Energy management in small buildings and local grids

Smart Energy Management

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Content

The objective of SmartCoDe is to enable the application of demand side management and smart metering in private and small commercial buildings and neighborhoods. This requires the development of new methods for automated (or smart) energy management that specifically considers the requirements of energy using products (EuP) in homes or offices and local renewable energy providers (LEP). The consequences for energy management will be described in three steps

1. Basic Definitions
2. Smart energy management
    1. Software: Methods to evaluate measured data
    2. Hardware: Intelligent data logger for data collection and building control
3. Local energy resource cluster for proof of SmartCoDe-concept

Basic Definitions

› Energy **monitoring** means the continuous measuring of energy related data. It is an energy efficiency technique based on the standard management axiom stating that "**you cannot manage what you cannot measure**"

› Energy **controlling** means the process of comparing energy consumption against energy demand according the rules defined from the management

› Ongoing or Continuous **Commissioning** is an ongoing process to resolve operating problems, improve comfort, optimize energy use and identify retrofits for existing commercial and institutional buildings and central plant facilities.

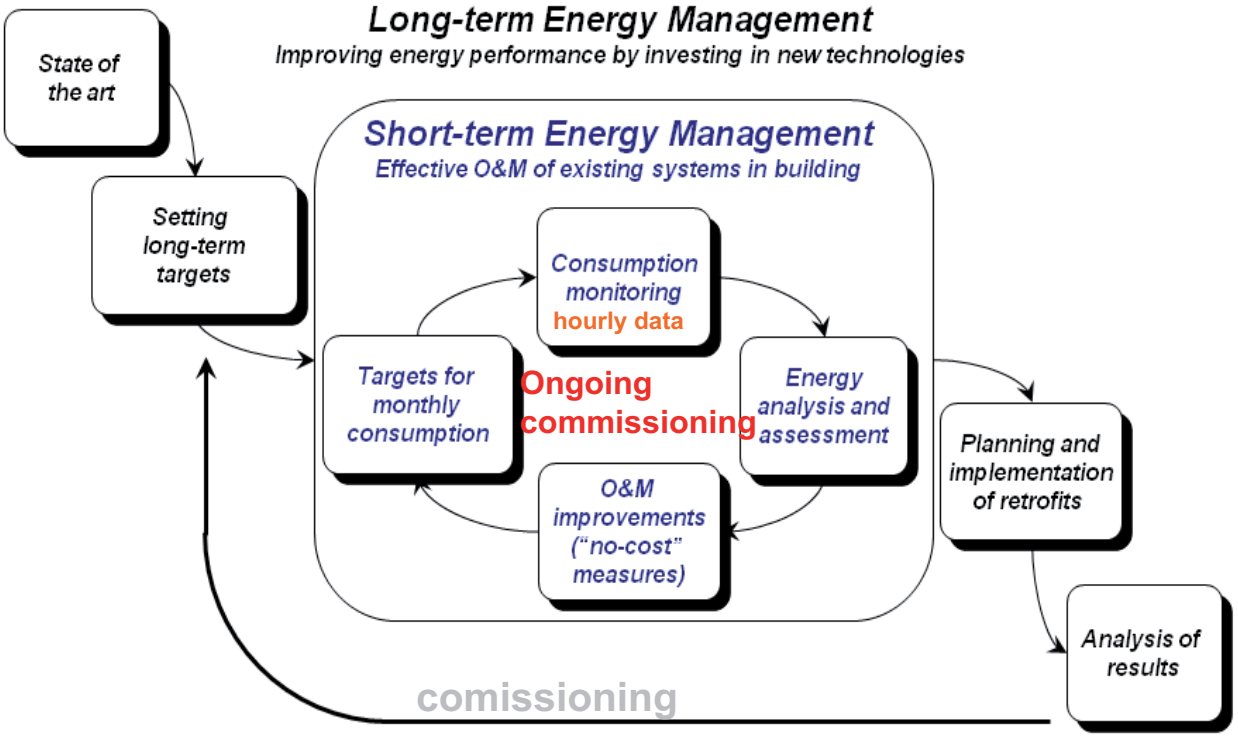
Basic Definitions

› **energy management** means a digital control system that is used to monitor and possibly control the function, operation, schedules, and/or optimization of the central plant equipment, the HVAC equipment, process equipment, and/or building conditions (e.g., lights, temperature) from a central location.

