SEVENTH FRAMEWORK PROGRAMME

ENERGY DEMAND-AWARE OPEN SERVICES FOR SMART GRID INTELLIGENT AUTOMATION

SmartHG

Project Overview

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ATANVO

instituto iMdea energía

Panoramic POWER™

DEVELCO PRODUCTS

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

Solintel

seas-nve

THE GREEN INDUSTRIAL MUNICIPALITYOF KALUNDBORG

KALUNDBORG KOMMUNE

SmartHG

SmartHG Project I

Work programme topic addressed by SmartHG:

- Challenge 6: ICT for a low carbon economy
- Objective: ICT-2011.6.1 Smart Energy Grids
- Target Outcome: d) Home energy controlling hubs that will collect real-time or near real-time data on energy consumption data from smart household appliances and enable intelligent automation.

Project implementation:

- WP1: Management
- WP2: System Specification
- WP3: Design of Home Intelligent Automation Services
- WP4: Design of Grid Intelligent Automation Services
- WP5: Evaluation
- WP6: Demonstration
- WP7: Dissemination & Exploitation

SmartHG Project II

Partners main focus:

- UNIROMA1 – coordination, computation
- AU – communication
- IMDEA – power systems
- HMTI – modelling
- ATANVO – modelling
- PANPOW – sensing
- SOLINTEL – energy service consulting
- SEAS – DSO, test-bed
- KAL – test-bed
- MINSKENG – DSO, test-bed
- DEVELCO – sensing

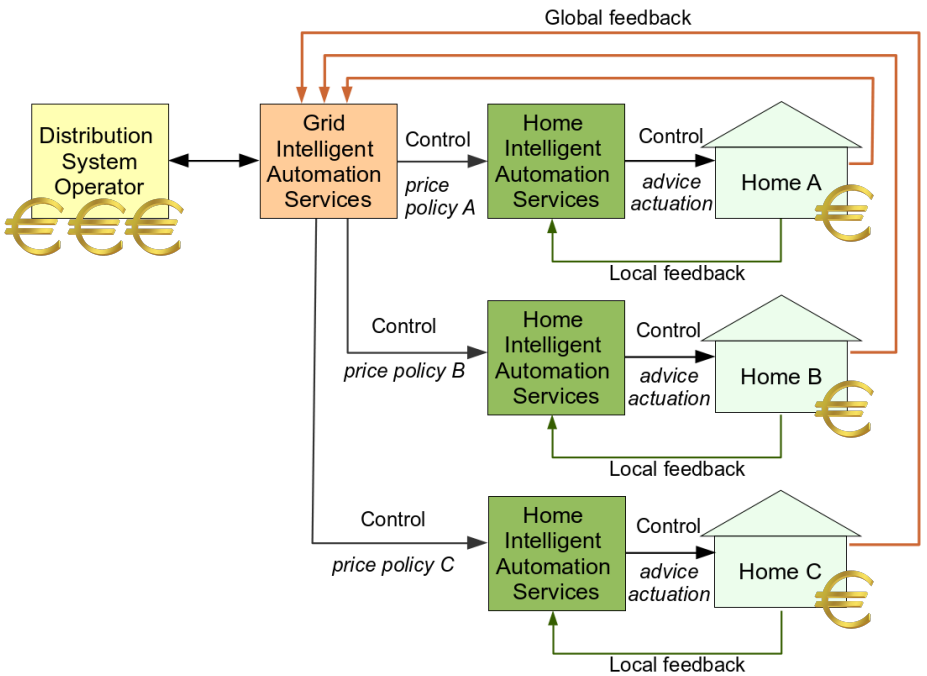
SmartHG Objectives

SmartHG has the goal of devising economically viable open services for Intelligent Home Automation

- Economically viable
  - Obstruction to overcome
    Technology available for commercial buildings is too expensive for residential users
- Openness to avoid vendor lock-in

