DSM Day IEA/DSM TASK-17: DG, DR and storage

Integrating the demand and supply flexibility

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Contents

- US, Sweden, Austria, Switzerland, Netherlands, Cu-alliance
- **Context**
- Task 17 structure
- Progress and results

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Power flows in electricity grids (traditional)

Large generation

CHP, Wind

HV/MV Transmission

Industry

LV/MV Distribution

Transition to new flows appearing

- New types of generation
- Electrification
- Simultaneous/ bidirectional
- Synergy electr./gas/heat/cold

Large generators

Combined heat/power, wind

HV/MV Transmission

Industry

μ (C)CHP

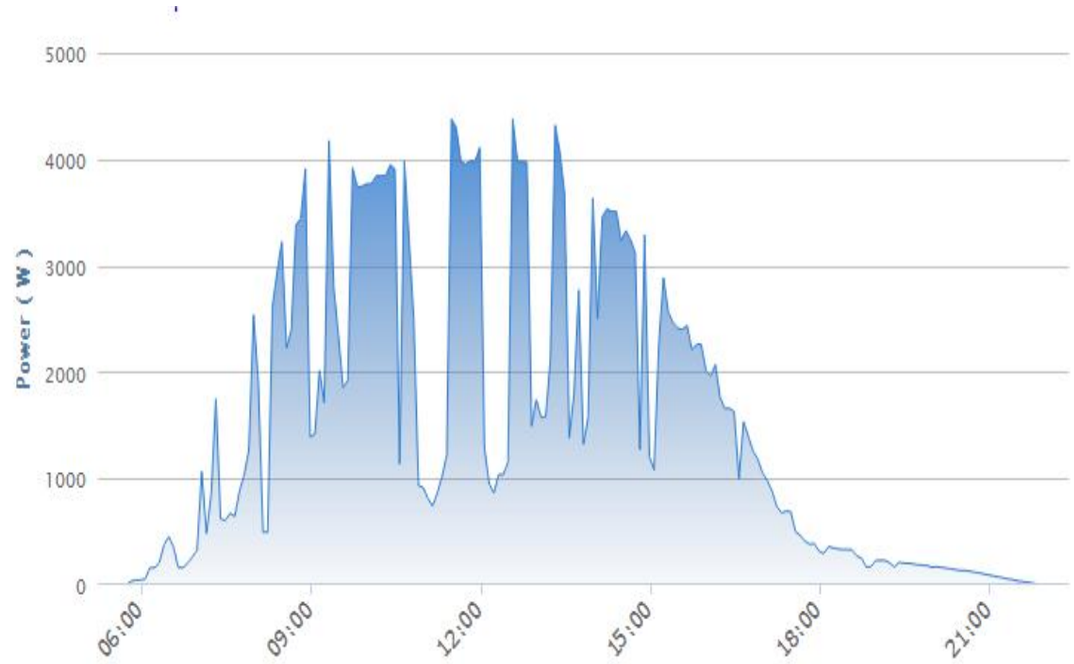
Solar cells

EVs

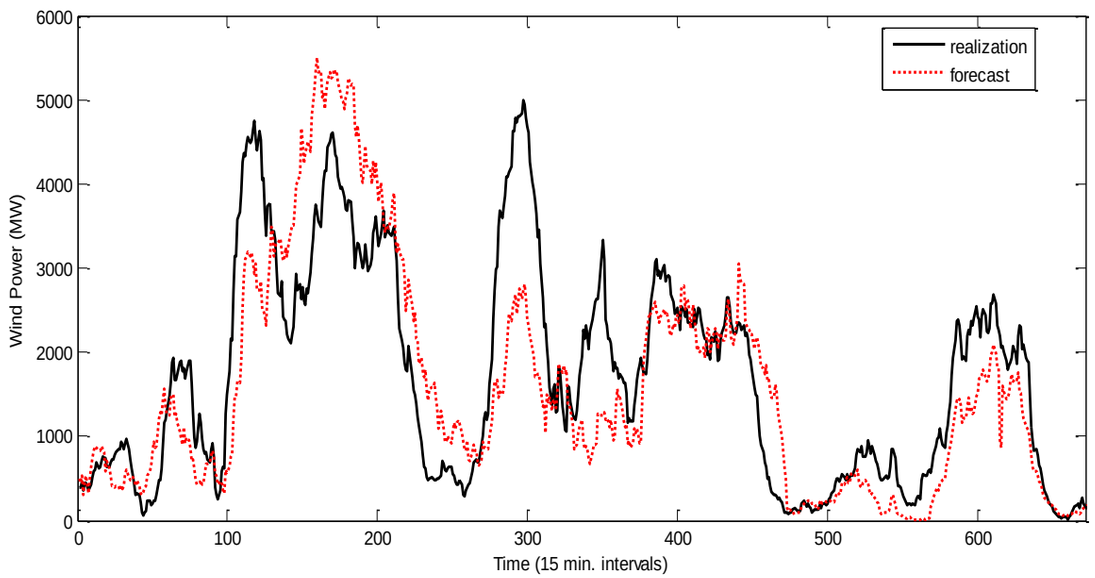
Heatpumps,Air

Increase of Volatility and need for Balancing

- PV generation on a cloudy day



- Wind generation and deviation from forecas



→ need for balancing

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End-user Flexibility (Demand response <> Generation uncertainty)

- Electricity grids
  - Decarbonisation/electrification/substitution of carrier
  - Limits of embedding more distributed and dispersed generation reached
    - local: **Voltage, Thermal loading**
    - global: **frequency**; lack of system inertia
  - Smart grids and (hybrid) energy storage are key to solutions

