The SmartCoDe Demonstrator - a testbed to evaluate energy management

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Summary of demonstrator

Objective:

- Set up a demonstrator including „living lab“, together with a local energy generator,
- Demonstrate the Project outcome to a broad community.

Experience to be gained:

- Usability of the approach in a „real world scenario“,
- Dependability of communication between nodes in wireless network,
- Validation of models and simulation results.

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Outline

- Goals and objectives of demonstrator
- Demonstrator location and structure
- Calculation of energy savings
- Assessment of project impact
- Conclusions

Goals and objectives

Show the outcome of the project to a broad community.

Get practical experience on the usability of the approach in a “real-world scenario” that embraces regenerative energies (wind turbine, solar panel), energy using products and local energy management.

Evaluate the outcomes under realistic conditions.

Prove that all the theoretical assumptions and models produced in SmartCoDe are correct.

Provide a feedback to the models developed so that real-world data can be integrated to finalize the models.

Show to the public that the concept and implementation of SmartCoDe is feasible and thus provide a proof that the budgets of the project are spent for the benefit of the society.

Specific technical objectives

Prove that SmartCoDe methods for automated energy management are efficient.

Show the benefits of SmartCoDe high resolution energy management.

Show the communication and remote control of EuPs using the SmartCoDe devices.

Demonstrate technical and economic feasibility and benefit of SmartCoDe intelligent energy management.

Quantify possible energy savings due to:

- Classical energy management,
- High resolution energy management,
- Coordination of supply systems,
- Coordination of energy using products, and
- Reduction of peak load.

Demonstrator location: Buchberg, Austria

Buchberg location includes a building used as restaurant as well as home for a family of five. The building is equipped with a small wind turbine, energy using products and energy management system.

Almersberg site is in addition, it is close to Buchberg and already has some of the needed equipment available.

Demonstrator structure: Buchberg site

Step 1: Technical Overview – „Consumption Model“

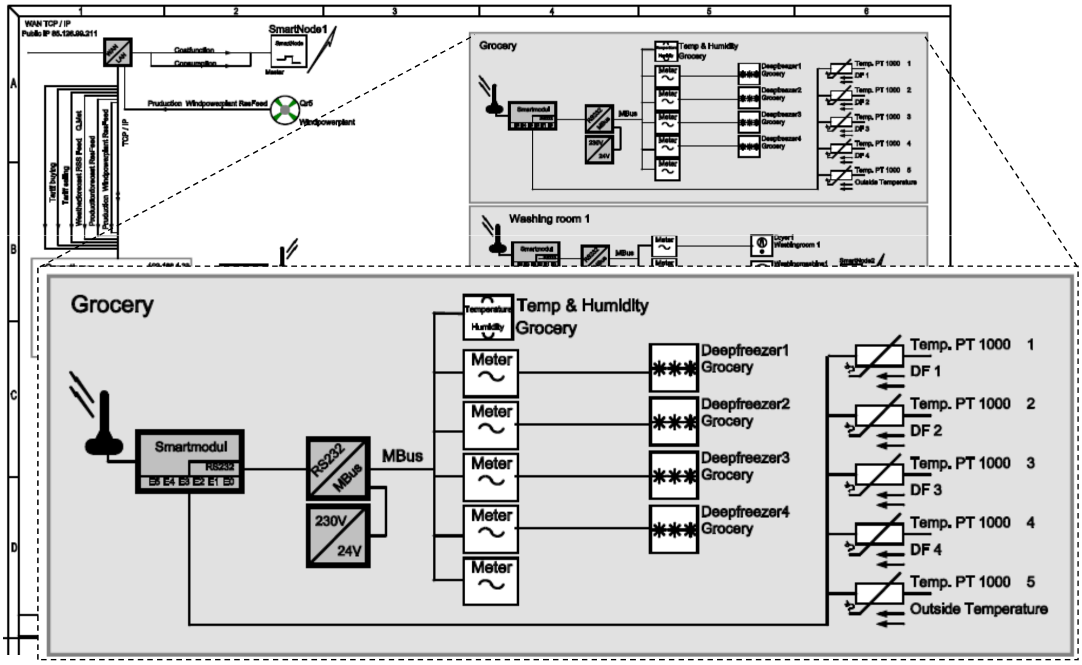
	Number	Power	Usage Hours	Consumption	Consumption	estimations
Deepfreezer: summery	4	0,86	3671	3.157	5,3%	12 month/a 24 hours/d in use
Whirlpool AFG 6512G	*1*	*0,2*	*2281*	*456*	*0,8%*	*DF1 / 1,25 kWh p d / 503l est: 0,2kW*
Austria Haustechnik GTX 47SS	*1*	*0,22*	*4480*	*986*	*1,6%*	*DF2 / 2,70 kWh p d / 386l*
AHT CC400 Type 807 Eskimo	*1*	*0,3*	*3772*	*1132*	*1,9%*	*DF3 / 3,10 kWh p d / 364l*
Elin GTL 0191	*1*	*0,14*	*4171*	*584*	*1,0%*	*DF4 / 1,60 kWh p d / 180l (est: 1,6 kWh pd)*
Washingmashine BSH WM16S750	1	2,30	209	480	0,8%	estimation 300 washings a 1,6 kWh
Washingmashine Miele Meteor 1000	1	2,40	213	510	0,9%	estimation 300 washings a 1,7 kWh
Dryer BSH WDT60	1	1,50	160	240	0,4%	estimation 150 dryings a 1,6 kWh
Dryer Electrolux EDC 5310	1	4,37	150	656	1,1%	estimation 150 dryings a 4,37 kWh
Oven BSH HTSHBP7	1	3,70	81	300	0,5%	estimation 500 preparations a 0,6 kWh
Cooling room	1	0,08	8760	394	0,7%	est. 12 month/a 24 hours/d 60% on duty
Restaurant	1	6,00	5368	32.208	53,7%	est. 11 month/a 16 hours/d in use
Sigthseeing tower	1	1,80	8760	15.768	26,3%	12 month/a 24 hours/d est 1,8kW in use
Houshold	1	0,50	8760	4.380	7,3%	12 month/a 24 hours/d est 0,5kW in use

