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SAPIENZA
UNIVERSITÀ DI ROMA



Panoramic
POWER™

DEVELOCO
PRODUCTS



A.V. LUTKOV HEAT AND MASS TRANSFER INSTITUTE OF
THE NATIONAL ACADEMY OF SCIENCES OF BELARUS



SmartHG at a glance

- **EU FP7 Project** Number 317761
- Period: **Oct 1, 2012 – Sept 30, 2015**
- Funding: **€ 3.3M**
- Coordinator:

Enrico Tronci
Sapienza University
Rome, Italy

<http://smarthg.di.uniroma1.it>

Consortium

1. Sapienza University of Rome (**Italy**) - Coordinator
2. Aarhus University (**Denmark**)
3. IMDEA Energía (**Spain**)
4. A. V. Luikov Heat and Mass Transfer Institute of the National Academy of Sciences of Belarus (**Belarus**)
5. ATANVO GmbH (**Germany**)
6. Develco Products A/S (**Denmark**) replacing GridManager A/S (DK)
7. Panoramic Power (**Israel**)
8. Solintel (**Spain**)
9. SEAS-NVE (**Denmark**)
10. Kalundborg Municipality (**Denmark**)
11. Minskenergo (**Belarus**)

Project goals

Support both

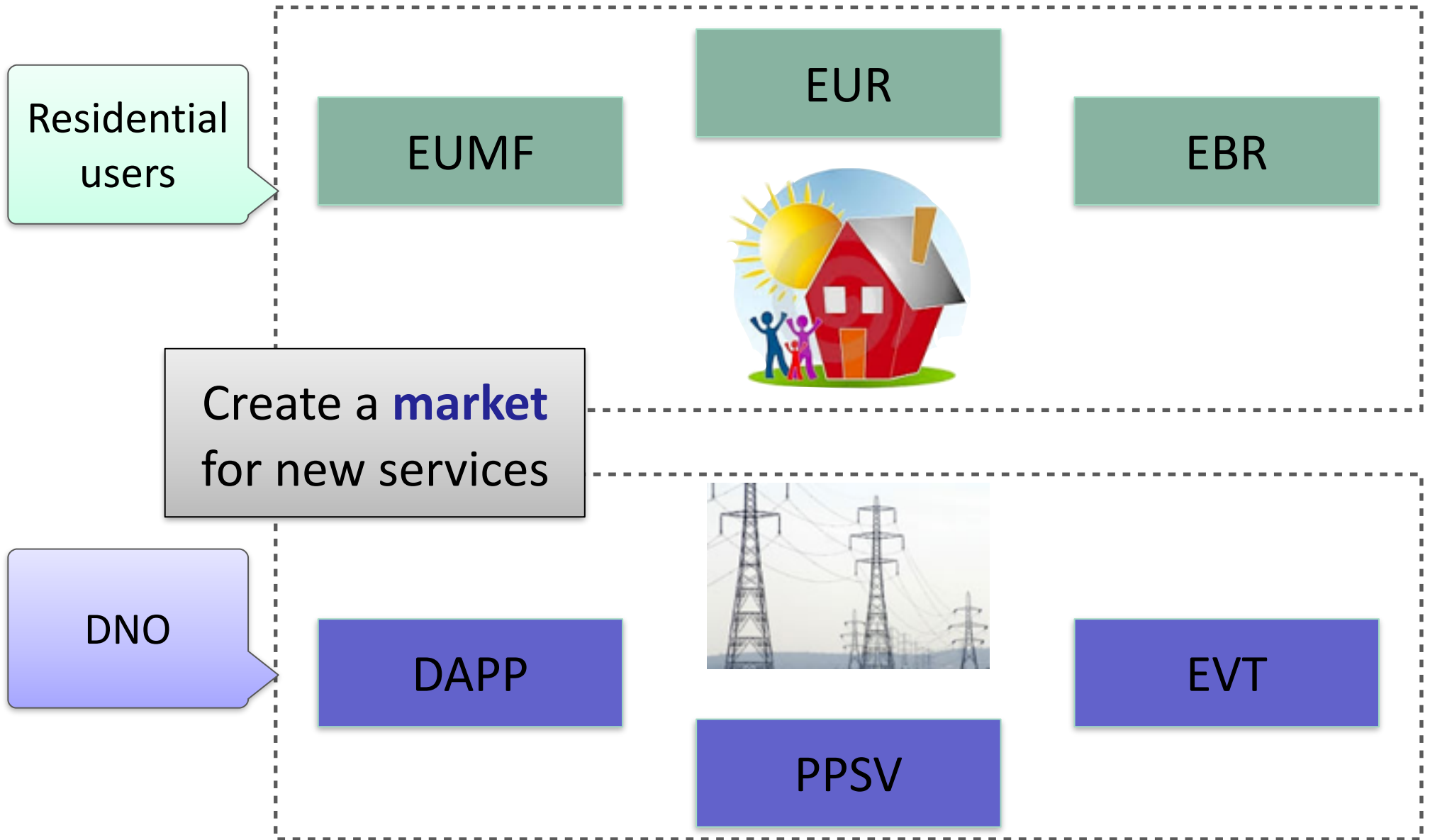
- residential users and
- Distribution Network Operators (DNO)

in exploiting the opportunities of Smart Grids:

- residential users: minimise energy usage & cost
- DNO: optimise grid operation

Make the aggregation of benefits for single residential users a business case for DNOs

Intelligent Automation Services



Intelligent Automation Services: EUMF

Energy Usage Modelling and Forecasting (EUMF)

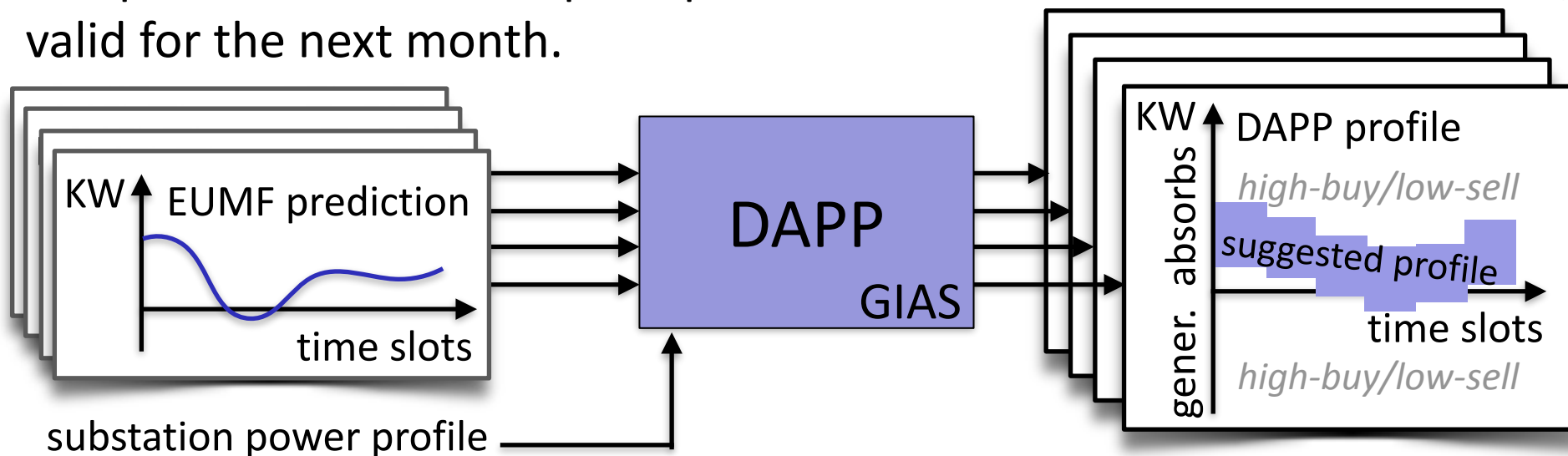
computes a **predictive** model of energy usage/generation of a residential user



Intelligent Automation Services: DAPP+PPSV

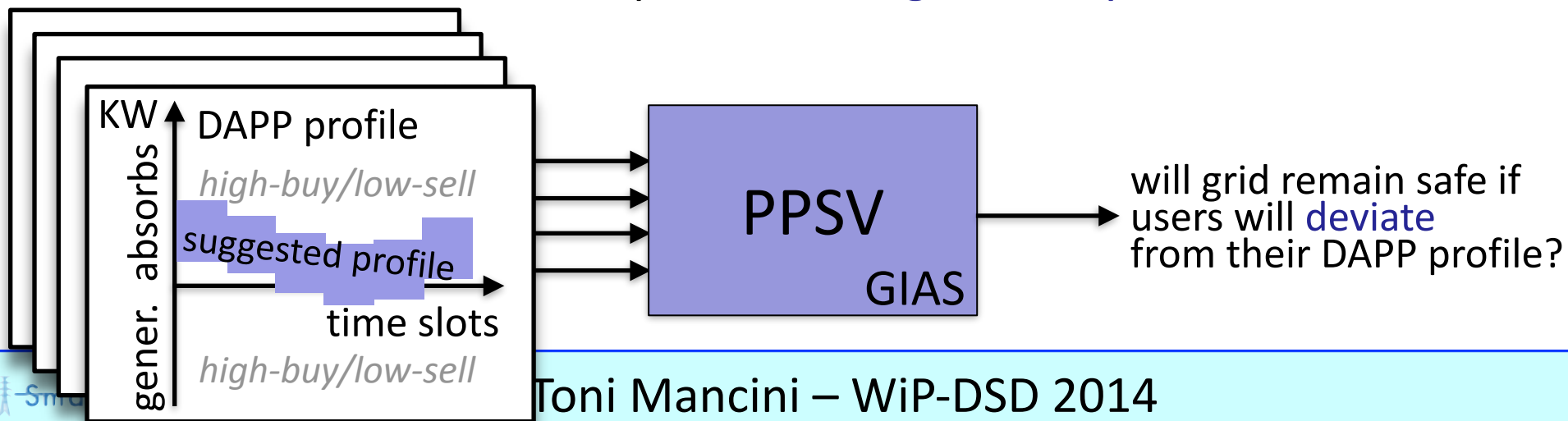
Demand Aware Price Policy (DAPP)

computes **individualised** price policies to each user on a substation line, valid for the next month.