SmartHG Hierarchical Approach

Intelligent Automation Services

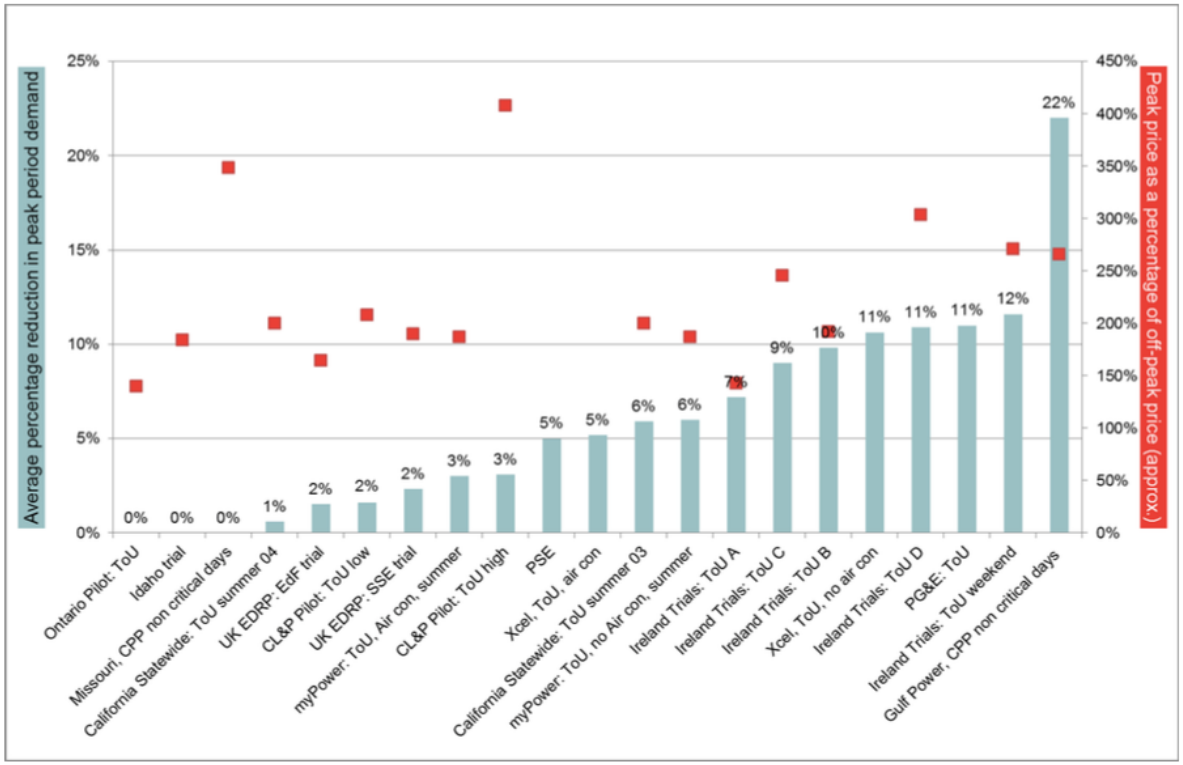


To develop open software services yielding benefits to both

- Distribution System Operator (DSO)
  by optimizing operation of the grid and returning part of attained saving to residential users via favorable energy price policies
- Residential users
  reduce electricity costs by following DSO proposed price policies

Autonomous Demand Response (ADR)

Peak period demand reductions and peak to off-peak price differentials under ToU tariffs (UK Dept. of Energy & Climate change, 2012)



