IEA DSM Task 17:
Integration of DR, DG, RES and ES

Phase 3: Systems View on Enabling Flexibility in the Smart Grid

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Background

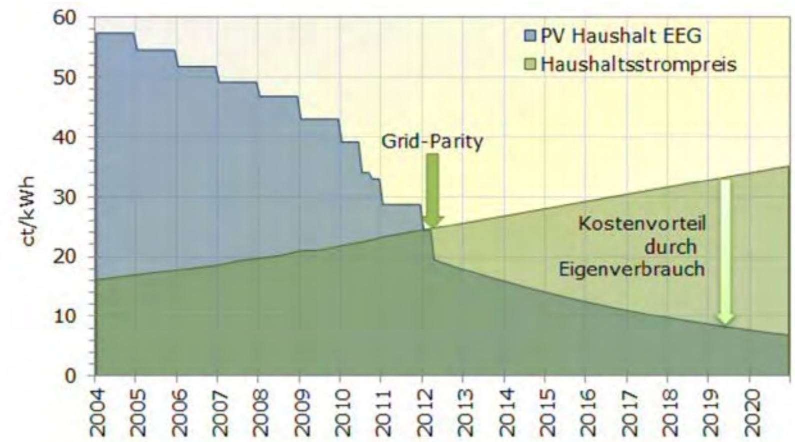
Increase of distributed generation – need for flexibility

- Increase of (**local) distributed generation** (e.g..: PV, CHP, Wind)

  → PV: „grid-parity“:
  → Impact on network: curtailment
  (Germany: since 2013: 60% Peak curtailment)

- Need of **Flexibility** of the demand

  → DR potential of storage
  - thermal: hot water, heat pumps
  - electric: batteries



Grid parity in Germany (Quaschning, 2012)

Background and Motivation

More reasons for the integration of demand resources

- **Integration** of renewable and distributed generation
  - Avoid peak generation
  - Mitigate fluctuations
- **Increase** of system efficiency and self coverage
  - (Local) supply - demand match
- **Reduction** of peak power, balancing reserve
  - Example: California „Title 24“ Building code: Requires building systems to be ready for demand response energy management

Background and Motivation

Studies and ongoing activities

- "**Shift, not Drift:** *Towards Active Demand Response and Beyond*" – Think, June 2013
- **"Integration of Renewable Energy in Europe"** – Imperial College, NERA. DNV-GL, June 2014
- **IEC/TR 62746-2** (DRAFT), *Systems interface between customer energy management system and the power management system,* June 2013

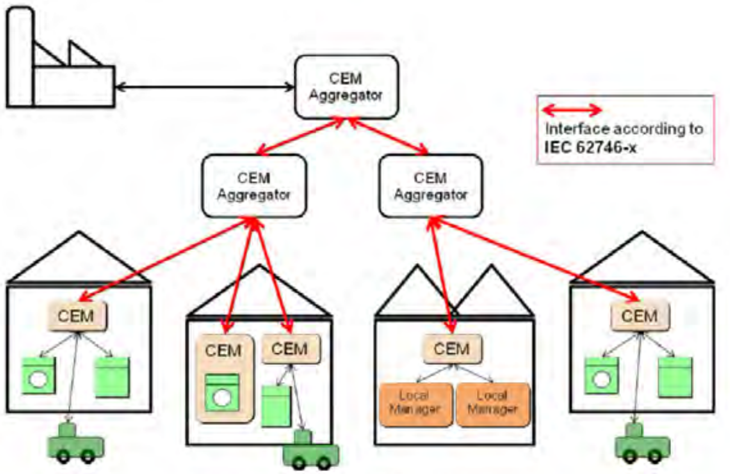
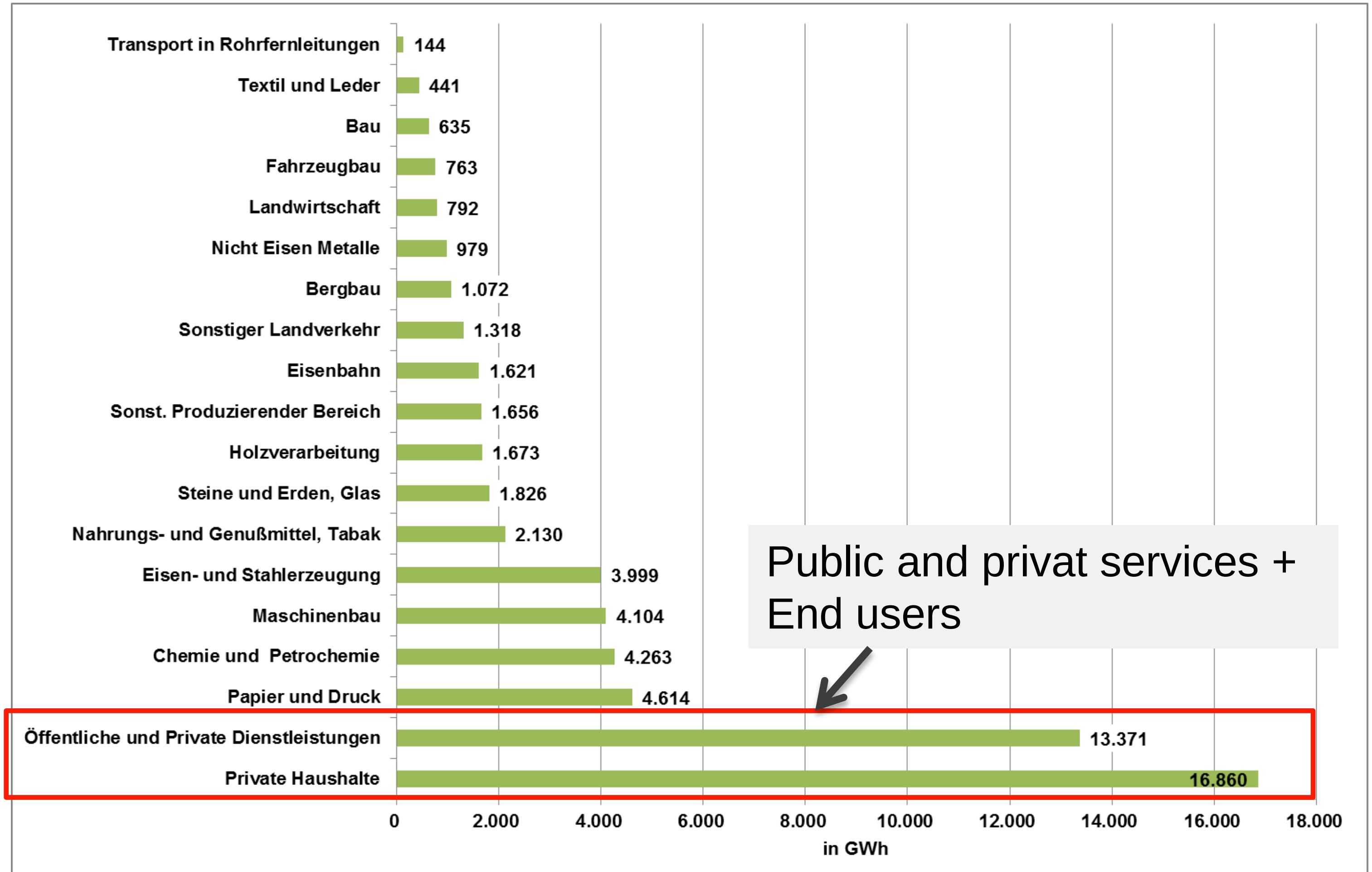