Price Policy Safety Verification (PPSV)

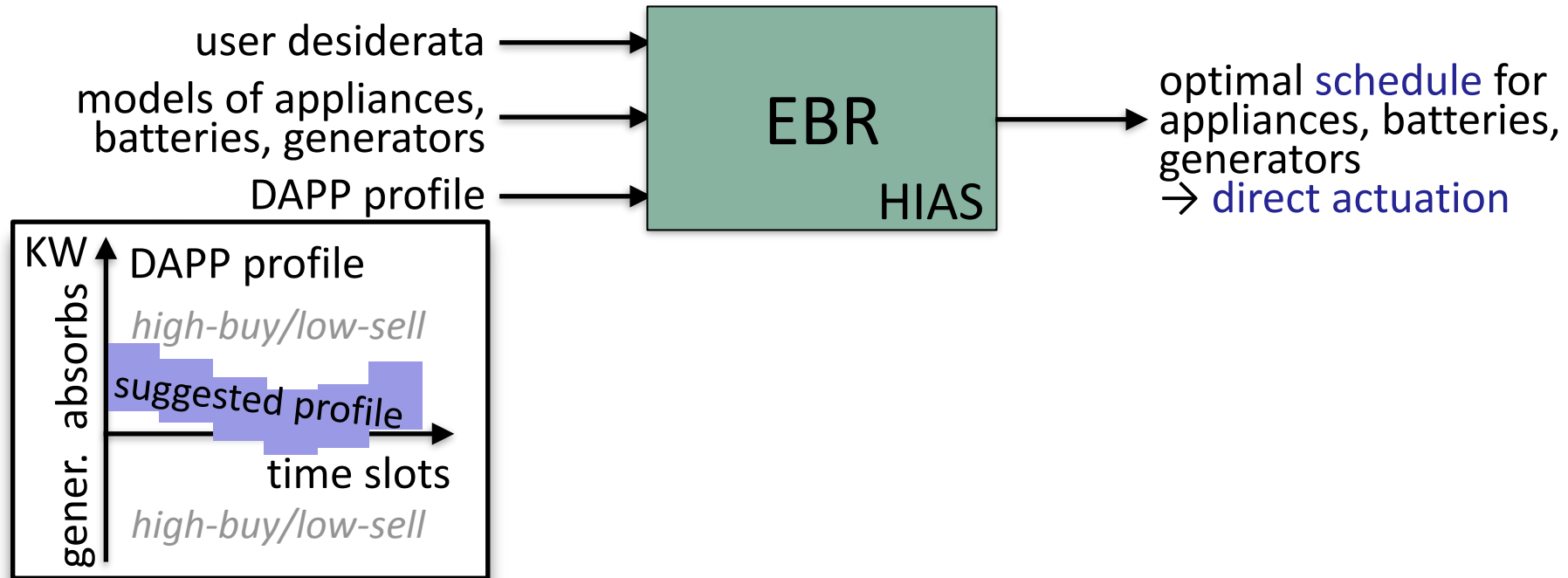
verifies **robustness** of DAPP policies wrt. **grid safety**



Intelligent Automation Services: EBR+EUR

Energy Bill Reduction (EBR)

supports residential customers in saving on energy bill, enabling load shifting



Intelligent Automation Services: EBR+EUR

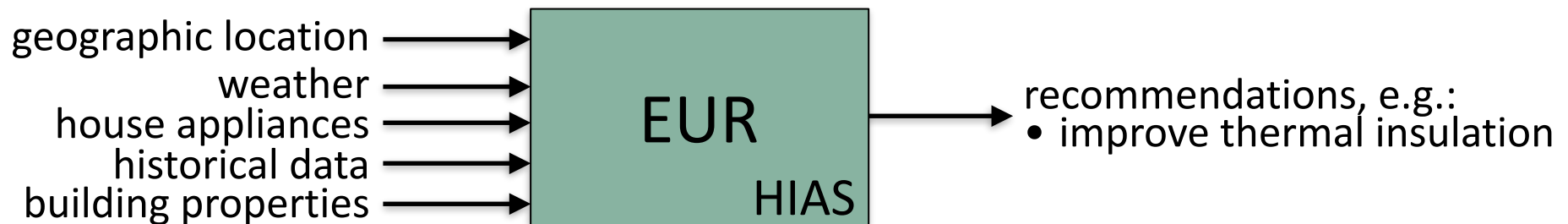
Energy Bill Reduction (EBR)

supports residential customers in saving on energy **bill**, enabling **load shifting**