Little evidence on the impact of ADR incentives on customers

$\Longrightarrow$ ADR moderately effective

SEAS-NVE ADR Pilot

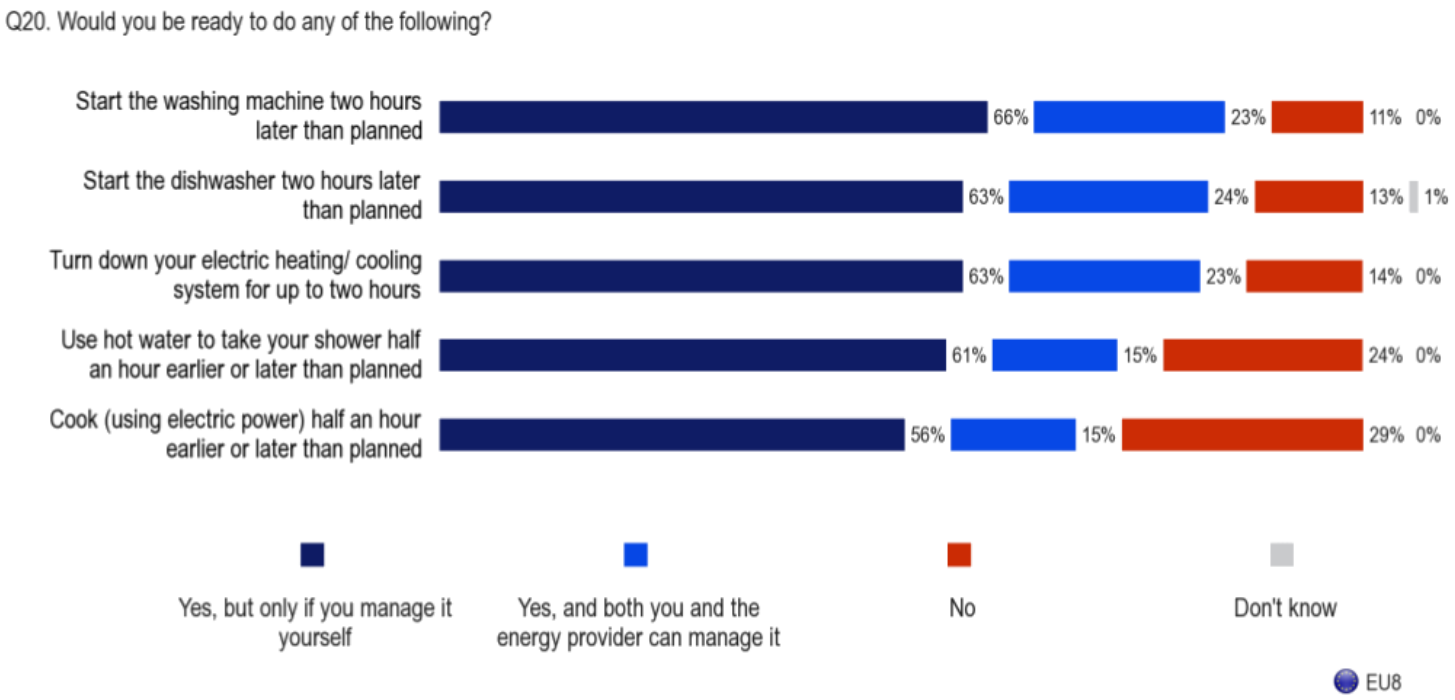
SEAS-NV pilot study

Vind med nye elvaner
(Win with new electrical habits)

- About 300 customers without electrical heating
- Pilot run from Oct 2013 to Oct 2014
- Pilot proposes to participants aTime of Usage (ToU) tariff:
  - Day (6am - 5pm) = 0.20 EUR/KWh
  - Peak (5pm - 8pm) = 1.07 EUR/KWh
  - Night (8pm - 6am) = 0.0 EUR/KWh (electricity free at night!)