Figure 6: Cascaded CEM architecture

Background and Motivation

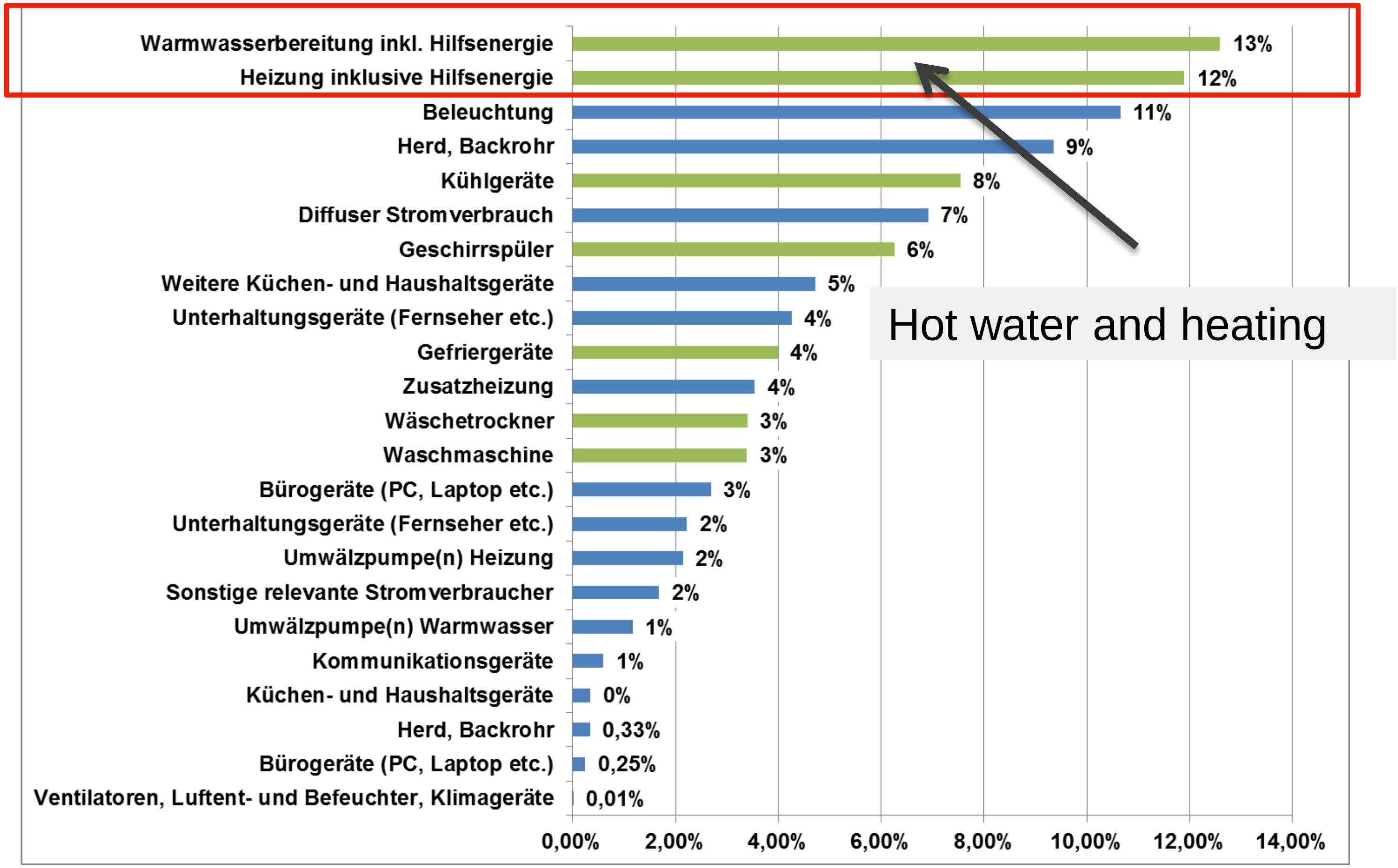
Sectoral electricity end use in Austria (2012)