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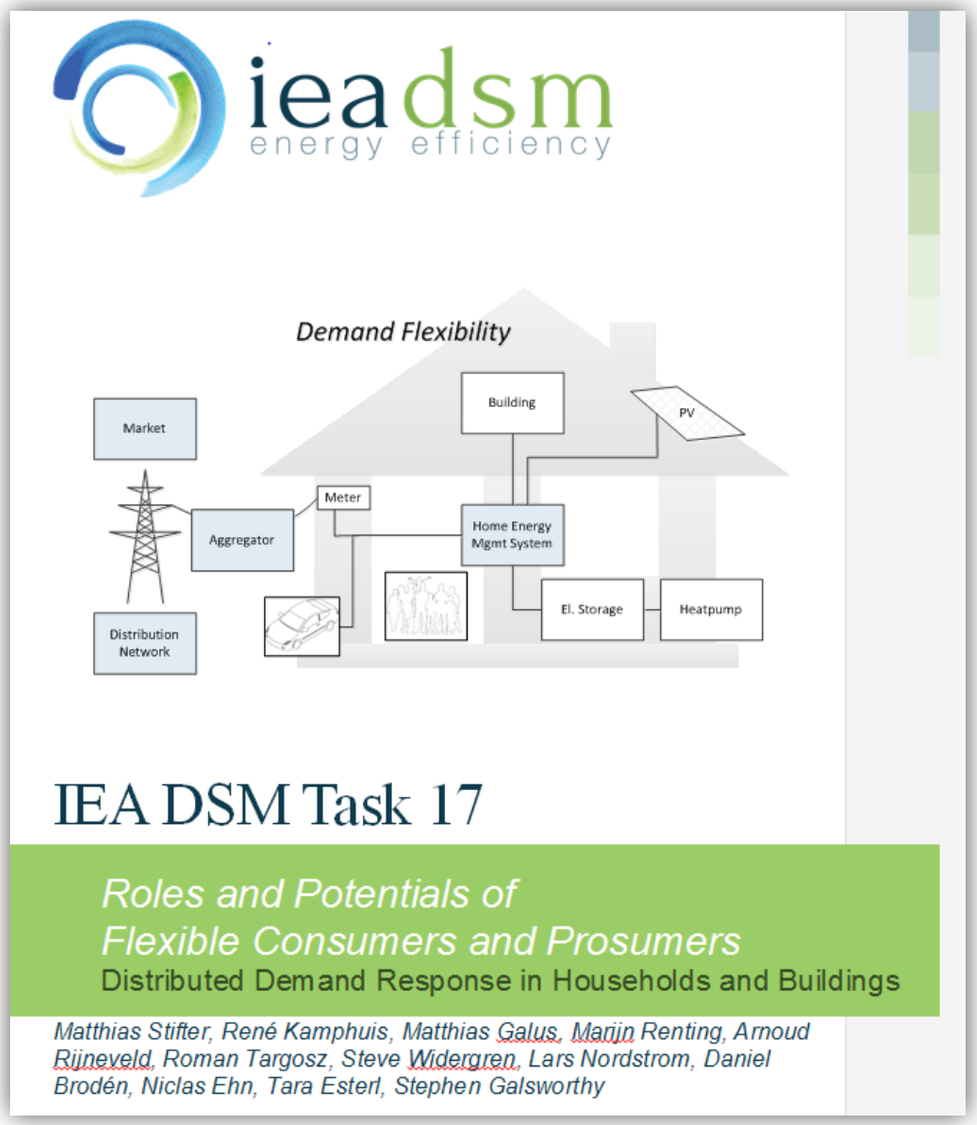
Subtasks

- Subtask 10 - Role and potentials of flexible consumers
- Subtask 11 – Impact on Grid and Markets
- Subtask 12 - Sharing experiences / finding best practices
- Subtask 13 – Conclusions and Recommendations



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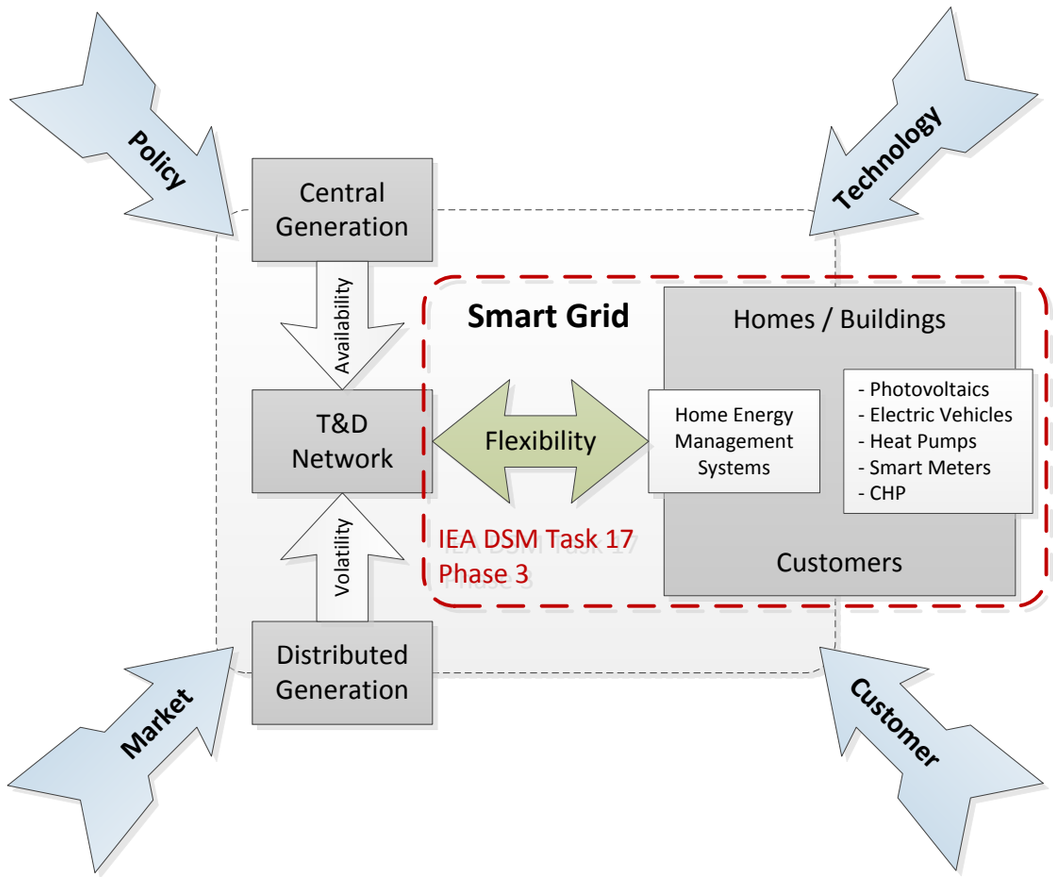
Overview: Systems view on enabling the Smart Grid

- Focus on the **enabling of flexibility in electricity production and consumption** and the impact of it on the stakeholders:
  - What are the requirements?
  - How do we manage it?
  - How will it effect operation?
  - What are the benefits?



