Dynamic smart metering based demand response

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CONTENTS

AMR in Helsinki

- AMR coverages 100 % of metering points
- All metering points are hourly measured
- AMR systems delivered by
  - Landis+Gyr (200 000 mp.)
  - Aidon (150 000 mp.)
  - Kamstrup (10 000 mp.)
- Functionalities:
  - Hourly measured energy (P/Q)
  - Circuit breaker
  - Power outage/Voltage quality information
  - **Dynamic Load Control**

Background

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A long tradition of load controls: introduced in the 60's&70's to balance the demand at night hours and to enable CHP & nuclear baseload

A time-of-use control was used in Finland and in other Nordic countries

In Helsinki alone there are 50 MW of controllable and storable electrical heating loads

- 2000 metering points <-> comparable to 25000 washing machines

The loads are connected to the meters at AMR roll out, and are available for controls

Motivation & Drivers

In the future more intermittent production in the system.

New ways to balance the system are needed.

In order to achieve a feasible business case

- Adequate volume of loads; and
- Low life cycle costs, are needed

→ Dynamic control of heating boilers via smart meters has many attractive characteristics

a) No other equipment needed: control via a relay in the AMR meter

b) Relatively high load, typically 25kW/ household

c) Daily heating needs met in <10 hours/day

Overview of the developed and field tested system

Electricity procurement, market operations

- Retailer has the need to adjust consumption
- Control messages are created in an external system

Elerctricity distribution, system supervision

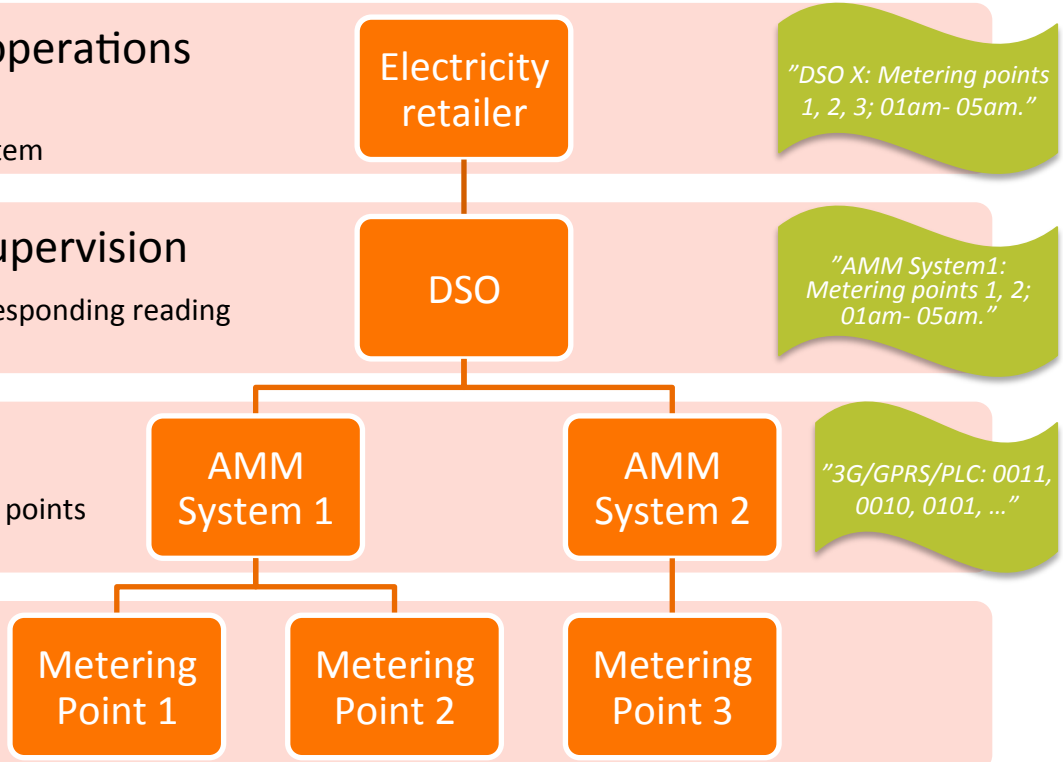
- DSO forwards the load control message to corresponding reading system