Energy Usage Reduction (EUR)

supports customers in reducing energy **usage**, detecting **inefficiencies**



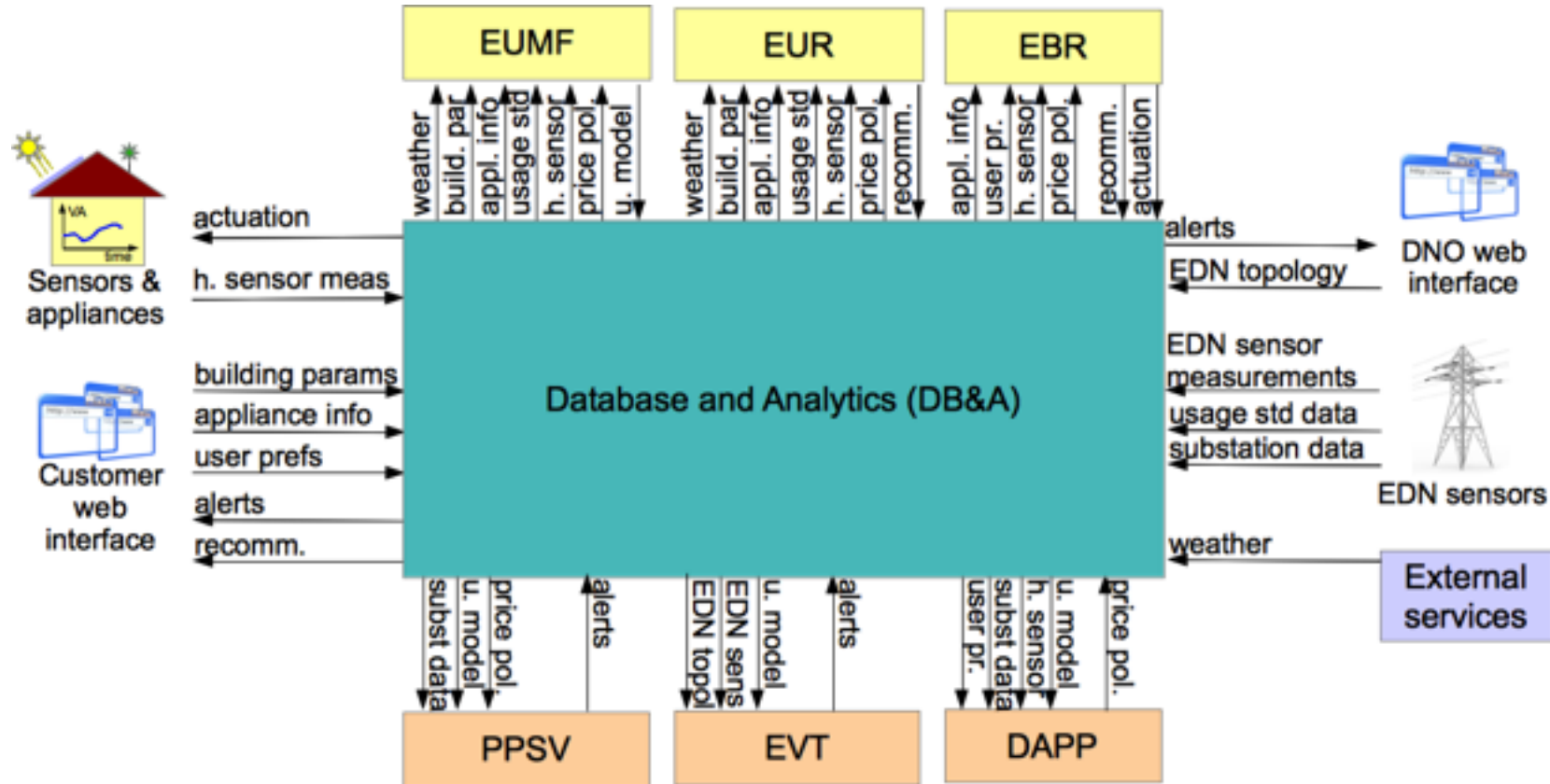
Intelligent Automation Services: EVT

EDN Virtual Tomography (EVT)

estimates grid state where no sensors are available



Database and Analytics (DB&A)



- DB&A as **secure/flexible centralised communication hub**
- IASs interact with DB&A to take/store (most of) their I/O
- hierarchy of **communication protocols**: in-house/Internet-based