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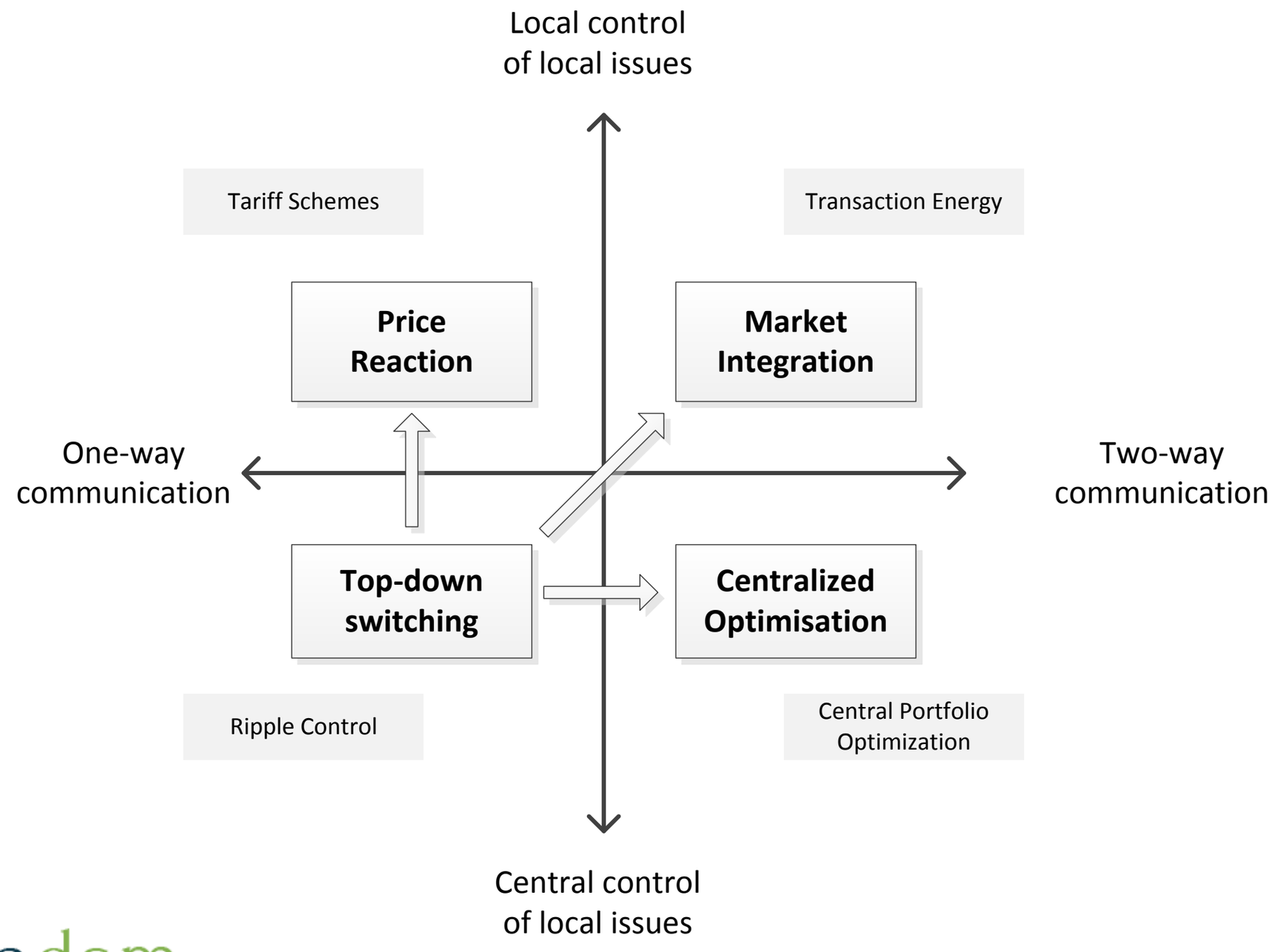
ICT architecture and actor topologies



Analyses of use cases

- Micro level
  - Self-consumption
  - EMS and feedback
  - Energy storage (electricity, hybrid, V2G)
- Meso-level
  - Congestion mitigation
  - Residential area energy storage
  - Energy communities
  - PV curtailment mitigation
- Macro-level
  - Portfolio optimization
  - Balancing
  - Load/generation peak mitigation
  - Ancillary services

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Business cases for flexibility

Business Cases for flexibility

Market Business Cases	Grid Business Cases (DSO)	Customer Business Cases
Optimizing for day-ahead spot prices	Voltage stability	Increase of own consumption
Optimizing for intraday spot prices	Reduction of losses	Reduction of grid connection costs (country spec.)
Balancing markets depending on technical characteristics	Upkeep of supply in cases of system incedents	Reduction of prices for capacity (bigger customers)
Reduction of costs for imbalance settlement	Limit reference power from upstream grid (↓grid tariffs)	In future re-active power management
Partly capacity markets		

Potentials (momentaneous kW, kWh, capability) and primary process constraints for flexibility

- Thermostatically Controlled Loads (10-30 % flexibility)
  - HVAC
    - Heat pumps
    - micro-CHP (Stirling, fuel cell, …)
  - Food storage
    - Freezers, Refrigerators (30 mins flex)
- Wet appliances (cycle driven)
  - Washing machines
  - Dish washers
  - Laundry dryers
- Domestic EV home chargers
  - Range anxiety; fast charging
- Energy storage at what level in the grid
  - Electrical
  - Heat
- PV

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Automating appliance demand response

- Beneficial for tariff scheme controlled DR
- Interfacing
  - Primary process control of devices via bypassing existing control signals (NEST, Ngenic)
  - Standards are evolving (buildings, EV, openADR, EF-Pi)
- Integration ->> Living labs have been analyzed
- Actor interaction topologies for energy and capacity optimization in relation to ICT architecture are important
  - Home EMS systems
  - Cloud based architectures