› **smart energy management** supports the user in

- visualizing the measured data in various contexts
- selecting those data which indicate inefficiencies or faults
- control measured data according given rules
- propose measures to optimize operation to meet demand and/or other optimization by various criteria

Short- and long-term perspectives of energy management



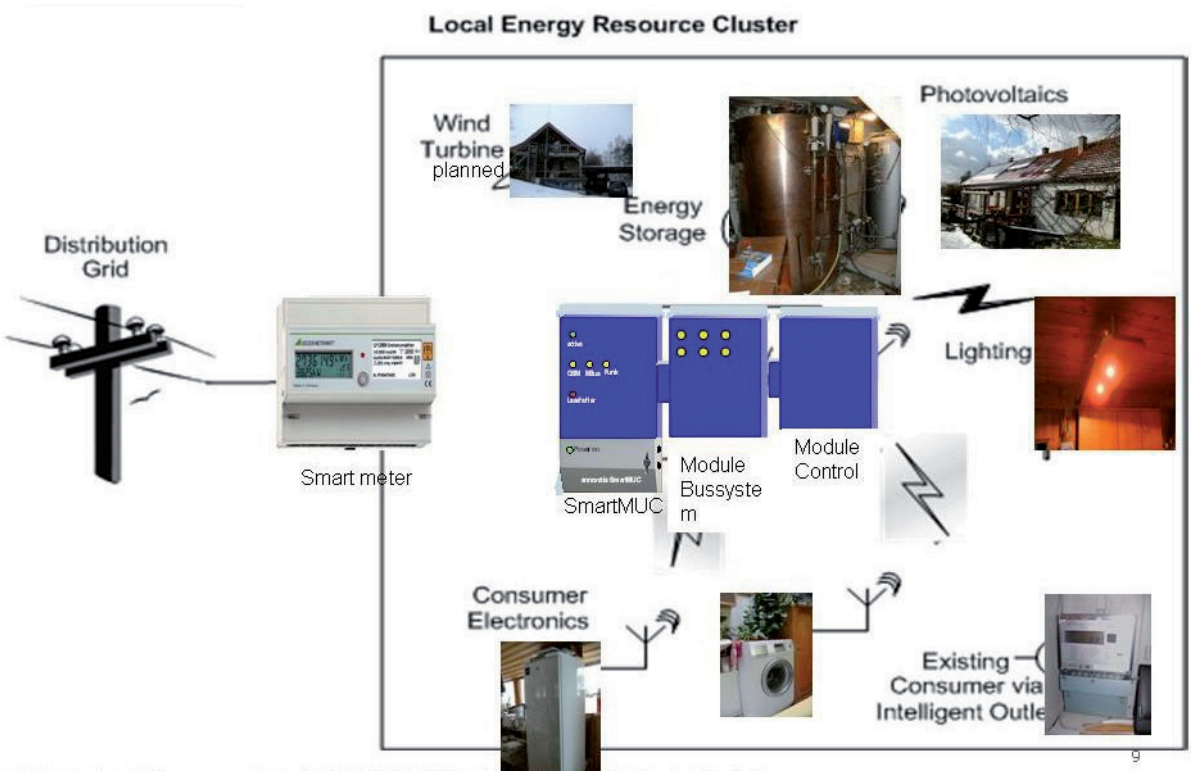
From annex 46

Basic Definitions

› **Smart energy management in small buildings and local grids** includes
- energy provider through the grid
- local renewable energy providers like solar or wind
- Locally available energy storages
- various energy using products
- sensor and counters

and
- combines energy users and energy producers typical for households or small offices
- tries to optimize energy consumption according to locally given criteria