Meter reading system

- Reading system sends the message to metering points

Metering points, customer sites

- Remotely read meters implement the load controls on site

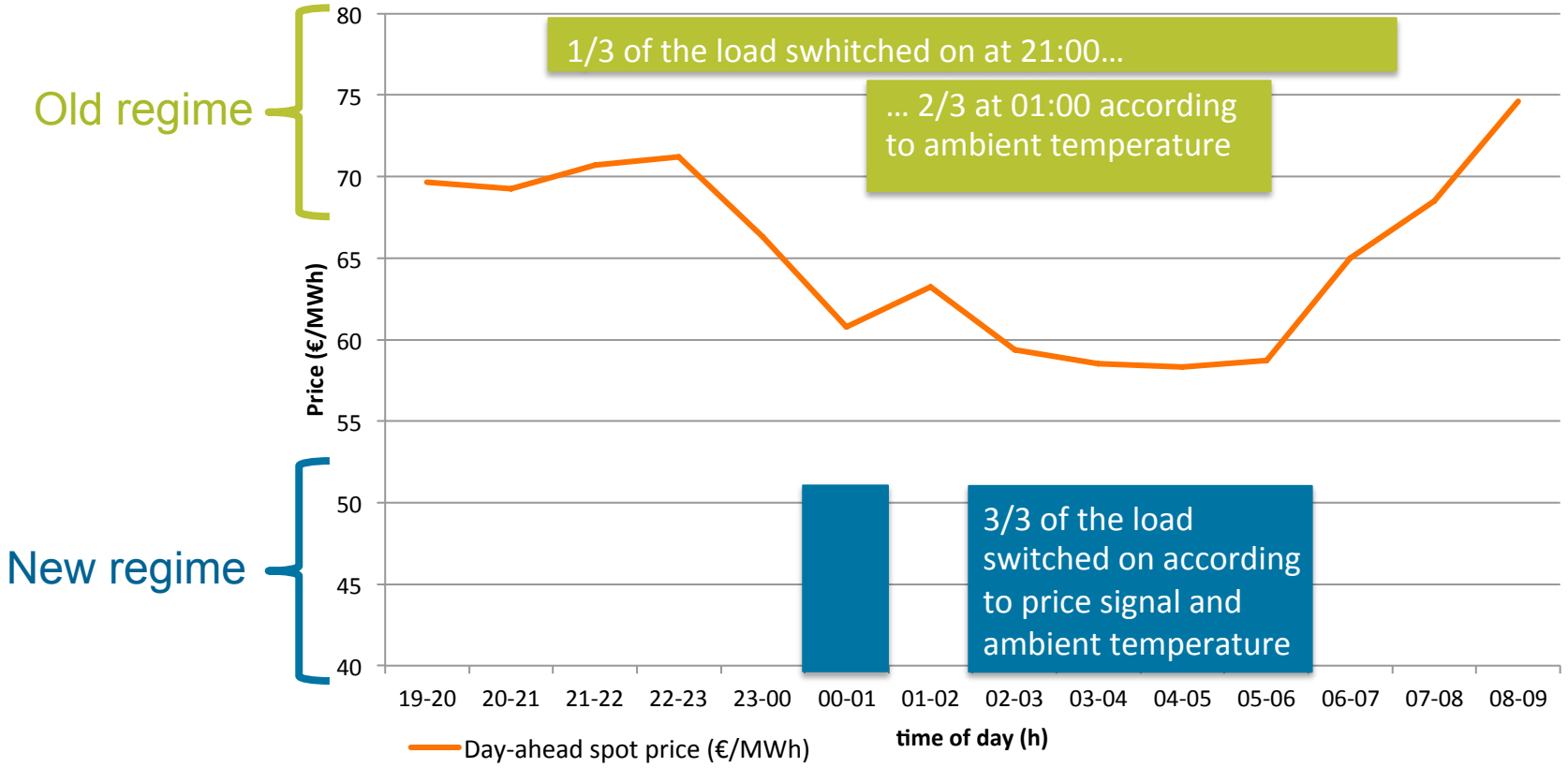


Key idea of dynamic load control

Switch on the storage heating loads when electricity price is at its lowest

1. When using the AMR infrastructure, decisions are made in upper level in the system
2. Loads are aggregated into tradable volumes
3. Behaviour of the electric heating loads are approximated
    1. Loads controlled discretely in full hours, but
    2. Energy consumption profile is continuous
4. The DSO enables a retailer or aggregator to operate the loads
    1. Individual controls;
    2. Daily varying group controls;
    3. Fixed, scheduled basic functions
5. The DSO supervises the system and applies default load controls upon failures.