Test beds



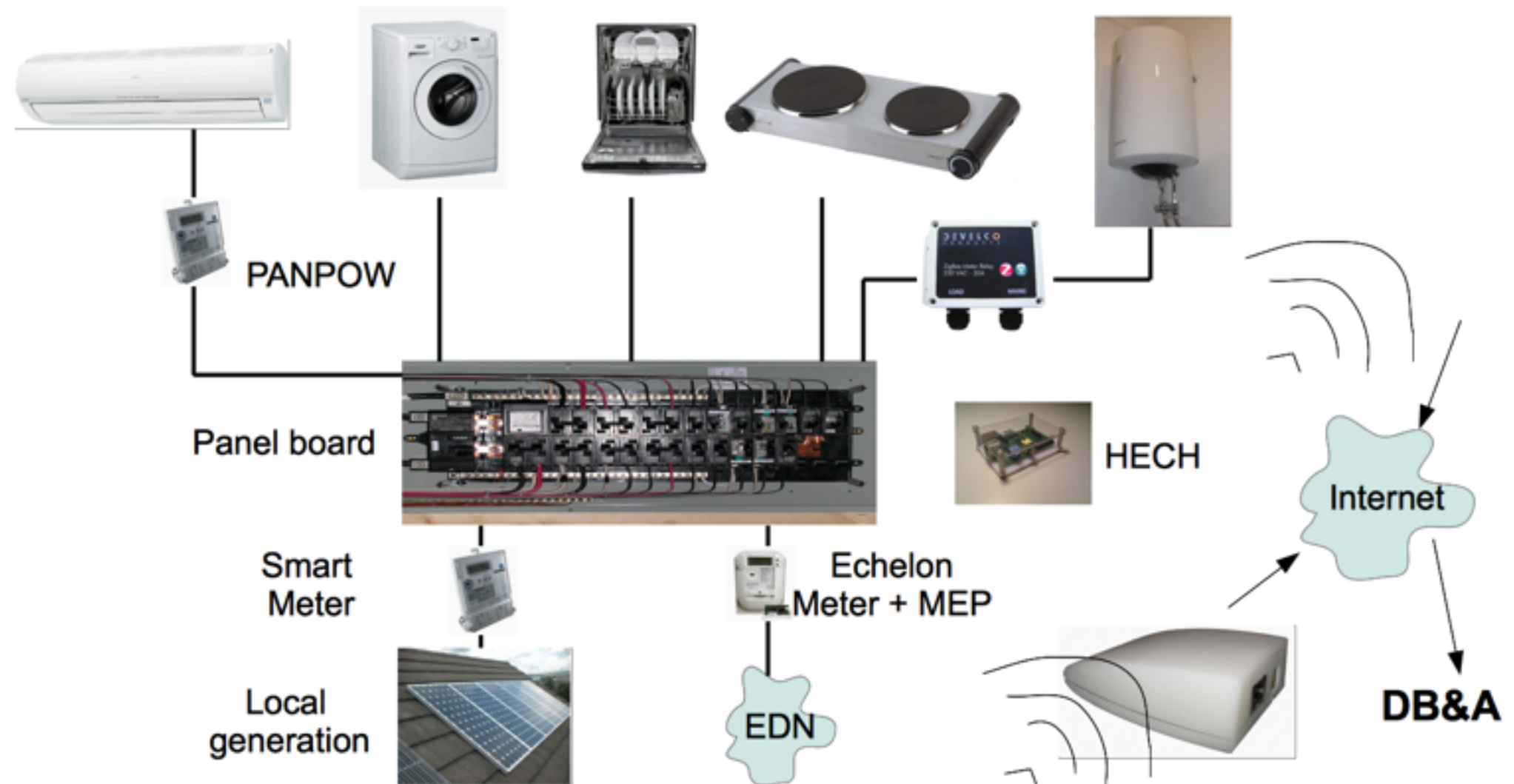
Kalundborg (Denmark)



Minsk (Belarus)

- Test beds to be equipped with **sensors** and a **communication infrastructure** for collection of energy related data
- SmartHG services to be applied on **current data**
- Adoption of **energy storage systems** within houses to be explored
- Services accessible via **web** by DNO & residential users