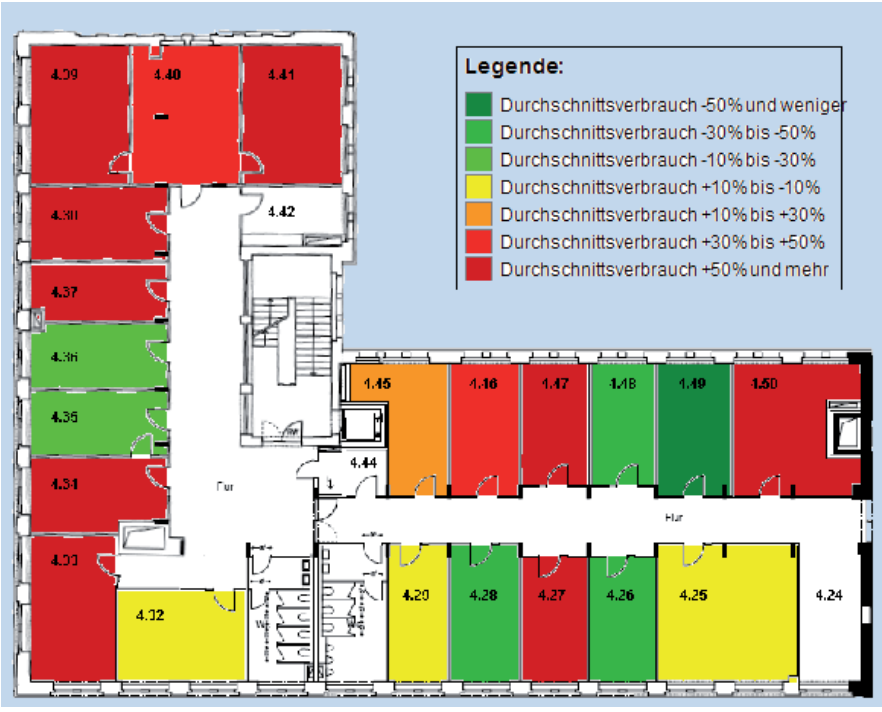
Electricity management in small buildings and local grids Example



Smart EM - methods to evaluate measured data

Intelligent metering

› People view data with high time resolution in various contexts



Comparison of heat consumption in an office daily and room wise

Intelligent metering: variation of heat consumption in appartments

yearly **monthly** **daily**

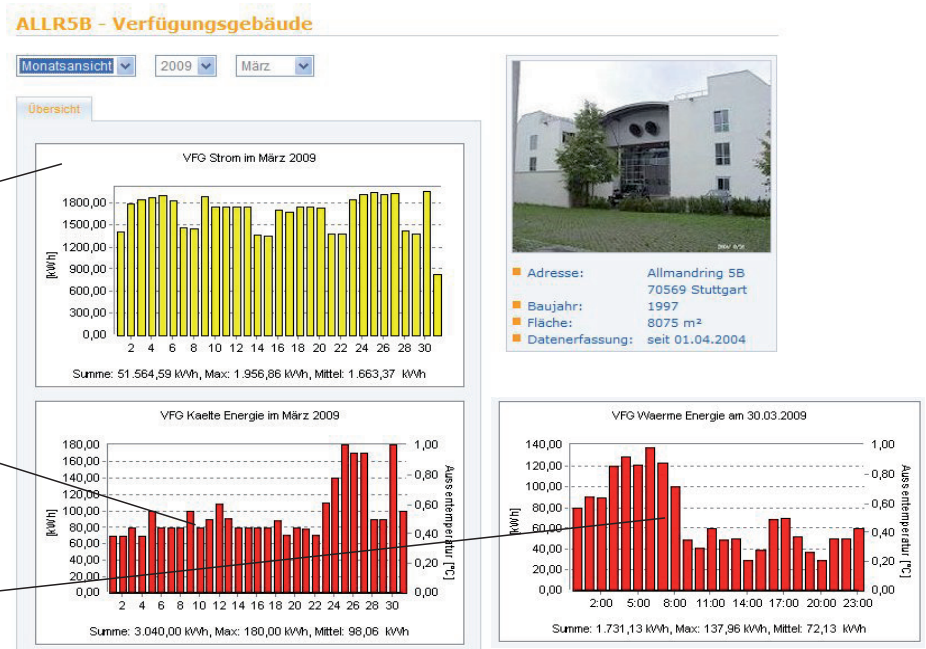
Intelligent metering: time series during operation