Source: Statistik Austria, 2013

Background and Motivation

Categories of electricity use in households (2012)



Source: Statistik Austria, 2013

IEA DSM Task 17

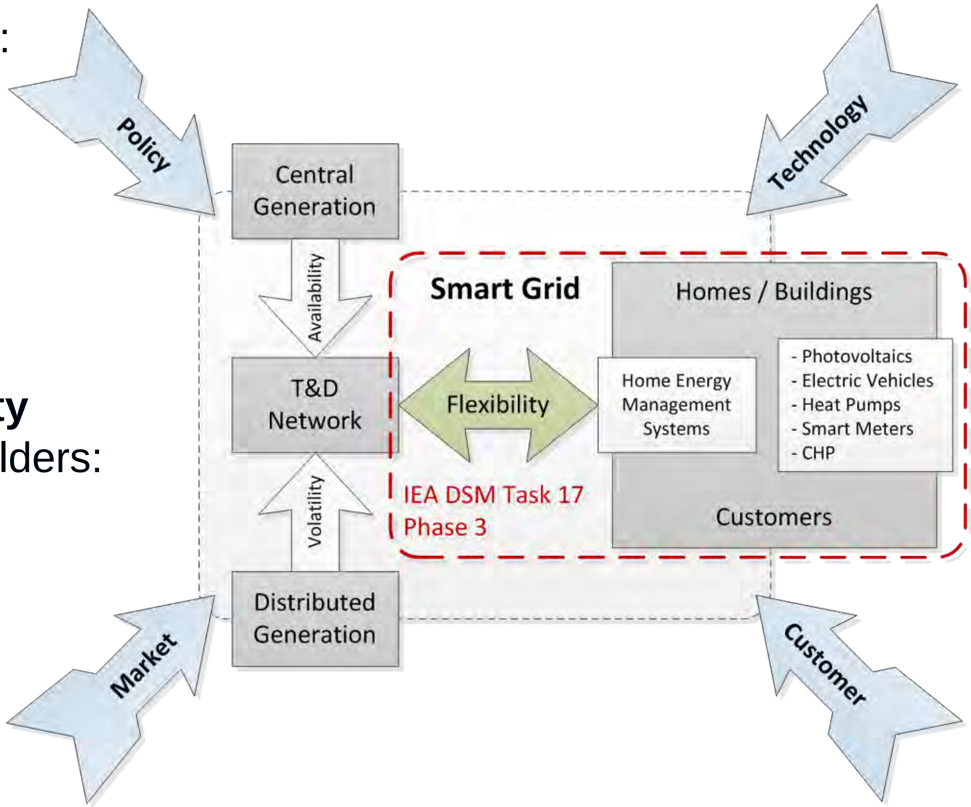
Objectives, Subtasks, Outcomes

Subtask of Phase 3 - Introduction

Systems view on enabling flexibility in the smart grid

- **Different views** on the Smart Grid:
  - Technology
  - Customer
  - Policy
  - Market

- Focus on the **enabling of flexibility** 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?



Subtask of Phase 3 - Introduction

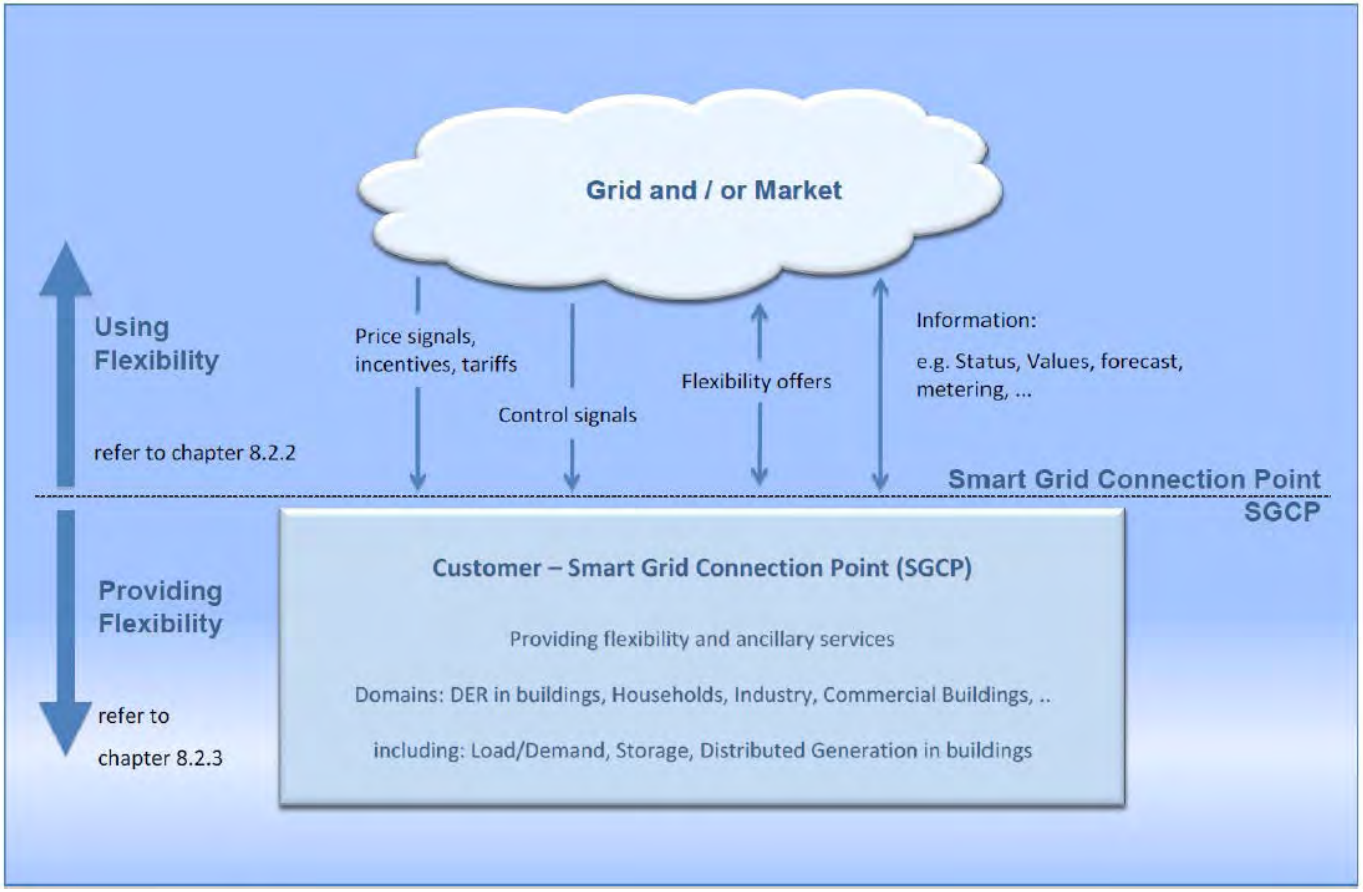
Differences to on-going initiatives and working groups