Nevertheless... only about 25% of electricity consumption has moved from peak hours to night accordingly to the gathered data

Citizens are ready for active demand BUT **only** if they manage it themselves



$\Longrightarrow$ DLC raises privacy and security issues

Business Issue

- We may deploy high-tech devices in each home to monitor and control energy usage
- Technically feasible
  BUT
  Economically uninteresting

Saving: €

Sensors/Actuators/Control cost: €€€

$\Longrightarrow$ Energy saving from a single residential home too small to provide an interesting business opportunity

SmartHG Hierarchical Approach to DR

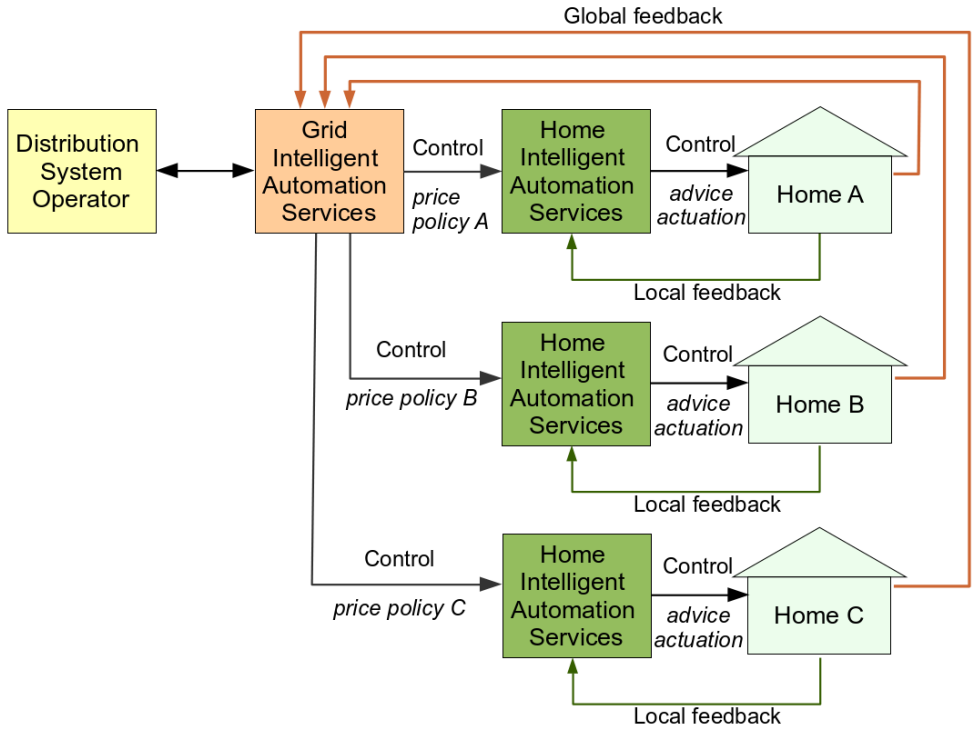
WHAT

- Demand-aware
- Combines ADR and DLC benefits
- Provides a viable business model

HOW

- Using energy demand (home meter level $\Longrightarrow$ no privacy issues)
- DSO computes fair power profiles to be followed by users
- Power profiles proposed to users via price policies
- Users follow price policies by using SmartHG services to manage home devices