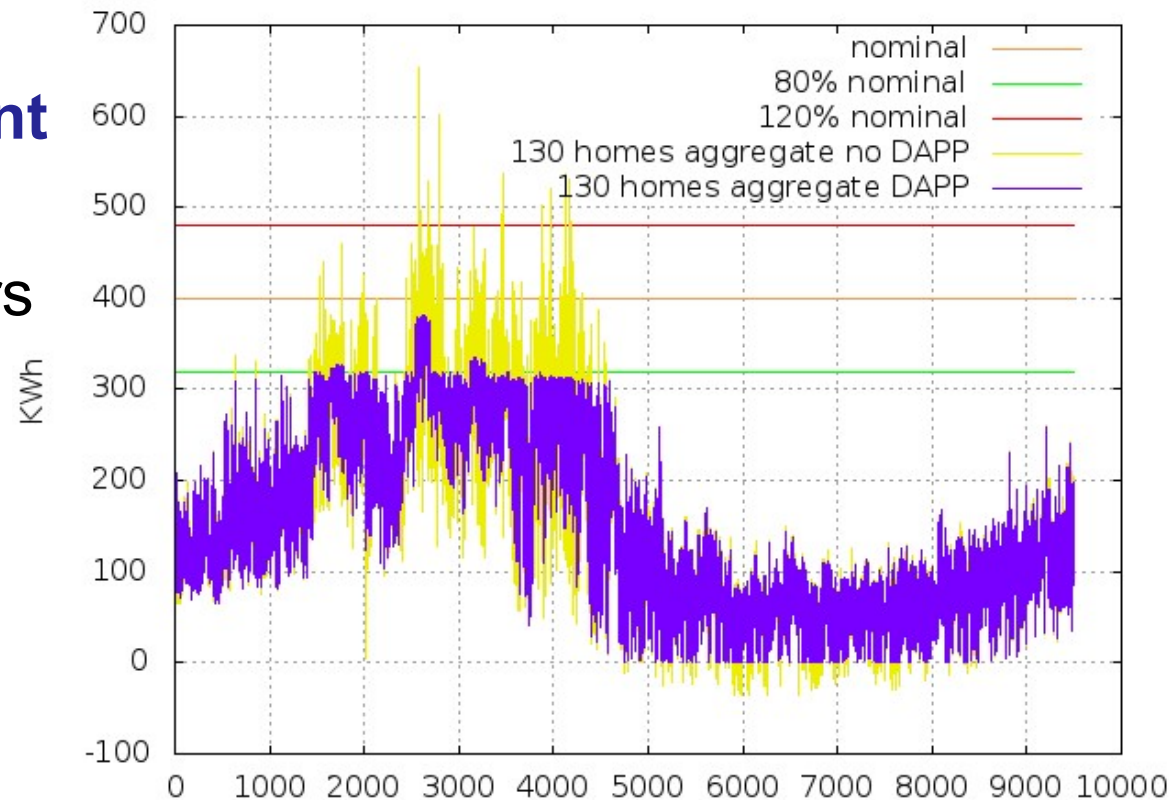
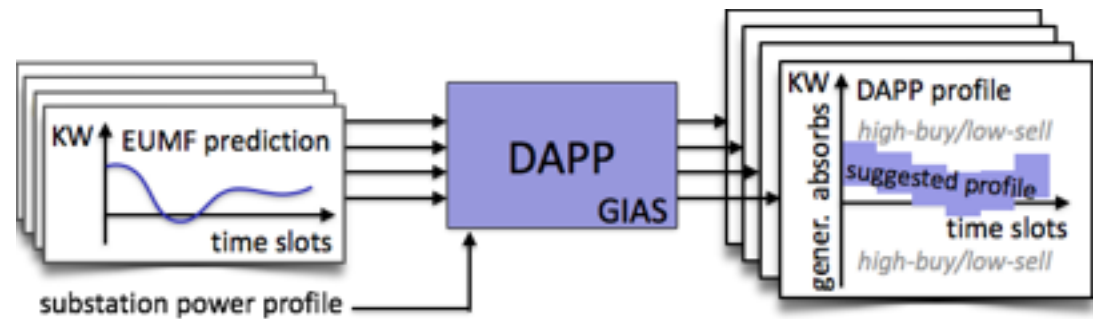
Test bed envisioned scenarios