- Phase 3 is **not about**:
  - Standardisation
  - SG Reference Architecture
  - Interoperability – protocols and formats
  - Business models
  - Use case repository
  - Cyber security
- Phase 3 is **about** analysing the interaction with the system:
  - Existing implementations, prototypes, pilot projects
  - Gap between theory and practice,
  - Identify missing methods / tools (DR forecasting)
  - Applicability to different countries, regions and regulatory frameworks

Subtask of Phase 3 - Introduction

Systems view on enabling flexibility in the smart grid

- **Technical Interfaces** CEN-CENELEC-ETSI Smart Grid Coordination Group



Subtask of Phase 3 – Overview of the Subtasks

Systems view on enabling flexibility in the smart grid

- **Subtask 10:** Role, and potentials of flexible prosumers (households, SMEs, buildings)
- **Subtask 11:** Changes and impact on stakeholders operations
- **Subtask 12:** Sharing experiences and finding best/worst practices
- **Subtaks 13:** Conclusions and recommendations

Expected Outcomes and Results

Deliverables, Publications, Contributions

- **Deliverables, Recommendations, Publications**
  - “Roles and potentials of providing flexibility in production/consumption using CEMS/HEMS systems”
  - “Financial and maturity assessment of technologies for aggregating DG-RES, DR and electricity storage systems”
  - “Best practices in applying aggregated DG-RES, DR and Storage for retail customers”
- **Public Workshops**
  - Summary / Review / Presentations
- **Newsletters**
  - IEA DSM Spotlight
- **Networking, Collaborations**
  - Exchange Information with international and national Stakeholder Groups
  - ISGAN, IEEE IC-CSHBA, EC SG-Expert Group, IEEE IES TF Smart Grids
- **Project/Task Proposals**

Experiences from pilots and field tests

Sharing best and bad practices and defining use cases

Project SGMS-HiT– Smart Grids Model Region Salzburg

Buildings as interative participants in the Smart Grids

SMARTGRIDS Modellregion Salzburg · Salzburg AG · Salzburg Wohnbau · cure center for usability research & engineering · SIEMENS

SGMS – HiT

Utilizing HVAC-Systems (heating, hot water)

- Separate **usage of energy** from **energy supply**

  → **Buffering** with thermal storages

- Use **energy** which is most **efficient** for the grid
  - Biogas (CHP)
  - PV
  - Grid
  - District heating

  → **grid friendly building**

- **Comfort** must be **preserved**.