1. Patterns and dependencies are not very clear but we can see:

Electricity
base load too high

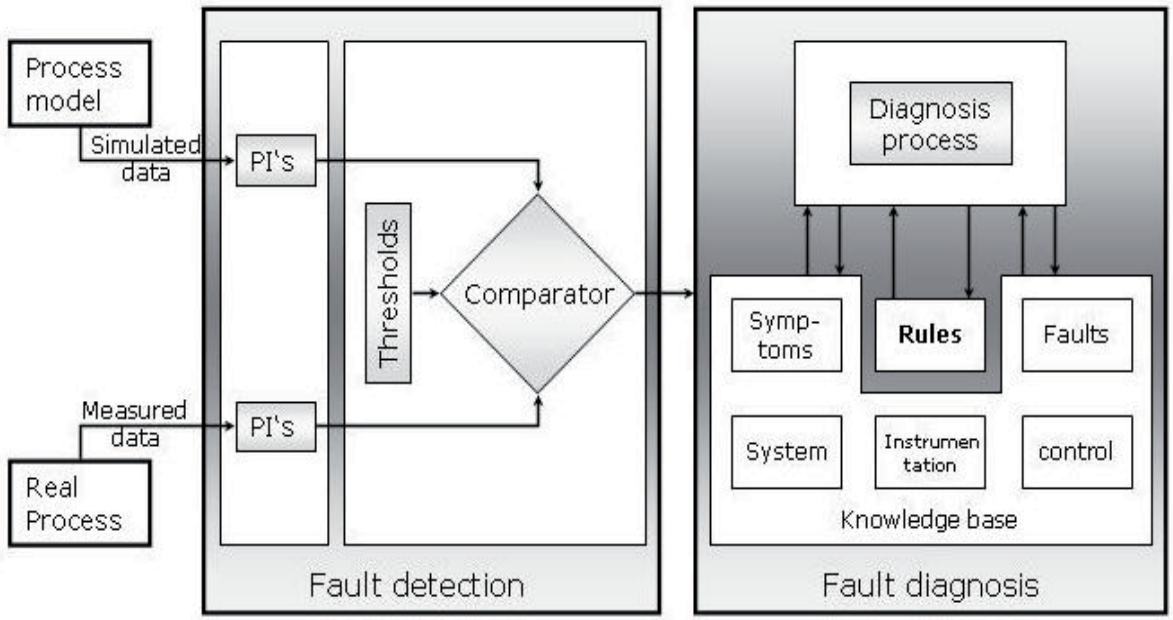
Cold
no weekend set back

Heat
unreasonable heating during night time



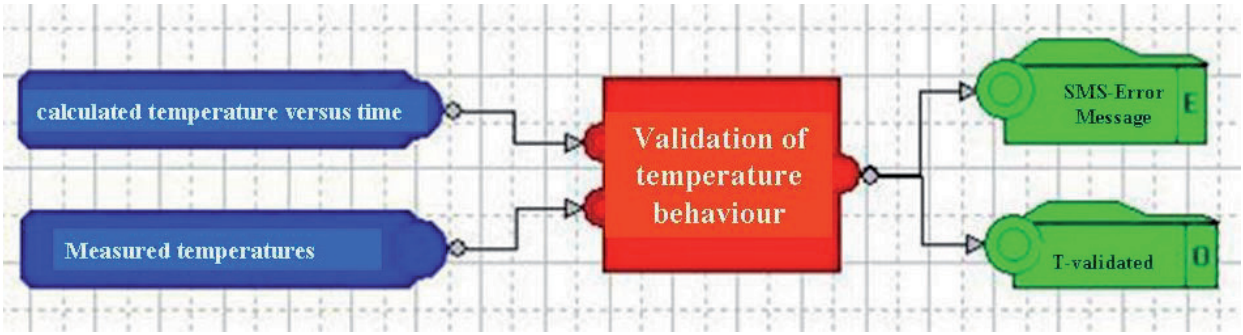
Smart EM - methods to evaluate measured data