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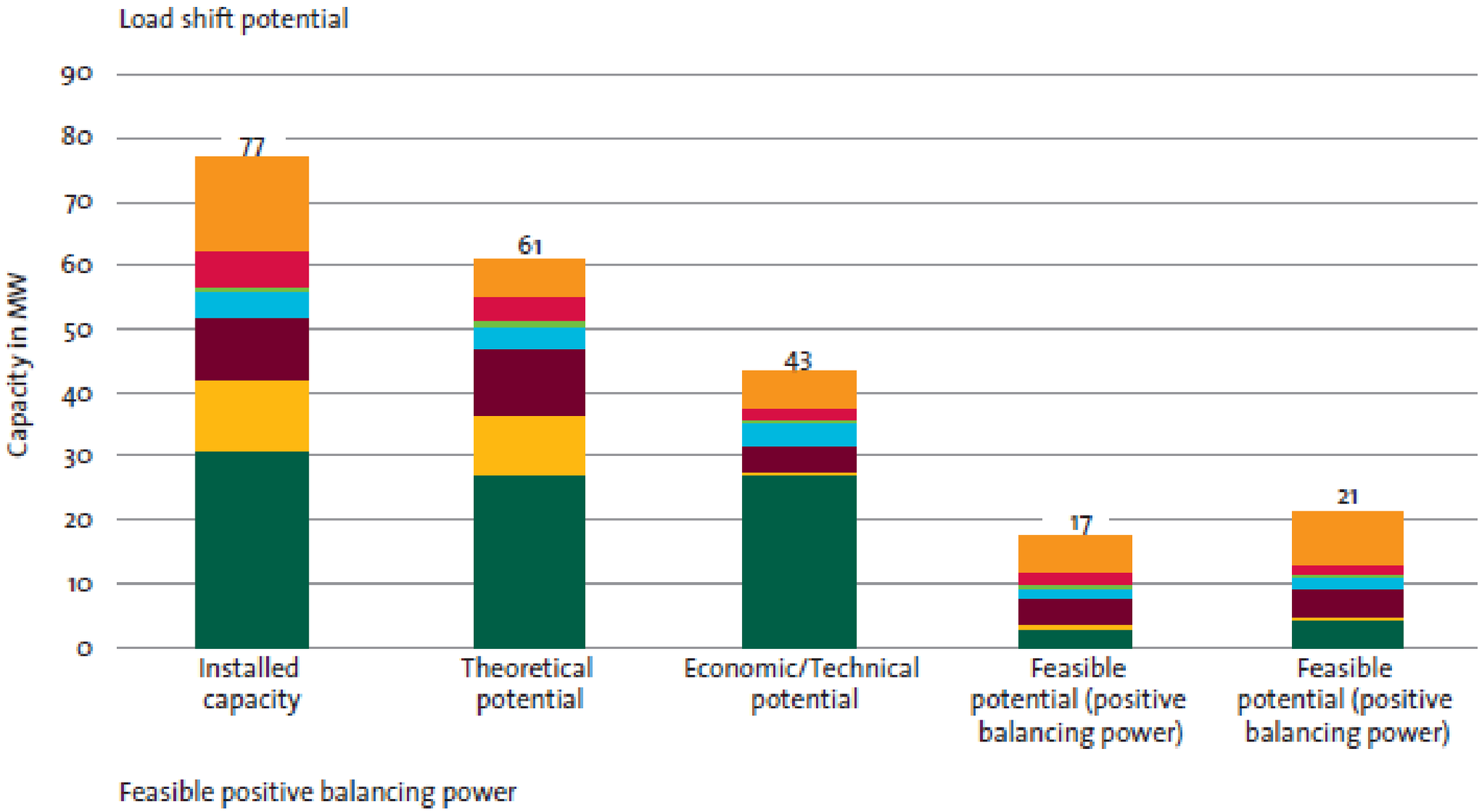
Moma (e-Energy): cooling and refrigeration



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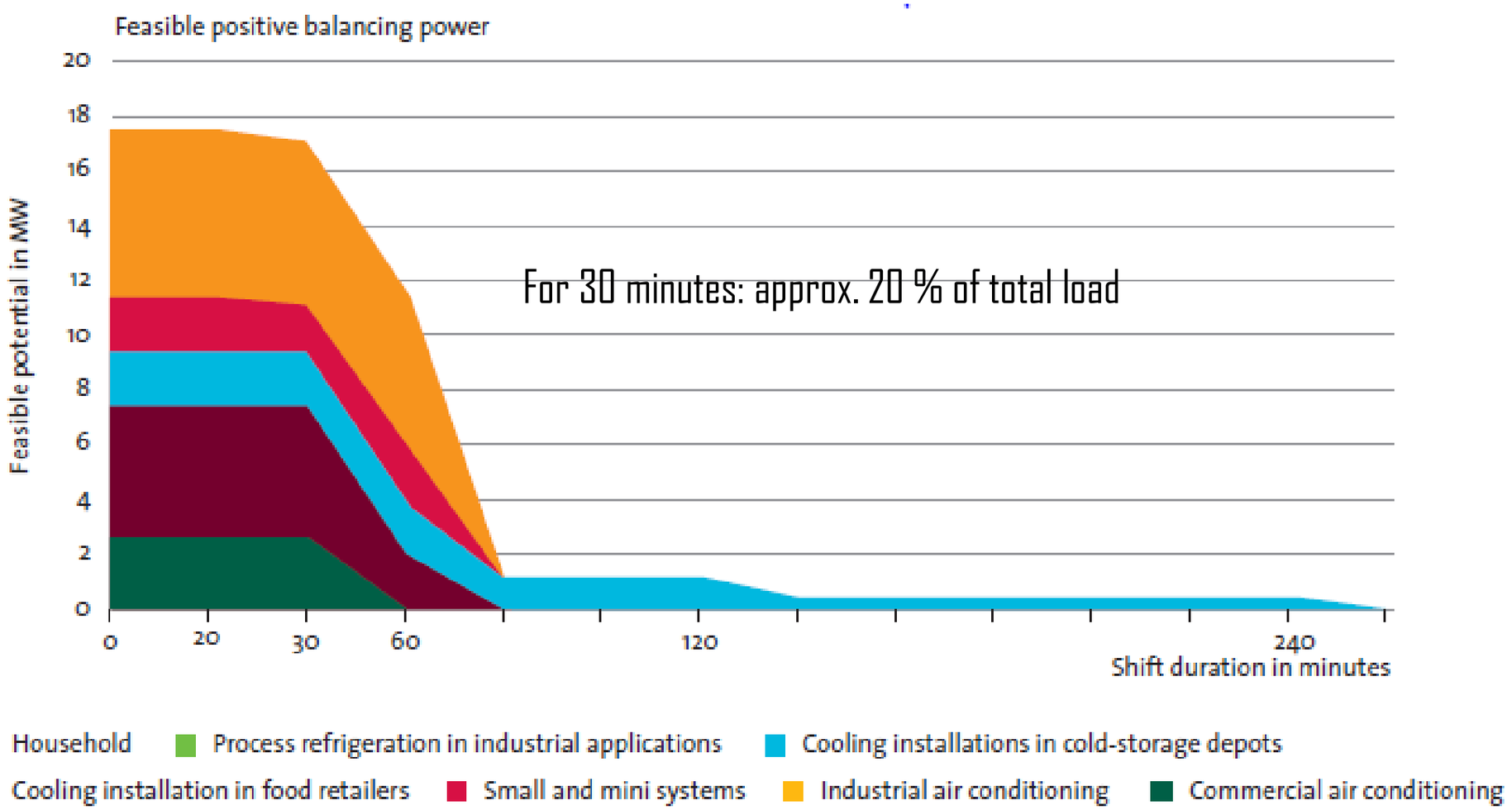


DNV-GL study the Netherlands

Tabel 37 Samenvatting besparingseffecten (Tou = time of use; CPP = critical peak pricing)