SGMS – HiT

User interaction

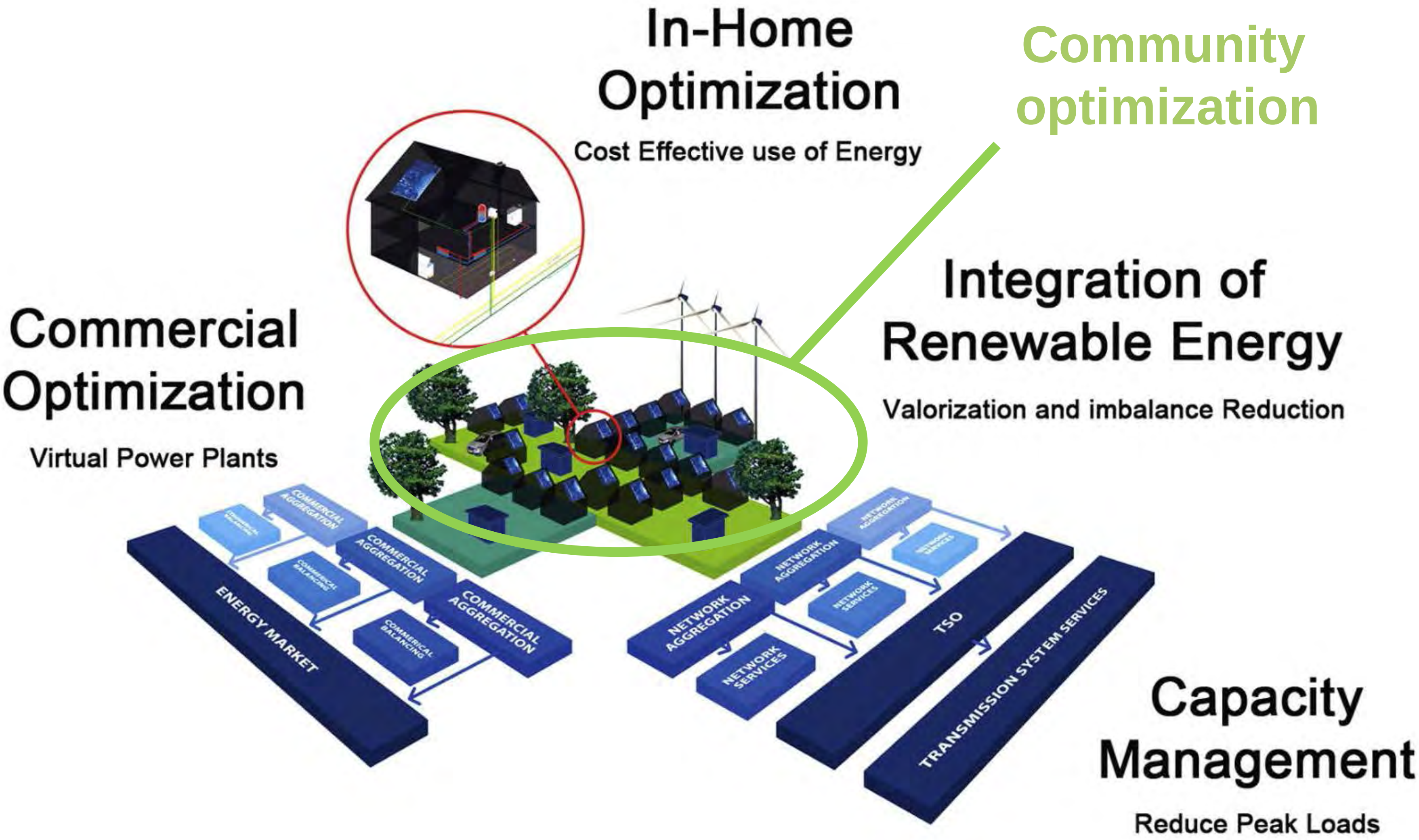
- **FORE-Watch**

12 hours forecast

- (simulated) Tariffs

RED:	Standard Tariff + 5 Cent / kWh
YELLOW:	Standard Tariff
GREEN:	Standard Tariff – 5 Cent / kWh

Project: Power Matching City (NL)



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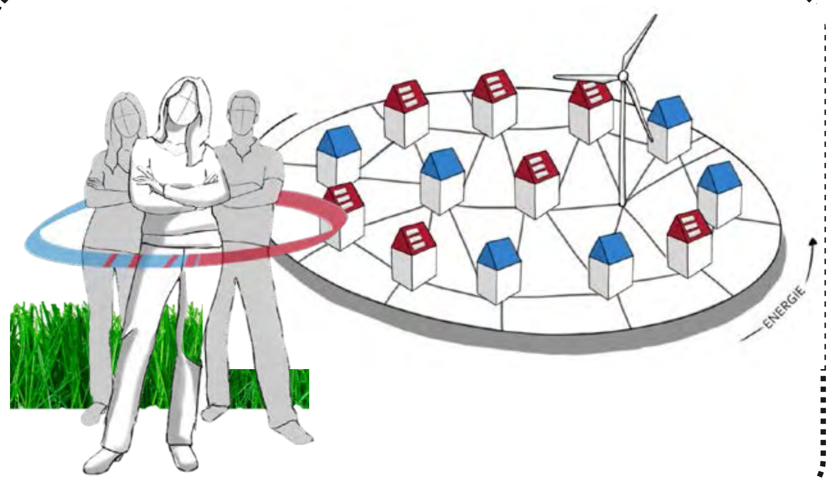
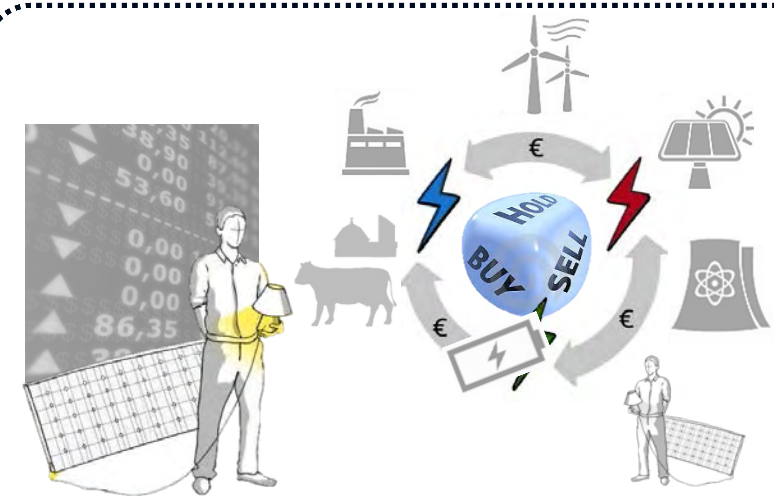
Project: Power Matching City (NL)