2. Model based monitoring - software
   - Derive rules how to interpret consumption data from demand calculations
   - Apply software to fire rules



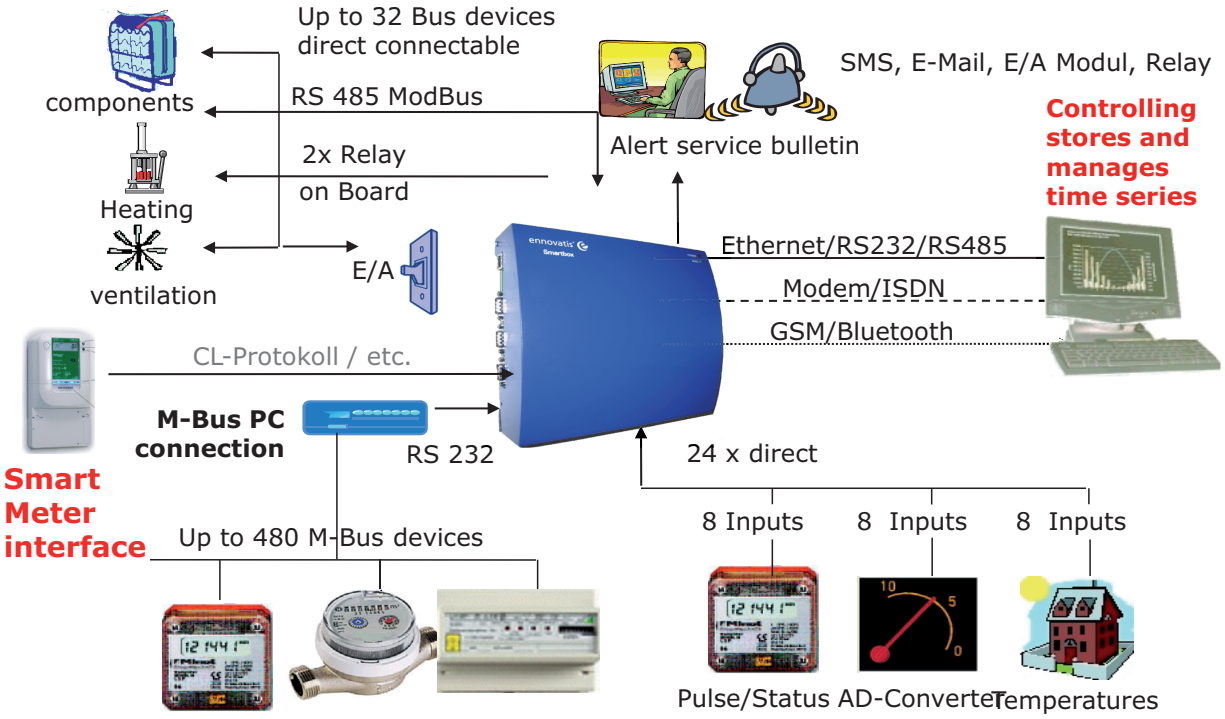
Smart EM - methods to evaluate measured data

3. Rule based monitoring - hardware
   - Derive rules how to interpret consumption data from intelligent metering
   - Apply soft- or hardware to fire rules