From time-of-use control to dynamic control



The research program

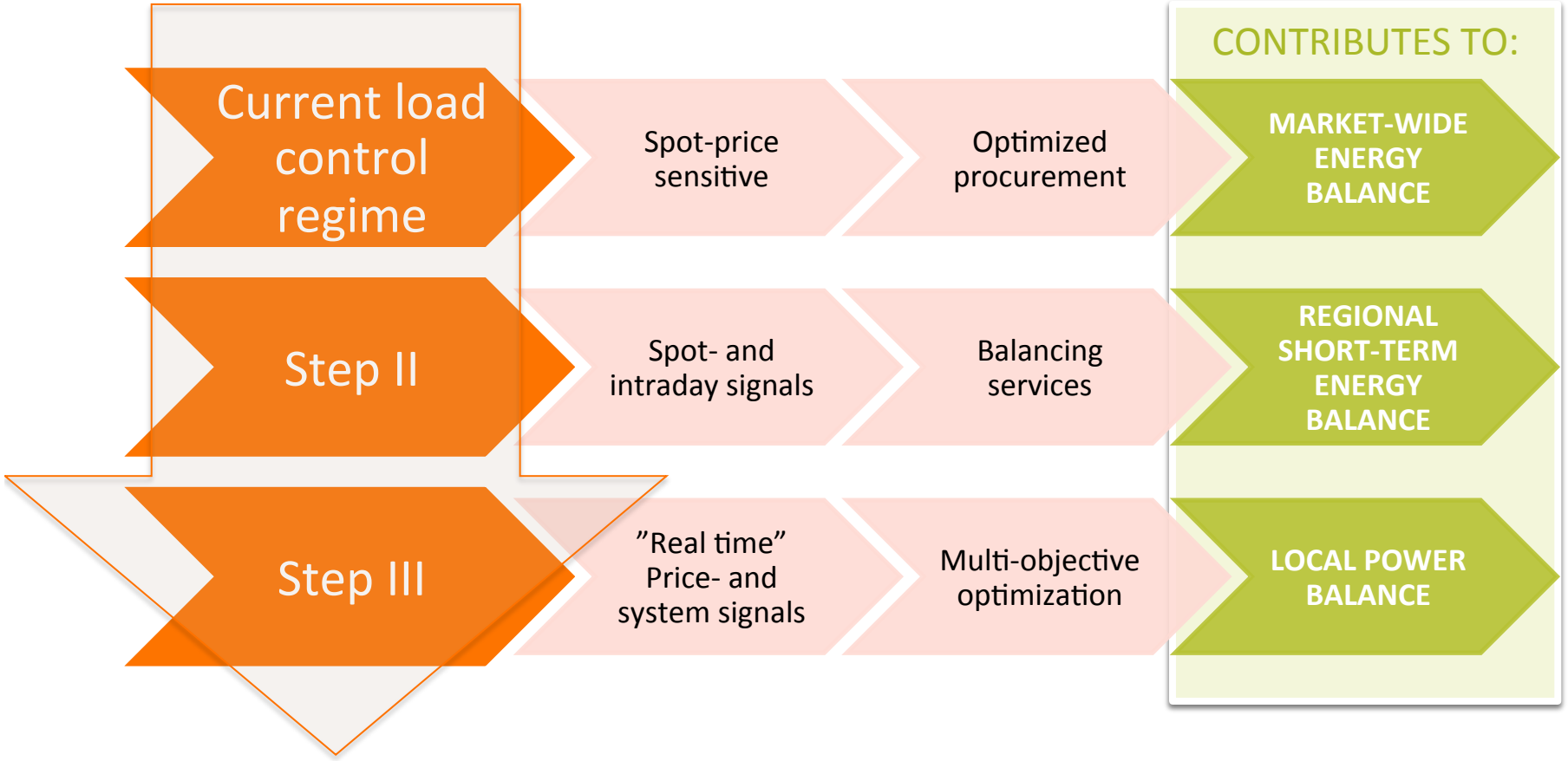
Approach and methods

1. Measurements, models and benefit potential were analyzed and simulated, and target houses for pilots were selected
2. Operating model was developed for the purpose, including message exchange between the relevant market actors
3. Two smart metering system manufacturers implemented full support for this operating model
4. The solutions were verified in laboratory and then demonstrated in field tests

Ambitions

1. After the roll-out, the functionality can be extended to:
   - Heating of domestic hot water
   - Partial storage heating (= typically building structures, i.e. floors, fireplaces)
   - Car heaters
   - HEMS-integration
   - EV-charging
2. The xml-message to be further developed and introduced as the basis for (national) standard
3. Neutrality of load control information exchange

The path forward



THANK YOU !

Related publications

P. Koponen, J. Seppälä, Market price based control of electrical heating loads, CIRED 2011, Frankfurt 6-9 June, paper 0796.

P. Koponen, O. Porri, J. Seppälä, Plans for the second field test year on smart metering based dynamic load control, VTT-R-07979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