First year results

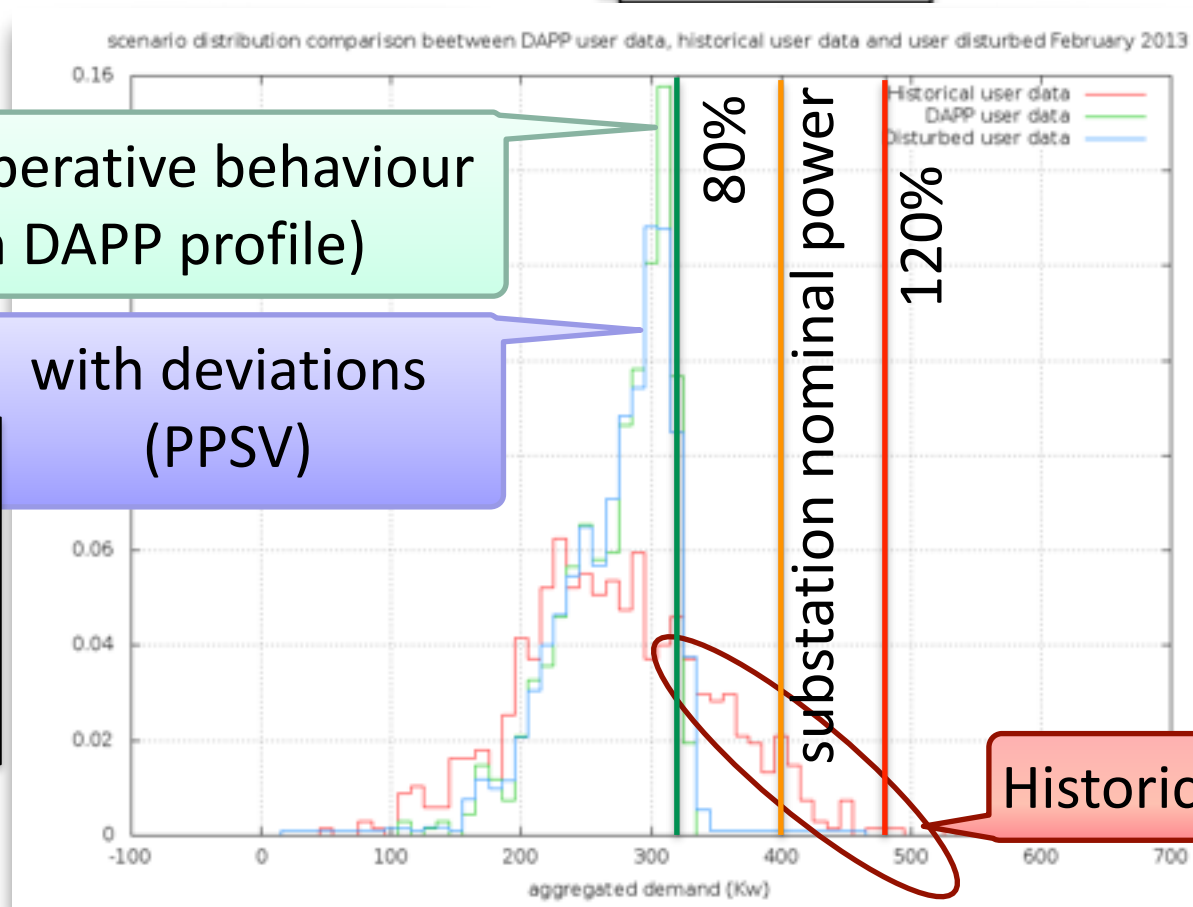
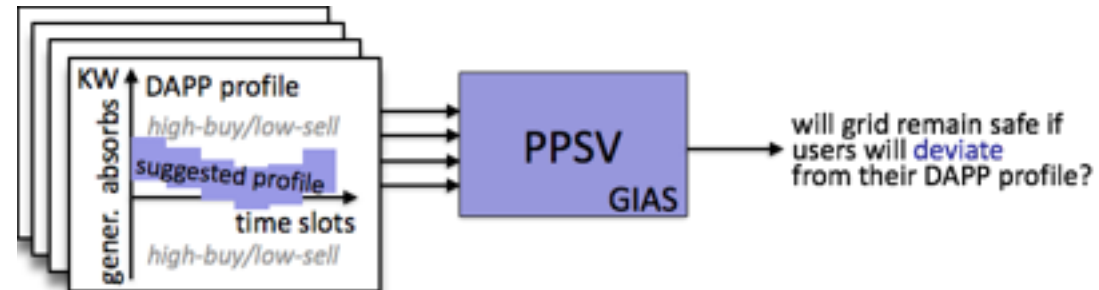
First year results: DAPP

- **Demand-awareness:** Each user only needs a **modest load shifting** capability to follow DAPP suggested power profile
- **Fairness:** DAPP policies are equally (and very!) **convenient** for **all** users
- **Safeness:** grid safe if all users strictly follow DAPP



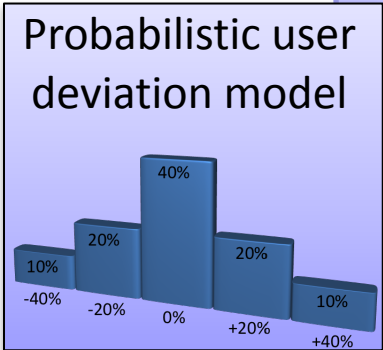
First year result: PPSV

- Robustness:** grid remains safe also if users *reasonably* deviate from their DAPP profiles



Fully cooperative behaviour (from DAPP profile)