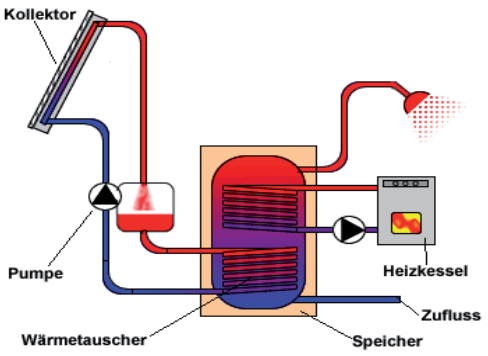
Note: Input can be due to both measurements and calculations

Hardware solution for data collection and building automation intelligent data logger



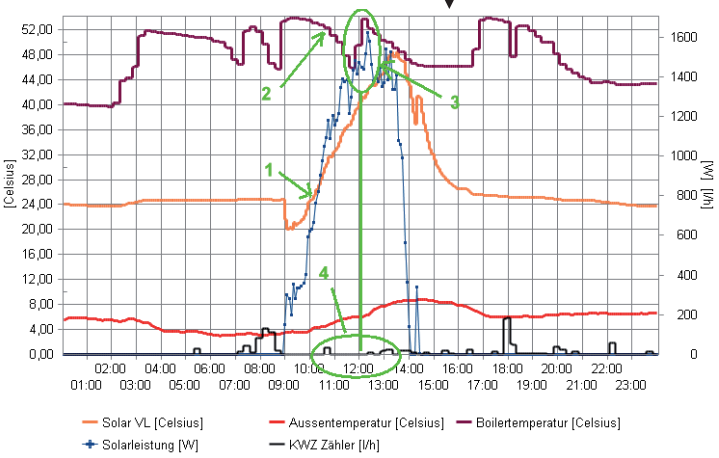
Detect controlling problem in solar heating system

Typical scheme of solar heating system:



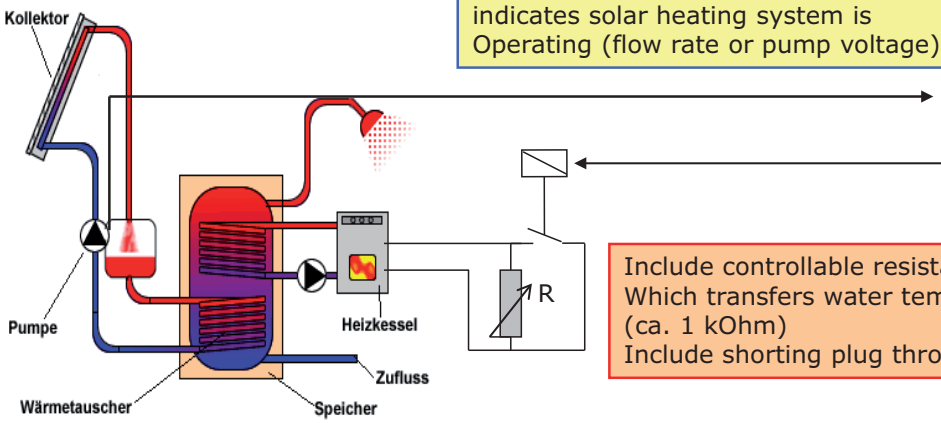
Sensor cables

Operation monitoring:



1. Begin of solar heating of storage tank
2. Temperature in storage decreases due to mixing
3. Burner starts heating water without
4. Any use of hot water
5. Temperature in storage tank increases and solar gains decrease.

Solve controlling problem with Smartbox



Provide signal to Smartbox which indicates solar heating system is Operating (flow rate or pump voltage)

Include controllable resistance into sensor cable
Which transfers water temperature from boiler (ca. 1 kOhm)
Include shorting plug through parallel relay

Incorporate the following **rules** in the Smartbox:
If
Solar heating is in operation
and
temperature in storage tank greater 35°C,
than
Open relay to pretend a higher storage temperature
This will avoid to switch on the burner.