The analysis helps to understand, which devices and consumers have what part in all over power consumption at the demonstrator.

It is a kind of „consumption model“ which has to be changed according to the detailed results of the measurement.

Demonstrator structure: Buchberg site

Step 2: Measurement Concept



Demonstrator structure: Buchberg site

Energy Management Unit (EMU)

- built in and operative
- connected to the router
- connection to smart module tested

Grocery

- power and temperature measurement in four deep freezers
- room temperature and –humidity are measured
- outside temperature is measured

Washing Room 2 (toilette)

- power measurement for washing machine
- power measurement for dryer
- room temperature measured

Demonstrator structure: Buchberg site

Main Electrical Distribution

- measurement of the main power meter (EVU)
- power measurement for sightseeing tower
- power measurement for cooling room
- power measurement for restaurant
- power measurement for oven
- power measurement for dryer
- power measurement for washing machine (1st floor)
- room temperature restaurant measured

Wind Power Plant
- connected to the router

Demonstrator structure: Buchberg site

Step 3: Optimisation Concept

The concept consists of
Energy Management Unit (EMU)
- SmartGridSwitch – simple device for testing user interaction
- SmartCodeNodes – advanced intelligent devices

Demonstrator structure: Buchberg site

The washing machine in the 1st floor is connected to the SmartGridSwitch with following functions:

- Input one starts the machine immediately.
- Input two: The machine should start within 4 hours.
- Inputs three: The machine should be ready within in the next 12 hours and
- Input four deletes the request.

Demonstrator structure: Buchberg site

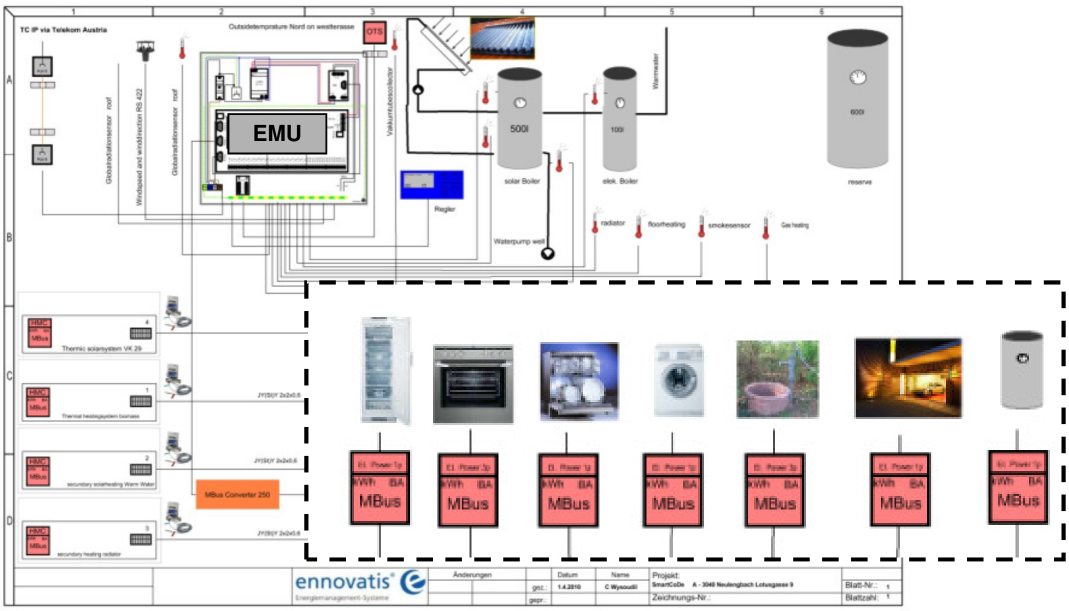
The following devices will be connected with a SmartCoDeNode:

- 4 refrigerators at the grocery
- Washing machine 1 at the Washing Room 1
- Oven 1 at the Restaurant
- Dryer 2 at the Washing Room 2
- Open: Cooling Room
- Open: Automate at the Sightseeing Tower

Almersberg location

Demonstrator structure: Almersberg site

Measuring Concept



Analysis of the measured data

Demonstrator will be used to:

- Calculate energy production by local energy production (wind generator and photovoltaic),
- Calculate energy consumption by local energy using products,
- Calculate energy savings compared to the pre-demonstrator energy consumption at the demonstrator site.

Quantification of possible energy savings due to:

- classical energy management,
- high resolution energy management,
- coordination of supply systems,
- coordination of energy using products, and
- reduction of peak load.

Steps to determine energy savings at demonstrator

1. Measure, collect and record baseline data.
2. Install and test the components and the demonstrator as a whole and verify that the demonstrator installation works properly (commissioning).
3. Measure and collect energy and operating data after the demonstrator is installed in a systematic way which is consistent with the baseline period.
4. Calculate the energy savings, report and present all the collected and computed data in a way which is suitable to demonstrate the effect of the demonstrator on the energy savings.

Calculation of energy savings

The methods which will be used to calculate energy savings are based on the IPVMP protocol (document: „*International Performance Measurement & Verification Protocol (IPMVP*)“, March 2002, www.ipmvp.org.).

Energy saving is the difference among the consumption according to the energy efficiency measures (EEM) and measured during the reporting period and the consumption prior the implantation (baseline period).

Consumption is influenced by different variables like weather, usage or occupancies. It is necessary to have consumption and conditions data prior the implantation of EEM in similar conditions as after the EEM. Also it is necessary to make suitable adjustments for changes in conditions and independent variables.

Assessment of project impact

The goal of the SmartCoDe project is to provide a solution which will allow manufacturers of energy using products to:

- add energy management functionality,
- with additional features such as remote control, safety and security,
- for very little additional cost,
- and thus enable local entities to participate in the energy market as an intelligent, managed “sub-grid” that can even contribute to a demand side management.

How do we evaluate and assess the overall impact of the project?

Economic feasibility

To assess the economic feasibility of the project we will address several aspects:

- What costs are involved for the different kind of groups (user, equipment provider, energy provider),
- How can invested cost be refund for the different kinds of groups, for example lesser energy costs, market penetration, lesser net load (i.e. lesser peaks probably mean that the maximum net load with which nets are built can be reduced),
- What actually are the benefits apart from energy cost reduction, for example what are community benefits as related to the CO_2 reduction.

Economic feasibility (continued)

We will compare the baseline data with the data collected during the demonstrator operation at the two demonstrator locations, and calculate energy savings due to the local energy production and intelligent energy management.

Energy cost savings will be classified as relative to:

- Cost reduction for buying energy from a third party (for example, the public grid),
- Load reduction for energy out of the public grid,
- Peak load reduction for energy out of the public grid,

Applicability and usability issues

We will have an external reviewer inputs to prepare, conduct and analyse the applicability and usability of the SmartCoDe solution.

The analysis will be based on monitoring the behaviour of the inhabitants of demonstrator locations to get an understanding how they used the demonstrator equipment and if they are using the suggested methods in an appropriate way.

Conclusions

We presented SmartCoDe demonstrator concept and structure, as well as how we will use the demonstrator to evaluate energy savings and assess the impact of the project.

Demonstrator is installed at Buchberg, with additional site at Almersberg, both near Vienna, Austria, with wind turbine, photovoltaic panel, energy using products, measurement sensors and SmartCoDe nodes, energy management system in place, and the web site showing the relevant demonstrator data.

In the forthcoming period we plan to use demonstrator to collect data which will be needed for calculation of energy production, consumption and savings.