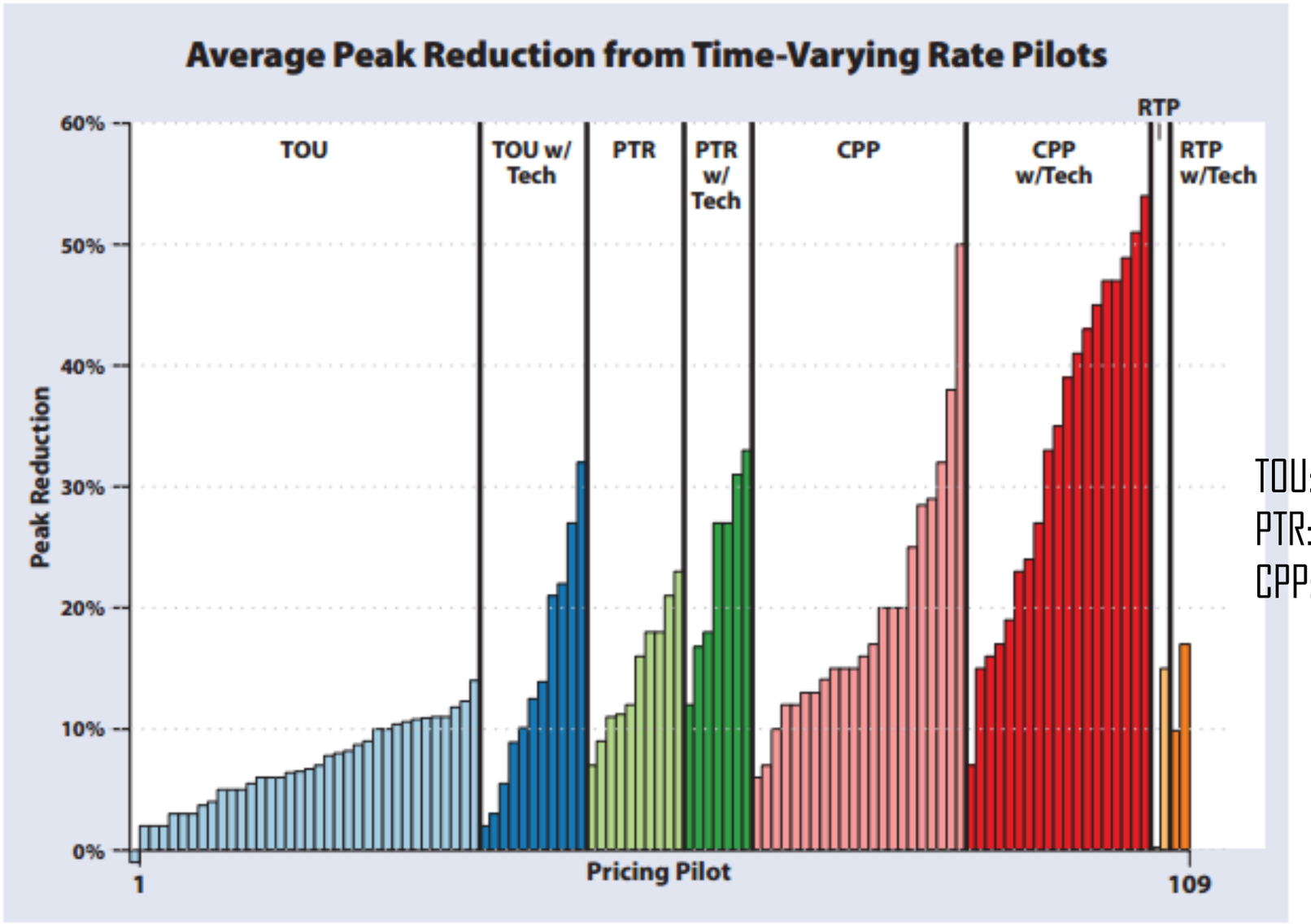
Effect	Piramidetrede	Besparing nulalternatief (bandbreedte)	Besparing projectalternatief (bandbreedte)
Indirecte feedback (huishoudens)	Passieve slimme meter	4% (0-10%)	0%
Directe feedback (huishoudens)	Passieve slimme meter	0,5% (0-3,2%)	0%
Prepaid contracten	Actieve slimme meter	PM	-
Piekverschuiving TOU (commerciële partijen en industrie)	Niet-gereguleerd/ Gereguleerd	0%	15% (3-25%) (verlaging piekbelasting)
Piekvermindering CPP (commerciële partijen en industrie)	Niet-gereguleerd/ Gereguleerd	0%	30% (23-45%) (verlaging piekbelasting)
Piekverschuiving TOU (huishoudens)	Niet-gereguleerd	0%	4% (0-5%) (verlaging piekbelasting)
Piekvermindering CPP (huishoudens)	Niet-gereguleerd	0%	16% (13-20%) (verlaging piekbelasting)
Energiebesparing door TOU	Niet-gereguleerd	0%	4% (0-5%) Absolute besparing

Peak shift C&I
With automation

Peak shift residential; with automation

Price reaction US: Time varying rates (Faruqui, 2012 US)
Peak reduction potential

Figure 2



TOU: Time of use
PTR: Peak time rebate
CPP: Critical Peak price

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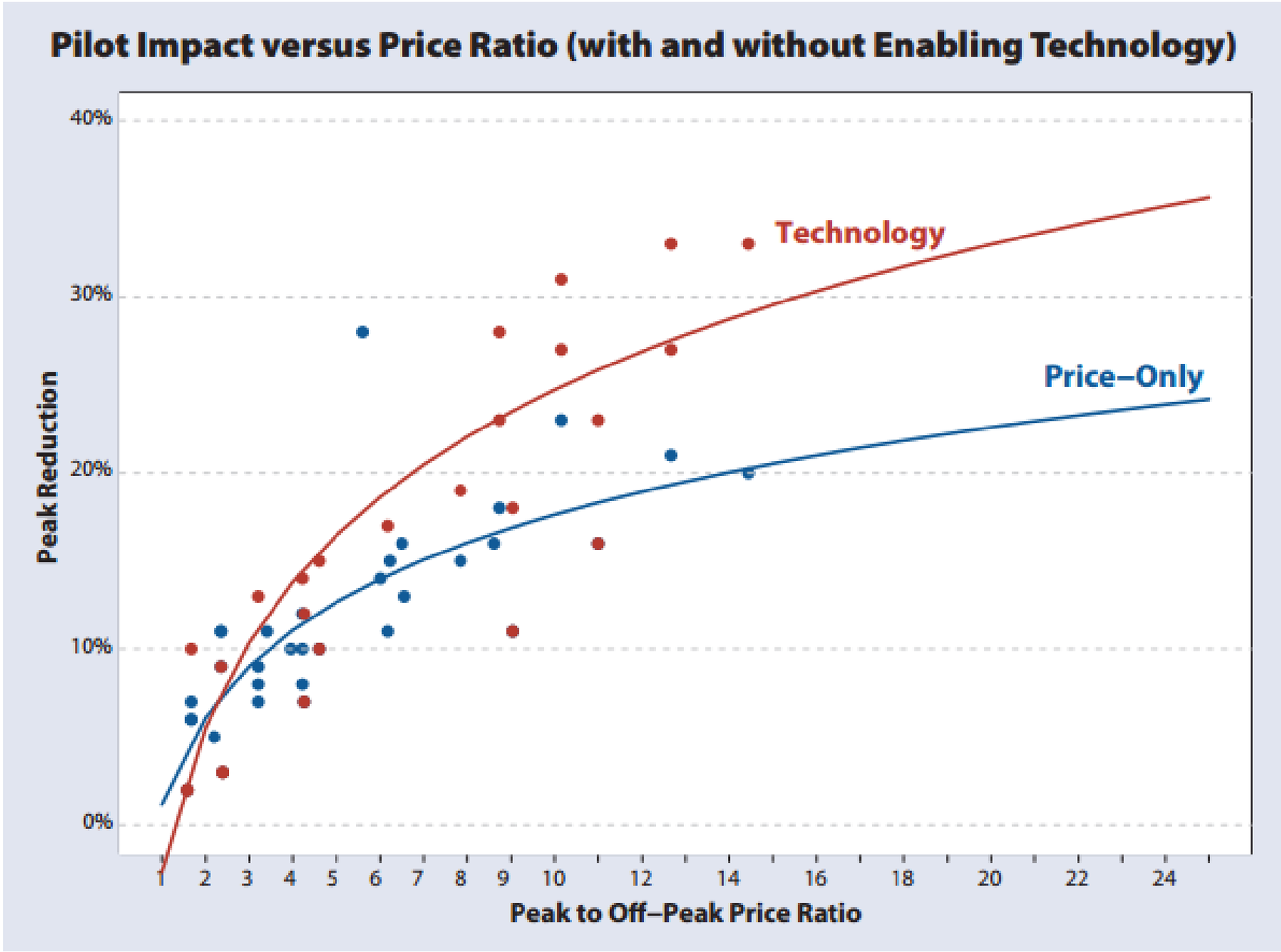
Price reaction US: Time varying rates (Faruqui, 2012 US) price elasticity and technology dependency

