A Swiss perspective of DSM for electricity networks
-Overview of ongoing projects -
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IEA DSM Task 17 Workshop, 21. May 2014 – Graz; Austria
Overview

• Introduction – DSM in Switzerland

• Research projects on DSM
  – Distributed load management
  – THELMA
  – SmartGrid-Polysun
  – LLM / Adaptricity

• Demonstration projects on DSM
  – WarmUp
  – BeSmart
  – Aggregation of water management infrastructures

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Introduction on DSM in Switzerland

• Ripple control established and widely used in CH

• Typically boilers / large loads are controlled

• Shift large loads into the evening hours

• Network is relived – network expansion reduced

→With distributed energy sources and a need for more flexibility, more control is needed on shorter time scales

→Modern DSM can be used for various purposes, but

Market ↔ Network
Potential of Demand Side Management
- Flexibility through aggregation and control -

Electric Water Heater properties

Storage

Consumption can be shifted (up & down regulation)

Aggregation properties

Aggregations are robust

Flexibility

- BG schedule compliance
- Offer ancillary services
- Integrate renewables

P [kW]

Energy constraints must be kept

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• Ongoing academic research
Project Aims:

- Investigate control and communication strategies for large aggregations of household appliances

- Analyze distribution grid operation benefits and constraints (PV integration, line ratings)

- Evaluate business models from the perspective of DSO’s and retailers
**Project:** Distributed Load Management

**Content:** Different market players, different interests

**DSO**
- ‘relieve the grid’
  - Peak Shifting
    - Reduce load on grid
    - Defer investments
  - PV Integration
    - Prevent over-voltages
    - Integrate PV energy

**Retailer**
- ‘minimize cost’
  - Optimal Energy Acquisition
    - Shift loads to low-cost hours
    - Reduce cost for energy
  - Schedule Compliance
    - Use loads to reduce deviations
    - Reduce balancing energy
  - Offer Control Reserves
    - Loads adjust consumption
    - Earnings at reserve markets

**Possibly different objectives on different voltage levels**

**Trade-off**

**Today:** price ~ grid loading

**High-RES:** price ≠ grid loading

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Project Aims

- Investigate electric vehicle impact on power systems (transmission, distribution)

- Use electric vehicles for power systems

- Investigate control for large aggregations of electric vehicles

- Evaluate business models from the perspective of DSO’s and retailers
Project: THELMA
Content: Assess network impacts, appliance degradation

- Different modules assess:
  - Impact on distribution/transmission systems
  - Impact on battery and transformer degradations
Project Aims:

- Analysis, planning and operation of load management and small-scale energy storage (office buildings) in power systems

- Develop software prototype with three target groups:
  (a) building planners
  (b) distribution system operators
  (c) market players

- Evaluate business models from the perspective of DSO’s and retailers
Project: SmartGrid-Polysun Project
Target group: Building planners, DSO, market players

DR Resources
- Large aggregations of thermostatically controlled loads (TCLs)
- Small-scale battery storage in buildings
- Small aggregations of office buildings

Power System Applications
- **Ancillary services**
  - Frequency control reserves
  - Methods: robust optimal control, state estimation
- **Market services**
  - Balance group optimization
  - Methods: stochastic optimization
- **Distribution networks**
  - PV integration & voltage control
  - Methods: hierarchical control and optimal power flow

Building Applications
- **Cost minimization**
  - Predictive control of buildings under dynamic electricity prices
- **PV self-consumption**
  - Rule-based control using heat pumps and batteries

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Project: DPG.sim  
Consortium: LLM / Adaptricity, ETH Zurich

Project Aims:

• Develop grid planning tool considering Smart Grid features

• Reduce grid infrastructure and system costs

• Taking into account prosumers / aggregators in operation and planning

• Benefits of prosumers / aggregators for grid purposes and congestions in distribution networks
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• Ongoing demonstration projects
Project: WarmUp
Consortium: ewz, misurio, SFOE

Project Aims:

• Using flexibility of thermal heat storage (buildings, hot water) and power-to-heat devices (heat pumps) for the electricity system

• Maximize the flexibility through a centralized management

• Optimization for grid and market (both) without disadvantages for user comfort
Project: WarmUp
Target group: DSO, Trading, market players

- Benefits of approach:
  - Environment friendly services for consumers
  - Flexibility for the market
  - Flexibility for the network

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Project: BeSmart
Consortium: Swisscom Energy Solutions, Repower, SFOE

Project Aims:

• Aggregation of flexible loads (boilers, heat pumps)
• Dynamic load management on top of ripple control
• Integration of virtual, controllable load and flexible generation
• Flexibilize load for ancillary services (secondary, tertiary control)
• Cost reduction through peak shaving
Project: BeSmart
Content: Flexibility of demand for ancillary services

Concept

Member network

Partners

„Demand-Side-plant“

Ancillary services
Balance groups (reserve for suppliers)
Other markets

Consumer Benefits

Monitoring
Detailed analysis allows for consumption reduction and comparisons.

Comfort and efficiency
Management of consumption during absence and energy efficiency.

Security
Immediate notification in the case of irregularities, technical failures etc.
Project: Aggregation of large infrastructure systems
Consortium: Infrawatt, Ryser Ingenieure, Alpiq

Project Aims:

• Load management with large infrastructure systems (water supply plants, sewage plants)

• Pooling of infrastructure systems for balancing energy (positive and negative)

• Pooling possible without disturbing normal operation of such infrastructures
Summary

- Various approaches to control load

- Various aims for which loads are controlled

- Interaction between grid and markets are so far unresolved

- Customer benefits indirectly from DSM, through new services or reduced costs

→ How can grid, market and consumer issues be integrated in an unbundled world
Thank you for your attention

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