Propositions are based in driving forces of customers

Renewable



Smart cost saving



Scope: **PV, µ-CHP , heat pump, washing machine, dish washer**

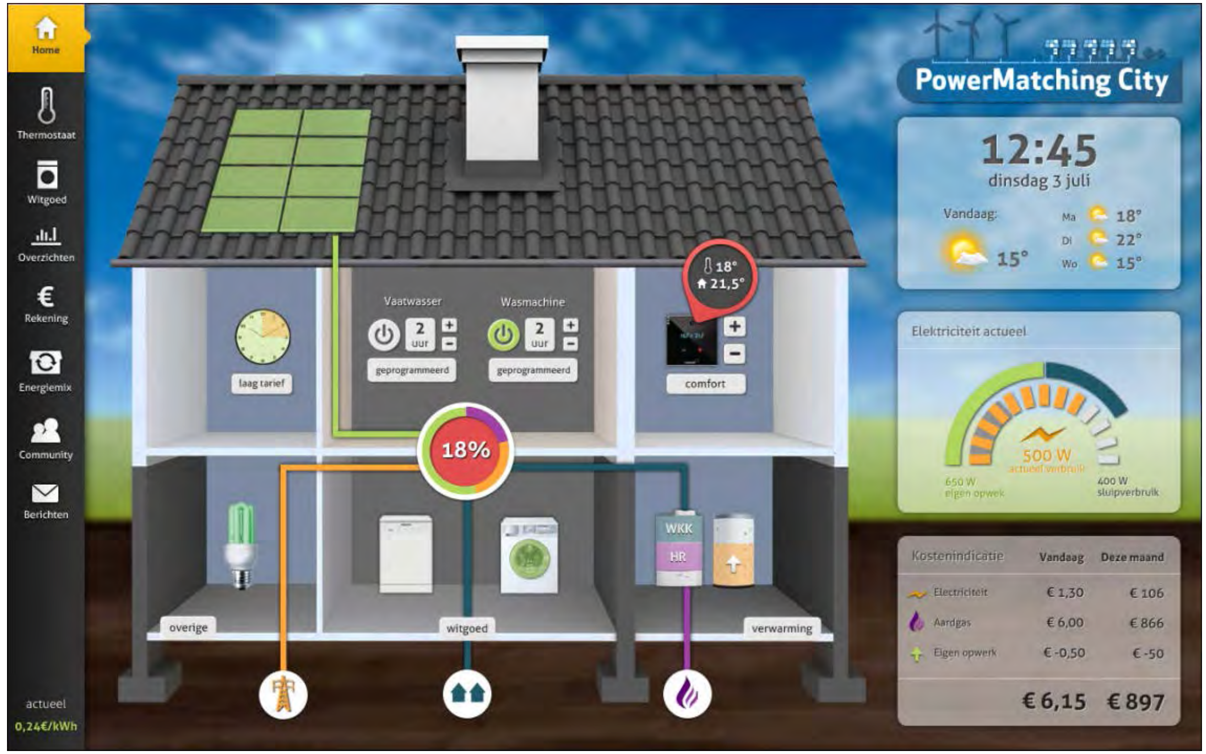
- **Utilize renewables**
- **Independent**
- **Comfort**

- **Together Minimize cost**
- **Lowest price**
- **Retain comfort**

PowerMatching City

Project: Power Matching City (NL)

Energy dashboard information

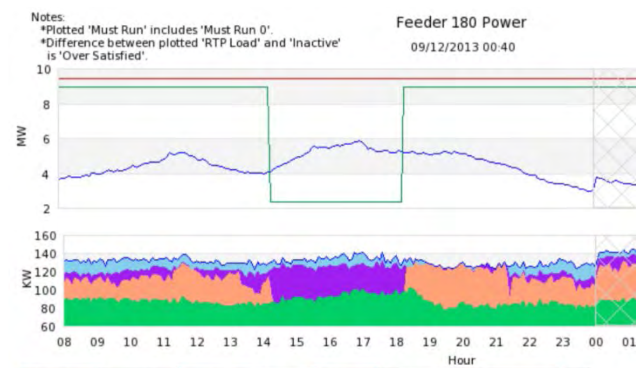


- Variable price for energy (real-time, history)
- kWh vs price
- Feedback on cost-effective operation of devices
- Monthly cost-saving
- Usage at several tariff zones

- Home balance: kW, kWh (real-time , history)
- Community balance: kWh (in real-time , history)
- Monthly usage per energy carrier

Project: gridSMART® RTPda Demo

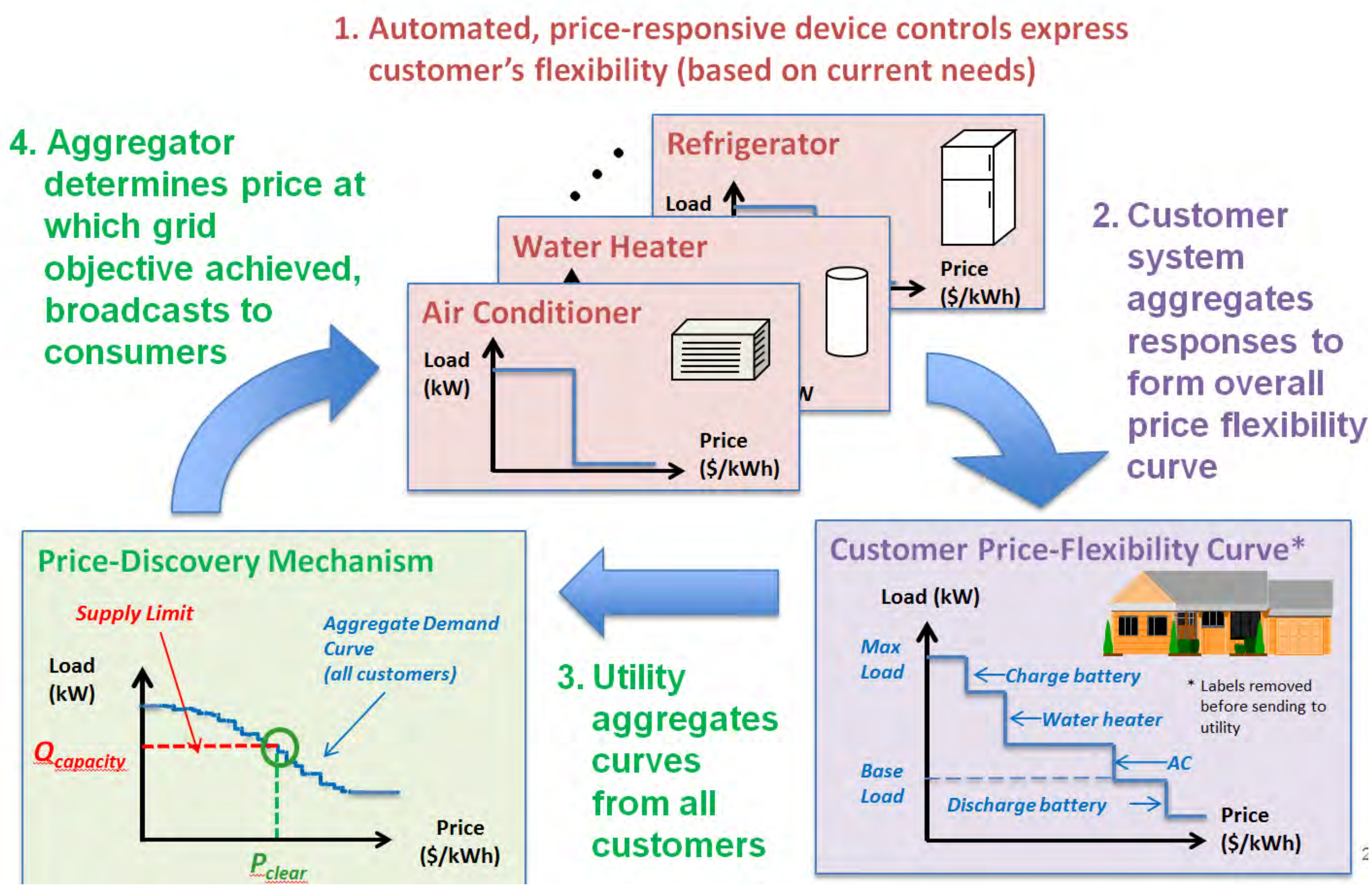
- First real-time market at distribution feeder level with a tariff approved by the PUC of Ohio
- Value streams
  - Energy purchase benefit
  - Capacity benefits: e.g., peak shaving
  - Ancillary services benefits
- Uses market bidding mechanism to perform distributed optimization – transactive energy
  - ~200 homes bidding on 4 feeders
  - Separate market run on each feeder
  - “Double auction” with 5 minute clearing
- HVAC automated bidding
  - Smart thermostat and home energy manager
  - Homeowner sets comfort/economy preference
  - Can view real-time and historical prices to make personal choices



