SMARTHG ENERGY DEMAND AWARE OPEN SERVICES FOR SMART GRID INTELLIGENT AUTOMATION



OBJECTIVES

To devise economically viable open services for Intelligent Home Automation

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

APPROACH

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)

ADR moderately effective

ADR may move from 0 up to 25% of electrical energy demand, e.g.

- UK Dept. of Energy & Climate change, 2012 report
- SEAS-NVE ADR Pilot Vind med nye elvaner results

FP7 AD VANCED ADR Pilot Citizens are ready for active demand BUT only if they manage it themselves Q20. Would you be ready to do any of the following? Start the washing machine two hours later than planned Start the dishwasher two hours later than planned Turn down your electric heating/ cooling system for up to two hours Use hot water to take your shower half an hour earlier or later than planned Cook (using electric power) half an hour earlier or later than planned Ves, but only if you manage it yourself was and both you and the energy provider can manage it Yes, and both you and the energy provider can manage it Yes, and both you and the energy provider can manage it

→ Direct Load Control (DLC) raises privacy and security issues

SMARTHG HIERARCHICAL APPROACH TO DEMAND RESPONSE

What

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

How

Using energy demand (home meter level → no privacy issues)

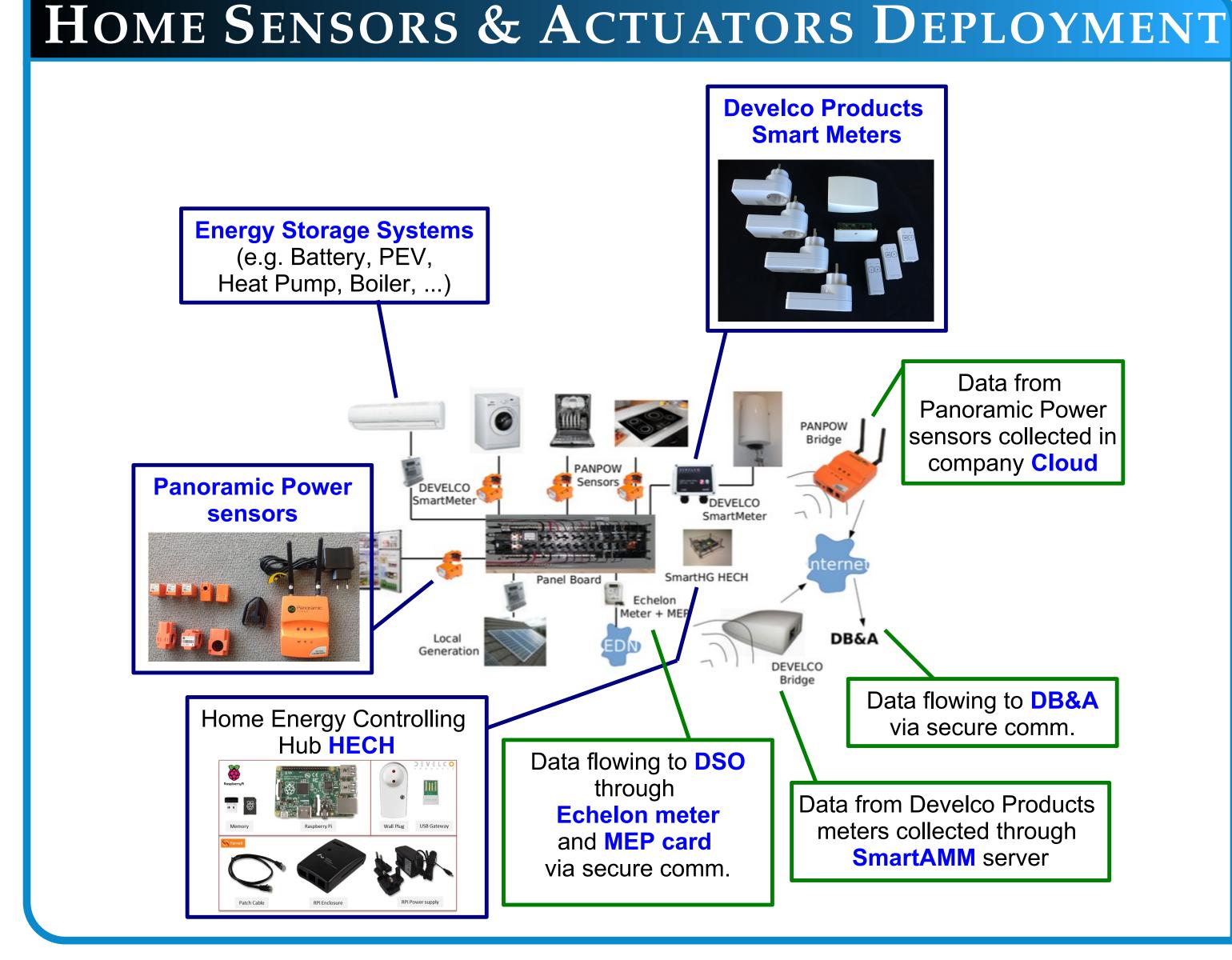
- DSO computes fair power profiles to be followed by users
- Power profiles proposed to users via price policies
- Users follow price policies by using SmartHG services to manage home devices

Advantages

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

Control price policy B Automation Services Global feedback Control Intelligent Automation Services Control Price policy B Automation Services Control Intelligent Automation Services actuation Control Intelligent Automation Services actuation Control Intelligent Automation Services Automation Services actuation Control Intelligent Automation Services Automation Services Automation Services Control Intelligent Automation Services Automa

SMARTHG ARCHITECTURE Communication via DB&A **EBR** Database and Analytics **Energy Bill** Global feedback Reduction **EUR Energy Usage** Home Distribution Control Control Intelligent Intelligent Reduction System advice Home A Operator **EUMF** Services Services policy A **Energy User** Local feedback Model Forecasting Control DAPP price policy B advice Home B **Demand-Aware** Price Policy Local feedback **PPSV** Home **Price Policy Safety** Control Control Verification price policy C advice Home C **EVT EDN Virtual** Tomography Home Sensors & Actuators Deployment



SMARTHG TEST-BEDS



Svebølle, Kalundborg (Denmark)



Central District (Israel)



Minsk (Belarus)



IMDEA Smart Energy Integration Lab

- 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-bed data to drive Micro Grid electronics loads and generators