Figure 6



Valuation, cost and benefits

- NL study societal benefits
- Rocky Mountain Institute study
- Faruqi data

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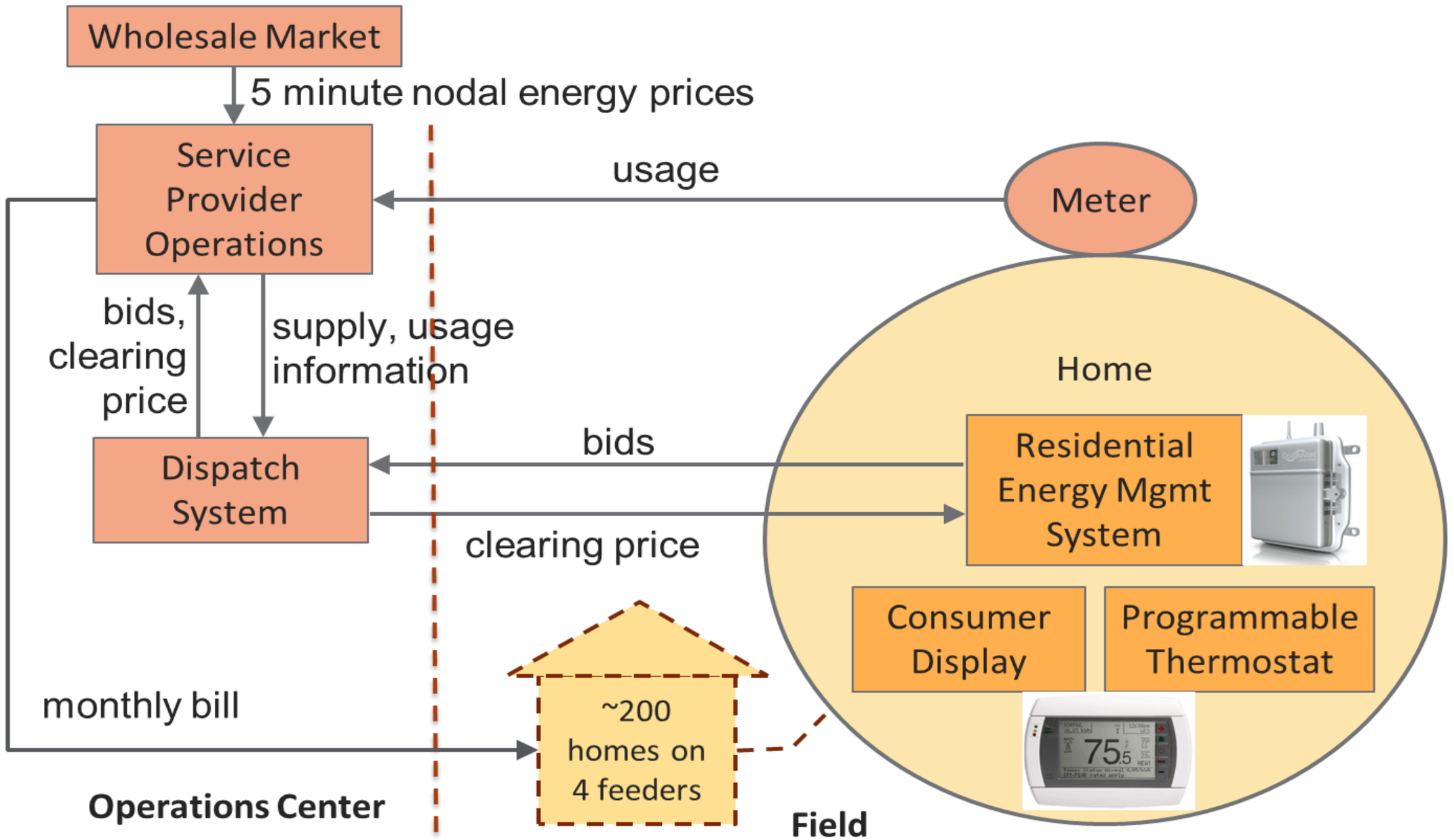
Demand side integration US: Transactive gridSMART



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Demand side integration US: Transactive gridSMART