Rated Cap.	9.426 MW	Must Run	79 KW	Inactive	6.3 KW	# HEM's	98
Cong. Lim.	8.9547 MW	Must Run 0	1.5 KW	Over Sat.	15 KW	# Bidding Devices	90
Total Power	3.0293 MW	Active	22.6 KW	RTP Load	124.4 KW		

Project: gridSMART® - Residential Real-time Pricing

Overview – Transactive Grid Control



Outlook

Status, Events

Outlook

IEA-DSM Task 17 – Phase 3

- **Start:** May 2014 - **End**: April 2016
- **Ongoing work**
  - Use case collection and analysis
  - Flexibility potential method development
  - DR Potentials in Austria – applicability of DR concepts
- **Upcoming events**
  - IEA Expert Group on R&D – *The role of storage in energy system flexibility* – 22./23. October in Berlin
  - Next Expert Meeting 3./4. November in Leiden (NL)

Countries
Austria
Switzerland
Sweden
Copper Alliance
Netherlands
USA
Italy
Belgium
India
Finland
Germany
Serbia

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Appendix

Additional Information

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Subtask of Phase 3 – Subtask 10

Role, and potentials of flexible prosumers (households, SMEs, buildings)

- **Controllability** requirements (generation and consumption)
- **Opportunities**, **challenges** and **barriers** for flexibility services (providers and technologies)
- Energy and power **balancing potentials**
- **Smart technologies** (SM and Customer Energy MS)
  - VPPs
  - EV charging
  - DG-RES integration and storage
  - Integrating heat pumps and thermal storages

Subtask of Phase 3 – Subtask 11

Changes and impact on stakeholders operations

- Methodology development for **assessing/quantifying impact**
- **Grid**, **market** and **customers** (prosumer/consumer) interaction
- Sharing common **benefits/losses**
- **Optimization potential** (eg. DR building audits and customer requirements)
- **Regulatory** and **legislative** requirements
- Comparison **costs** vs. delayed **investments**

Subtask of Phase 3 – Subtask 12

Sharing experiences and finding best/worst practices

- **Collection of data**
  - Workshops

- **Lessons learned** from existing pilots
  - EcoGrid-EU Bornholm, PowerMatchingCity I and II, Linear, Greenlys, Building2Grid, SmartCityGrid: CoOpt, eEnergy, …

- **Country specifics**
  - differences in the implementation
  - applicability

- **Extrapolation** of the results from previously collected projects on applicability

Subtask of Phase 3 – Subtask 13

Conclusions and recommendations

- Based on the **experts' opinion**

- Will provide a **ranking** based on
  - Impacts
  - Costs
  - Future penetration of the technologies

Collaboration with ISGAN

Contributions and exchange of results with focus on DSM technologies

Collaborations on **DSM specific focus**:

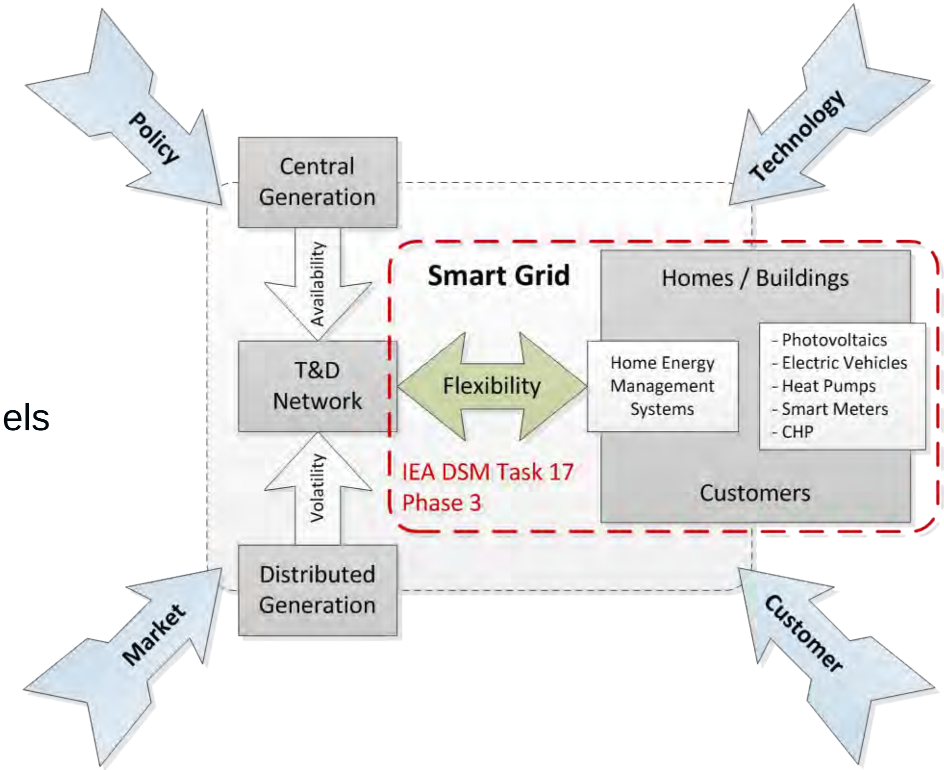
- Common workshops
- Contribute to ISGAN reports

Annex 1:
- Requirements for enabling flexibility

Annex 2:
- Use Cases and implementation models
- Best and bad practices

Annex 3:
- Impact on stakeholders
- Cost and benefits

Annex 4:
- Recommendations



CEMS and Power Management System interfaces

IEC 62746 Technical Report Objective

Use cases and requirements for the interface between the power management system of the electrical grid and customer energy management systems for residential and commercial buildings and industry.

- User stories → use cases → data model → information content & structure
- Examples:
  - The user wants to get the laundry done / EV charged by 8:00pm
  - Grid recognize stability issues
  - CEM feeds own battery pack energy into own network or into the grid
  - Heat pump and Photovoltaic Operation with Real-Time Tariff

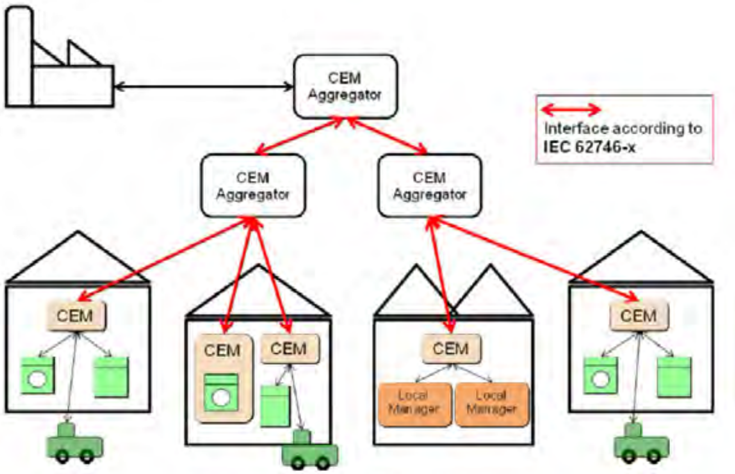


Figure 6: Cascaded CEM architecture

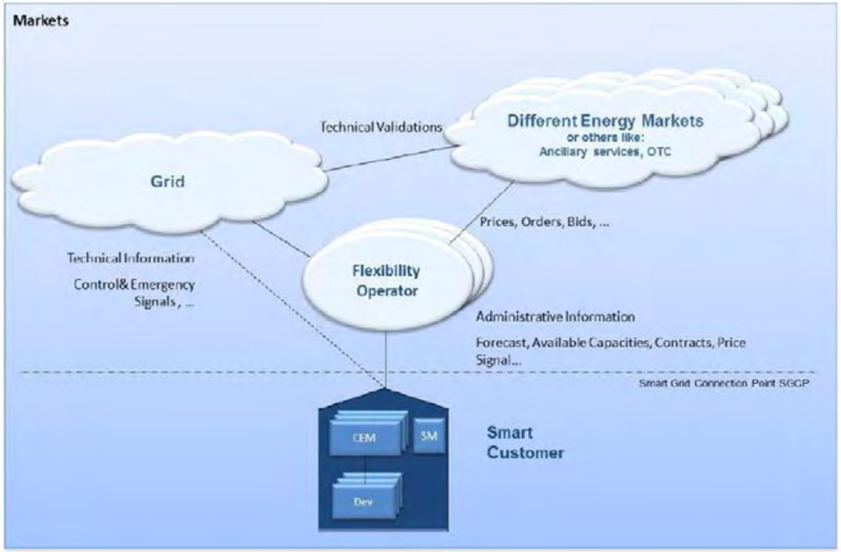
Smart Grid Coordination Group – Sustainable Processes

CEN, CENELEC and ETSI - M/490

The “Smart Grid Use Case Management Process” essentially describes the implementation of use cases in the standardization environment.

- Flexibility concept, understand demand response, Smart Grid & EV
- → Flexibility functional architecture
- → Use Case collection

- Examples:
  - Customer Energy Manager (CEM)
  - Market roles and interaction
  - Assessing impact of flexible resources on the grid (traffic light)
  - Flexibility operator



Collaboration with IC-CSHBA

Contributions and Exchange

IEEE-Standards Association *Industry Connections - Convergence of Smart Home and Building Architectures* (IC-CSHBA):

- Common workshops
  - Exchange experiences
- Implementation Guide white paper
  - Use Cases and implementation models
  - Best and bad practices
  - References
- Recommendations