Intelligent Automation Services

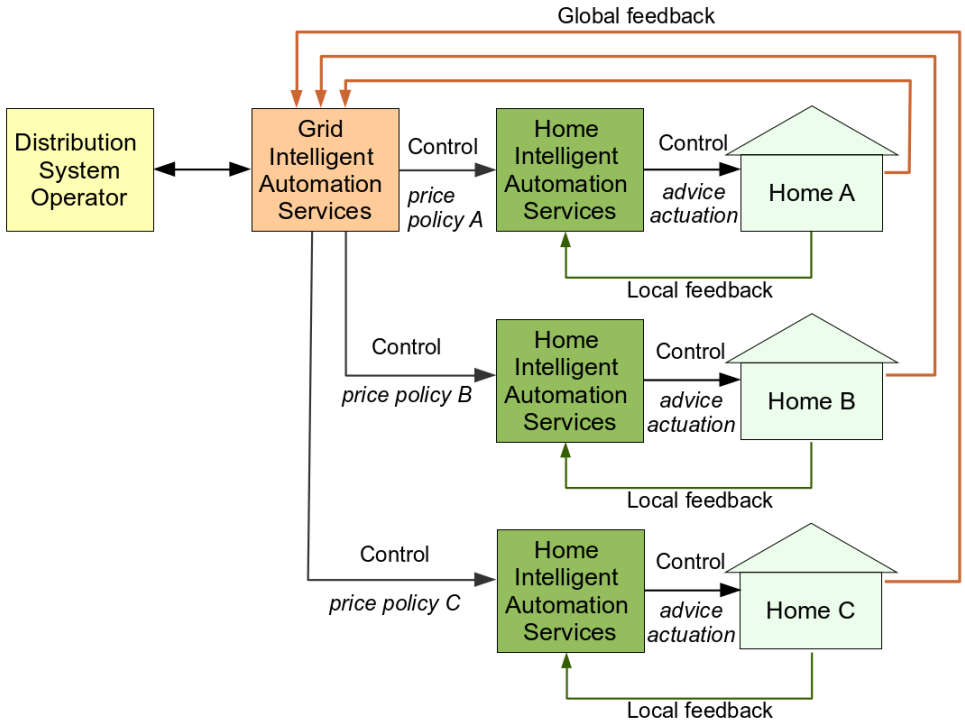


SmartHG Hierarchical Approach to DR

Advantages

- No home device data needs to be transferred to the DSO (as ADR)
  $\Longrightarrow$ Security issues avoided
- DSO does not directly control home devices (as ADR)
  $\Longrightarrow$ Safety issues avoided
- Home energy profile proposed by DSO (*soft* DLC)
- Home devices automatically managed by SmartHG services (*soft* DLC)