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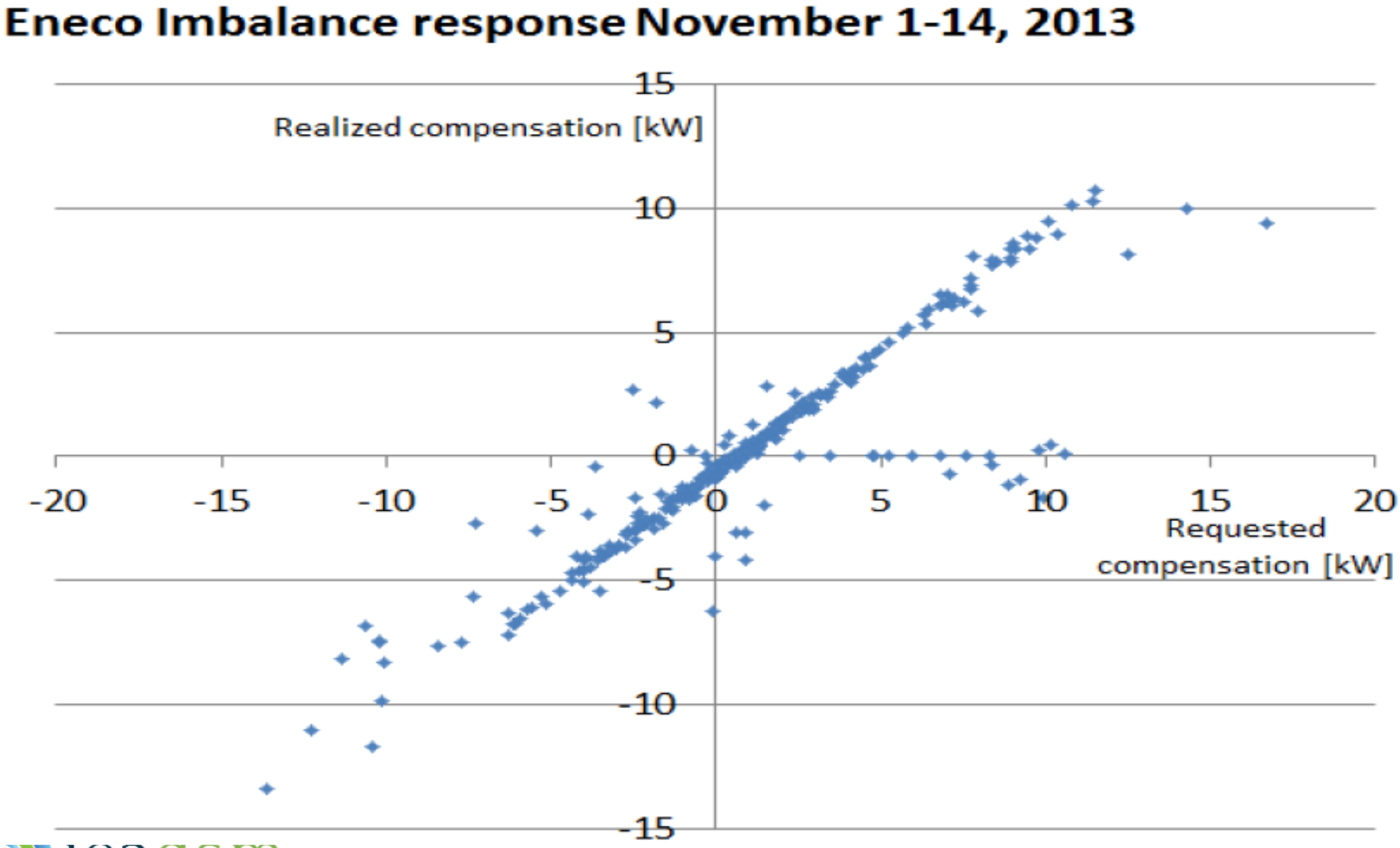
Demand side integration NL: Transactive Couperus



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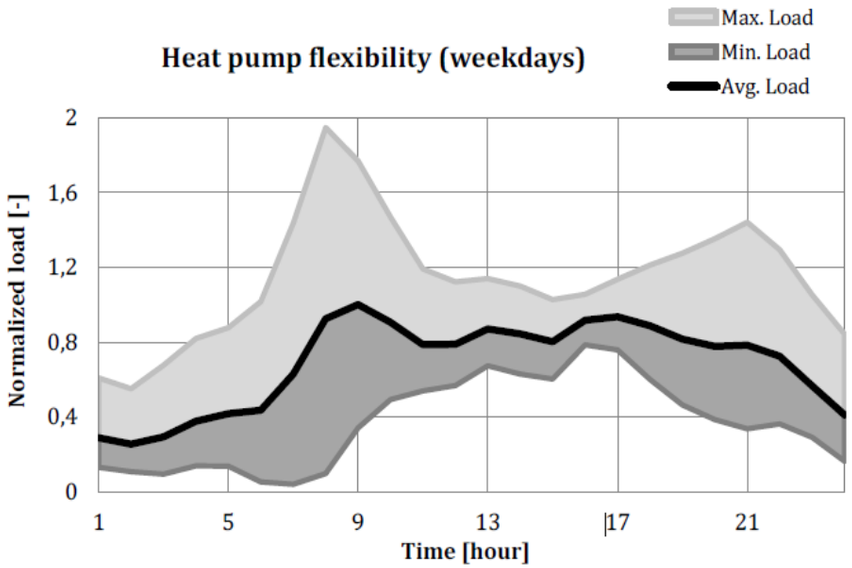
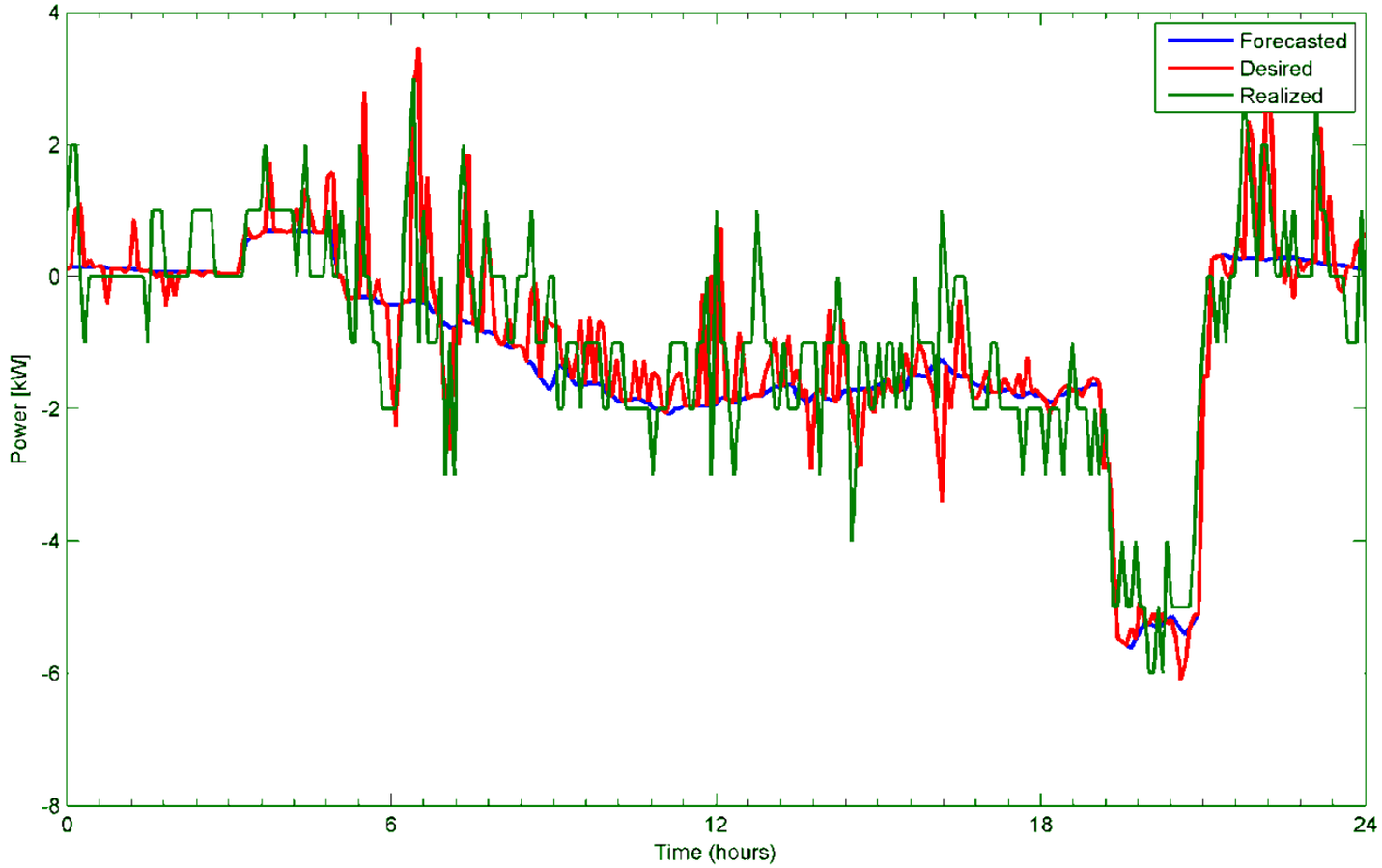
Demand side integration NL: Transactive PowerMatchingCity