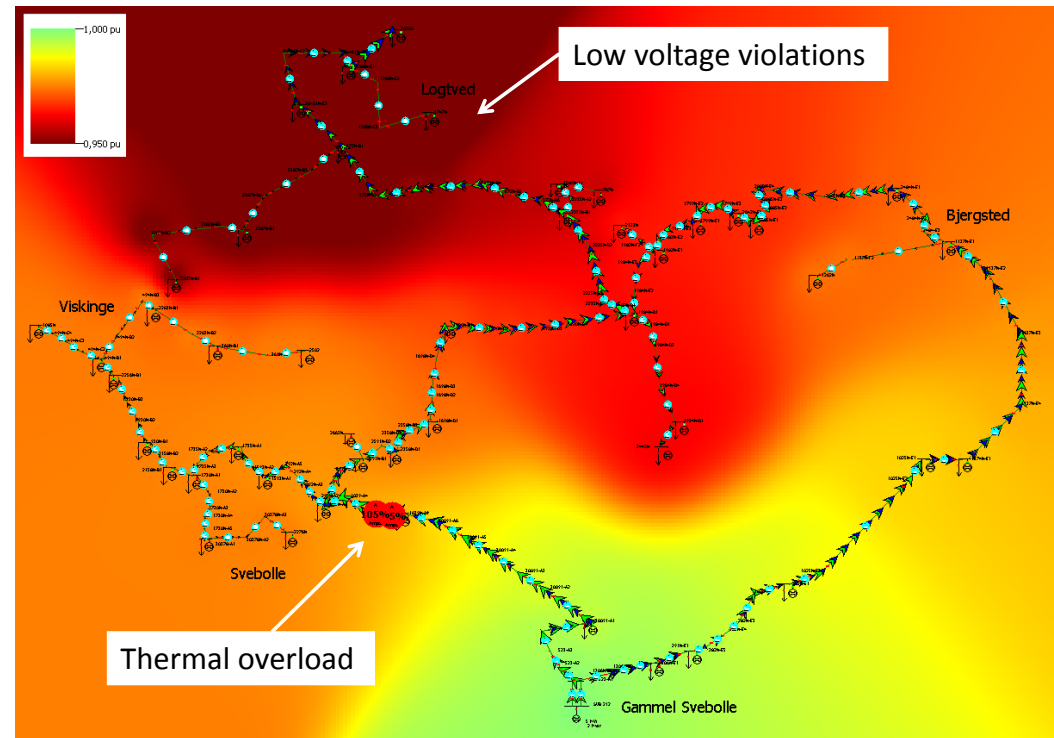
with deviations (PPSV)



Historical data

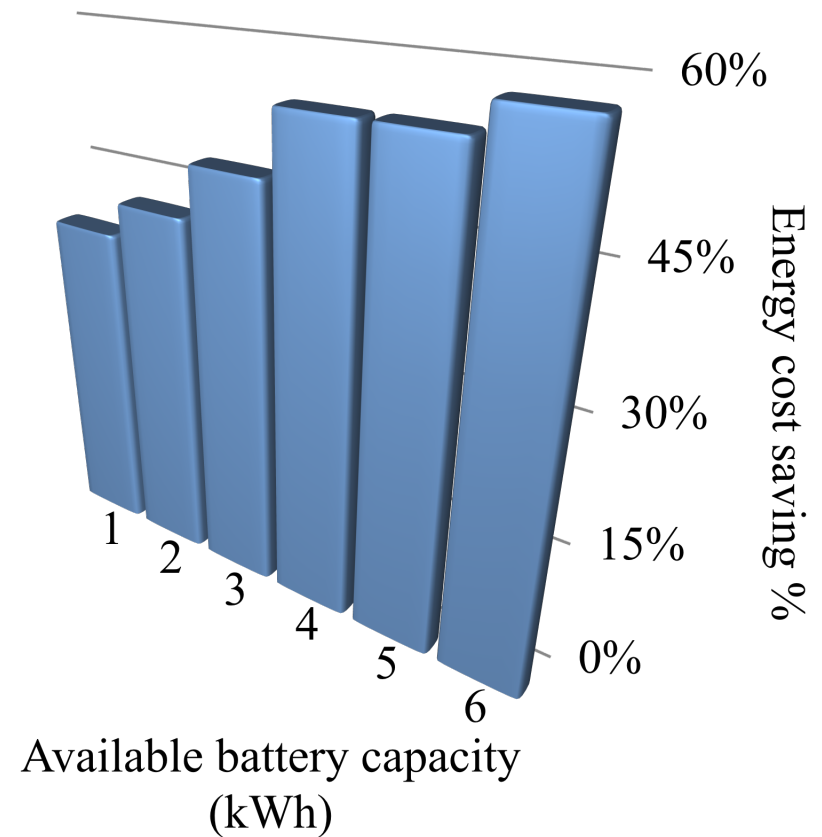
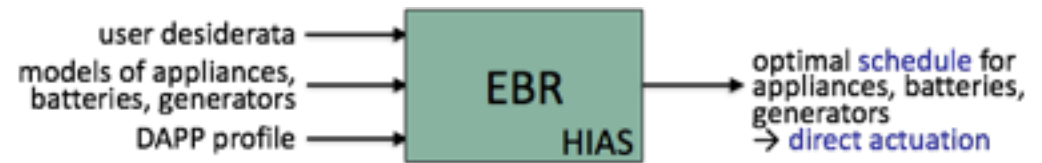
First year results: EVT

- **Detailed model** of the Kalundborg (DK) area network built in PowerWorld Simulator (IMDEA)
- Network **model analysis**
- **Most critical** network locations identified to support creation of test cases



First year results: EBR

- DAPP-suggested user power profiles
- Appliance models from literature
- EBR allows to **save $\geq 40\%$** on energy cost (DAPP tariffs)
- The higher available **battery capacity** the higher saving



Next challenges

- To better exploit the emerging availability of:
 - efficient **energy storage** systems and
 - advanced **energy conversion** devices (fuel cells)
- SmartHG intelligent services as enablers for **higher optimisation** on:
 - power profile **stability**
 - economical & environmental **savings**



Thank you!

Energy Demand Aware Open Services for Smart Grid Intelligent Automation

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