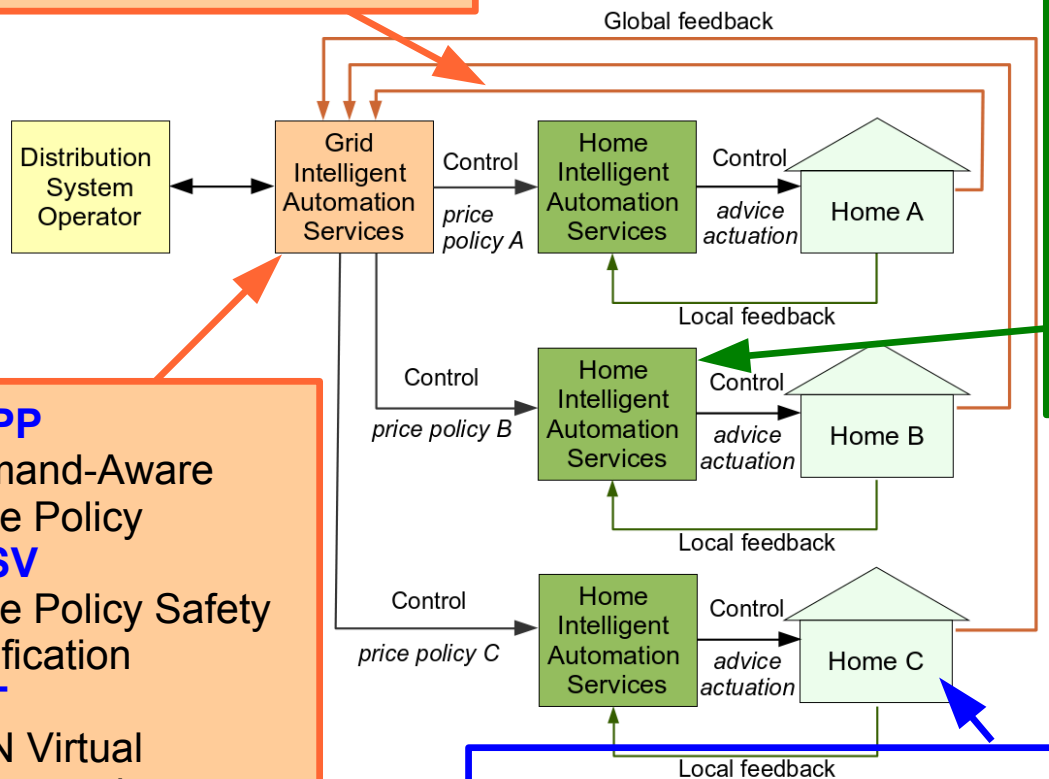
Intelligent Automation Services



SmartHG IAS Architecture

Communication via **DB&A**
Database and Analytics

- **EBR**
  Energy Bill Reduction
- **EUR**
  Energy Usage Reduction
- **EUMF**
  Energy User Model Forecasting



- **DAPP**
  Demand-Aware Price Policy
- **PPSV**
  Price Policy Safety Verification
- **EVT**
  EDN Virtual Tomography

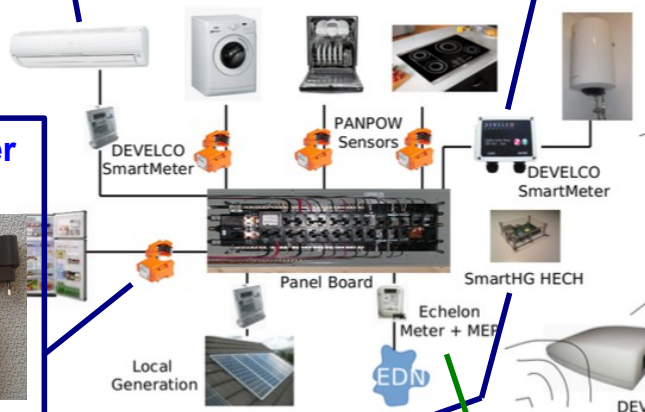
Home **Sensors & Actuators** Deployment

Home Sensors & Actuators Deployment

Develco Products Smart Meters

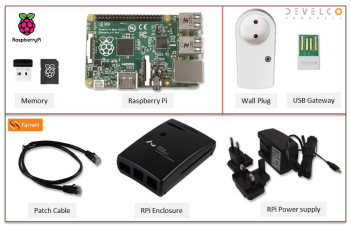
Energy Storage Systems
(e.g. Battery, PEV, Heat Pump, Boiler, ...)