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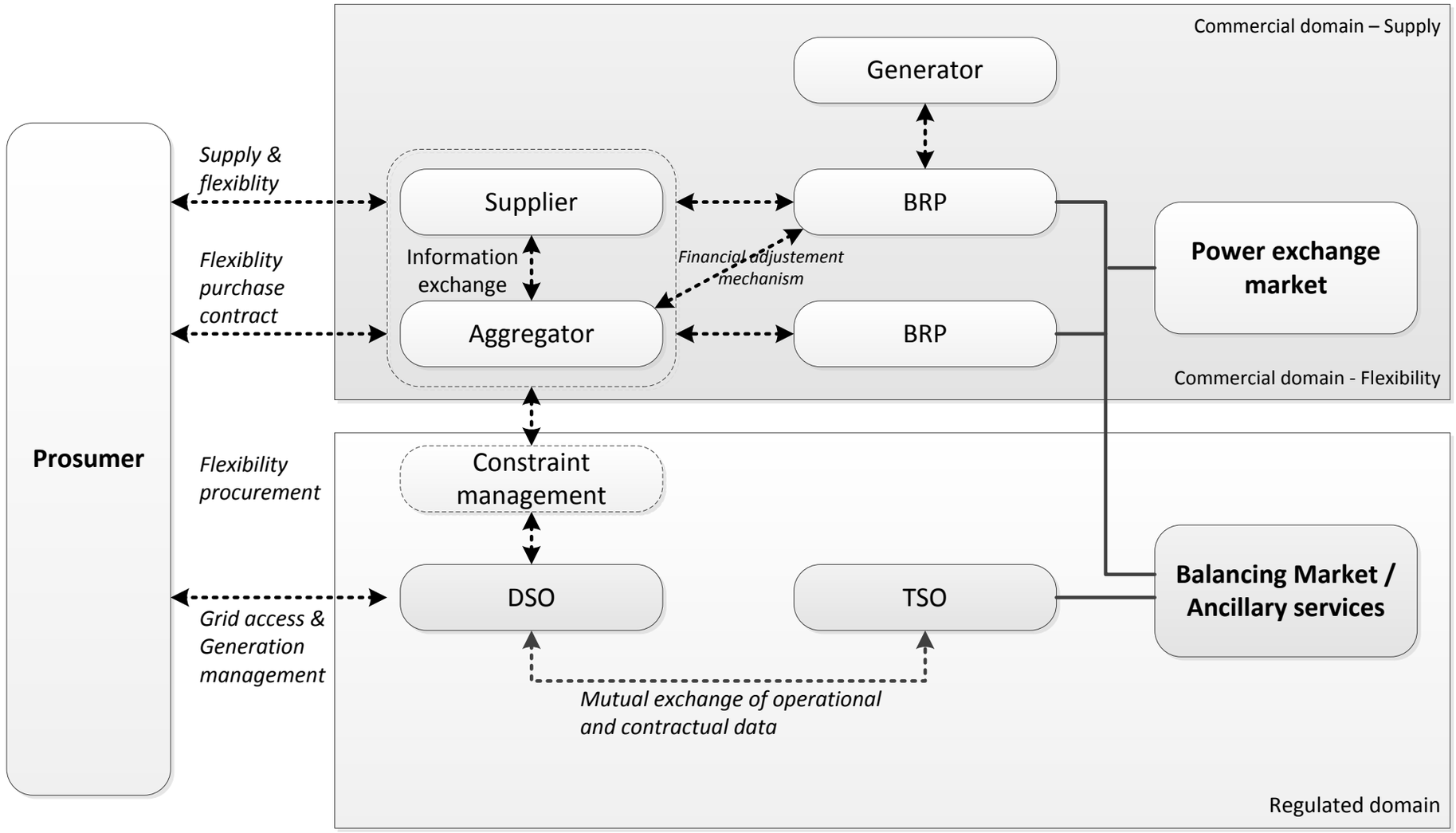
An integrated approach for future energy systems; required



Example of a layered bi-partitioning of electricity markets – possible relations between markets (Source: Expert Group 3, Smart Grid Task Force, "Regulatory Recommendations for the Deployment of Flexibility)

Observations

- Create lower limit and pre-qualification for market access
- Better mapping of distribution tariff components
- Remove top-down model remnants in legislation
- Rematch capability models and actors in the value stream
  - E.g. Aggregator
- Characterize resources and provide interfaces for components
  - e.g. Connected Building characterization framework (DoE), SG Ready Label,

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Progress Subtask 13 – Preliminary Recommendations

1. **Community creation supports user activation** as the sense of belonging to a community influences the engagement and participation
2. **Variable tariff models need to offer an added value** for an acceptable price to attract consumers
3. Based on the visualized electricity consumption data **consumers can be incentivized with premiums and other rewards** to participate in DR programs
4. **Data protection, privacy & security aspects need to be considered** when ICT infrastructures and systems are designed and participation agreements with consumers concluded
5. The institutional and regulatory transformation of the energy market requires the **introduction of new market players** that develop services attractive for consumers
6. **Detailed cost-benefit-analyses** are crucial for defining the added value of business models; financial advantages for consumers are quite low. Thus, aggregators respectively companies, who offer aggregation services, need to concentrate on key messages on a broader level in order to attract consumers
7. **Standardization and interoperability of technologies proved to be a basic condition** for interaction of technical appliances and enabling technologies.

Contact

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