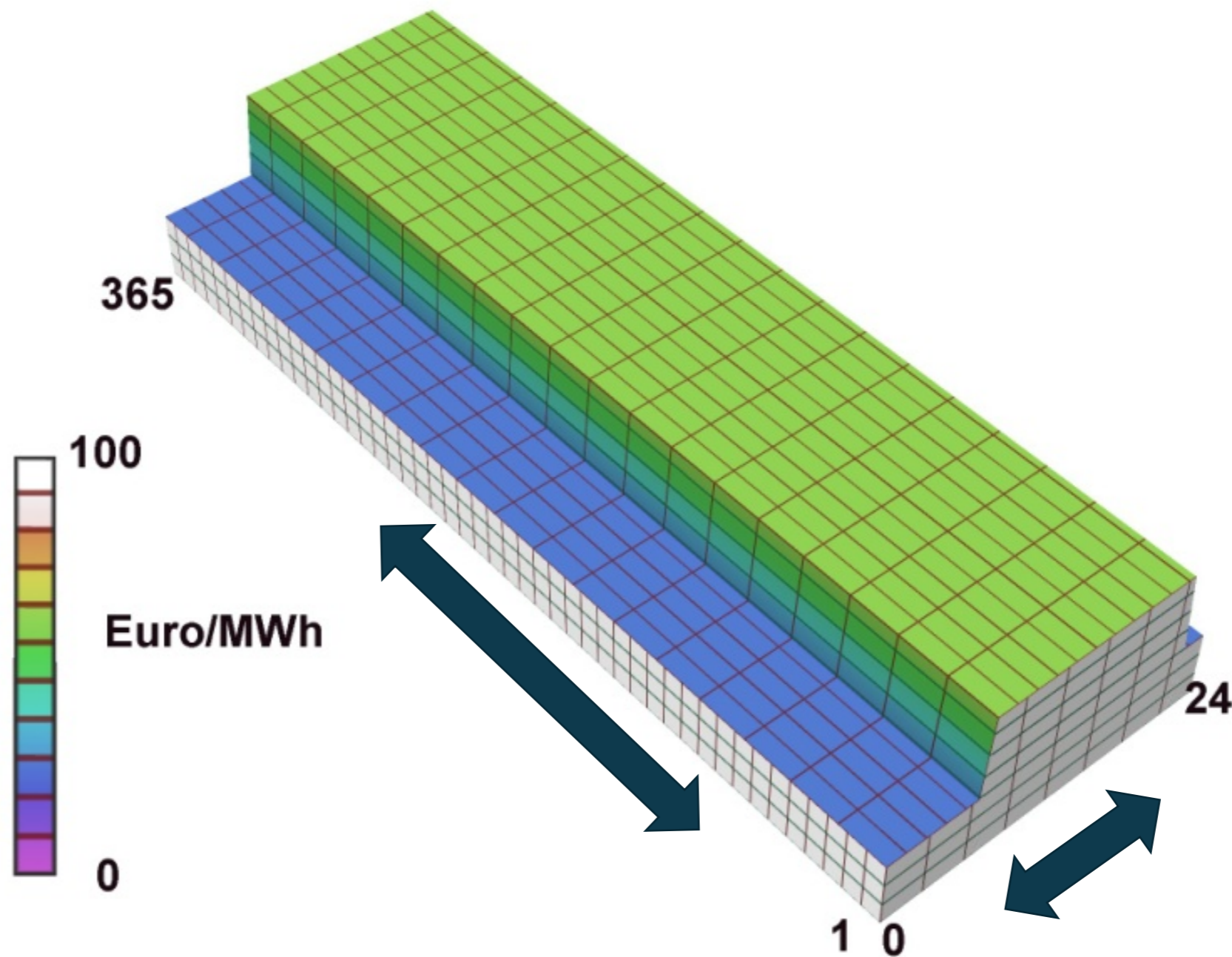
How can a new market design value flexibility Amsterdam Power eXchange-arbitrage 2003



*How can a new market design value flexibility
Amsterdam Power eXchange-arbitrage 2013*



How can a new market design value flexibility Tariff build-up 2003-2013



How can a new market design value flexibility Increased focus on involving Transmission and Distribution

- Optimal supply<>demand control
 - Balancing (commercial, grid operational management)
 - Portfolio management
- Mitigate congestion and capacity problems
- Power quality (Voltage, reactive power, frequency)
- > Malleable and more active electricity distribution grids
 - Many nodes
 - Residential
 - SME
 - > Aggregate and automate on data measured on MV/LV levels within shorter time-window and time-frame
 - From an operational perspective: months -> hours
 - From an asset perspective: decades -> 5-10 years

How can a new market design value flexibility Involve customer

- Remove disincentives for end-user DR
 - EU-directive succeeding Smart Meter directive
 - Rollout of systems also may not be gradual but disruptive
- More accurately map role of end-user/prosumer to commercial and grid operation
 - Dynamic/real-time tariffs
 - Use automation of DR and data extraction of grid related ICT-components
 - Use more transactive based mechanisms
- Remove legislative barriers for market access and aggregation
- Protect privacy and regulate data ownership
 - Resource -> assets
 - Aggregation of data at the functional level