Panoramic Power sensors



Data from Panoramic Power sensors collected in company **Cloud**

Home Energy Controlling Hub **HECH**

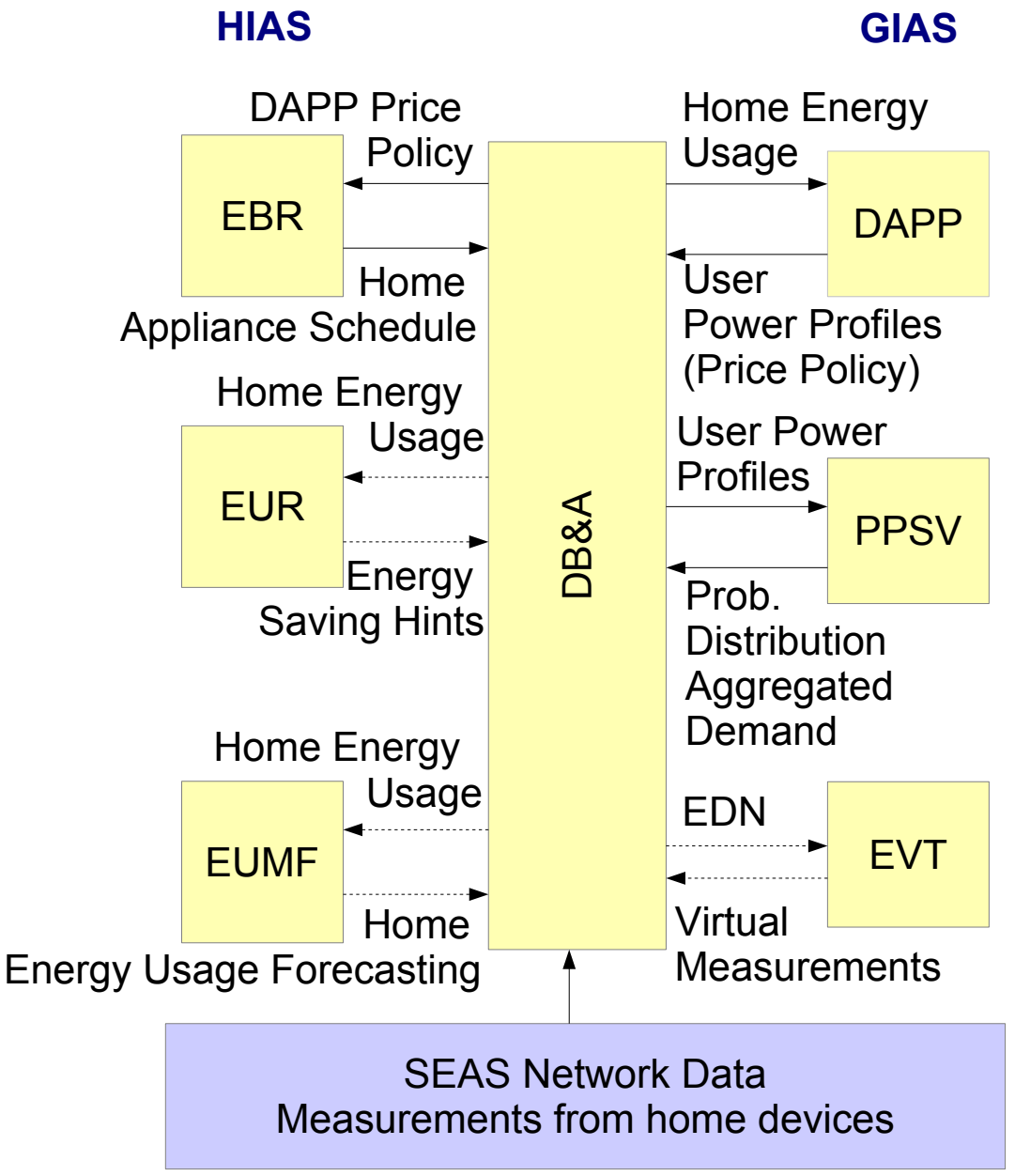


Data flowing to **DSO** through **Echelon meter** and **MEP card** via secure comm.

Data flowing to **DB&A** via secure comm.

Data from Develco Products meters collected through **SmartAMM** server

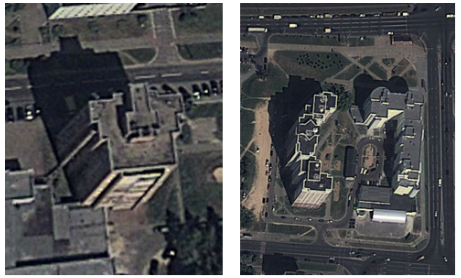
IAS: Summing Up



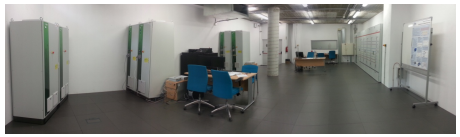
SmartHG Test-beds

Svebølle, Kalundborg (Denmark)

Central District (Israel)



Minsk (Belarus)



IMDEA Smart Energy Integration Lab

- Test beds equipped with sensors and communication infrastructure for collection of energy related data
- SmartHG services run on current data measured from sensors
- SmartHG services manage Energy Storage Systems (ESS) within houses (e.g., Plug-in Electrical Vehicles, batteries, heat pumps)
- SmartHG services accessible via web by DSO & residential users
- We use IMDEA Smart Energy Integration Lab Micro Grid to carry out experiments with ESS
- We use test-beds data to drive Micro Grid electronics loads and generators

Thanks