SmartCoDe local energy resource cluster

› For the concept of the SmartCoDe project, we consider "local energy resource cluster" that consists of the following energy resources (consumers and producers):

a) **Locally available renewable energies, especially small-scale wind turbines and/or building-integrated photovoltaic's.**

b) **Locally available energy storages such as car batteries (plug-in hybrids, electric vehicles), freezers or hot water systems.**

c) **Energy using products such as HVAC, electric lighting, consumer electronics, white goods, etc.**

› Two demonstration sides are foreseen

– **Almersberg with photovoltaic and home appliances**

– **Buchberg with wind turbine and restaurant appliances**

SmartCoDe Demonstrator Almersberg

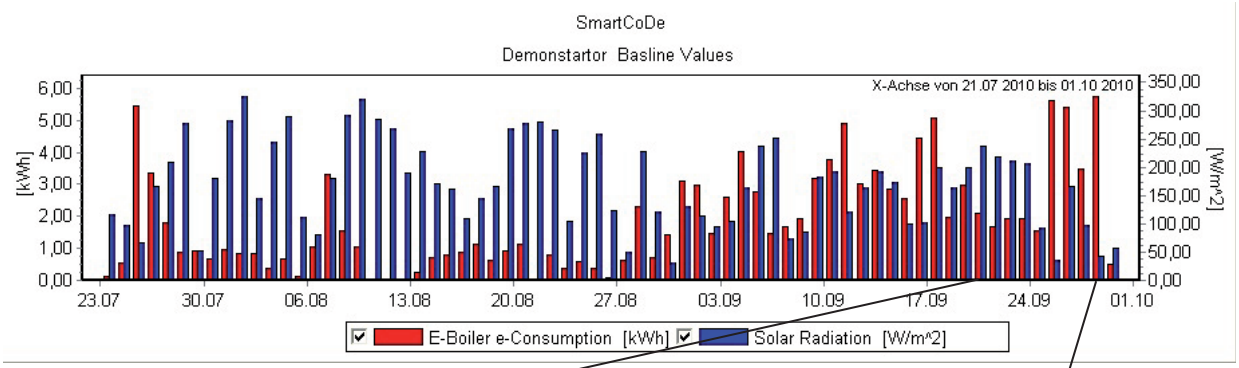
Building with photovoltaic

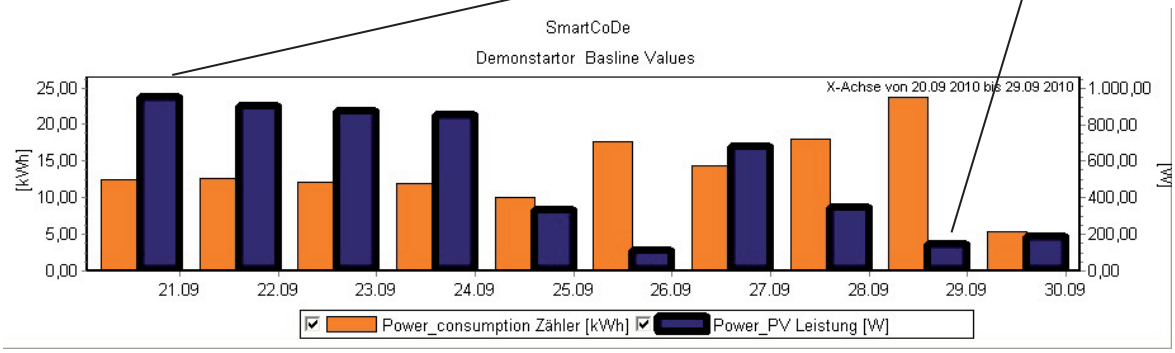
Heating system

medium period	2005	2006	2007	2008	2009
gas [kWh]	2.306	837	326	339	
electricity pub supply [kWh] 04 -03	10.609	10.776	10.030	5.771	
electricity sold to pub grid [kWh]	0	0	0	0	
electricity production PV [kWh]	0	0	0	0	4.510
warm water [m³]	No data	No data	No data	98	82
heating [kWh]	18.240	16.416	14.592	12.768	0

Question is will the SmartCoDe concept allow a higher efficiency in using PV

SmartCoDe Demonstrator Almersberg





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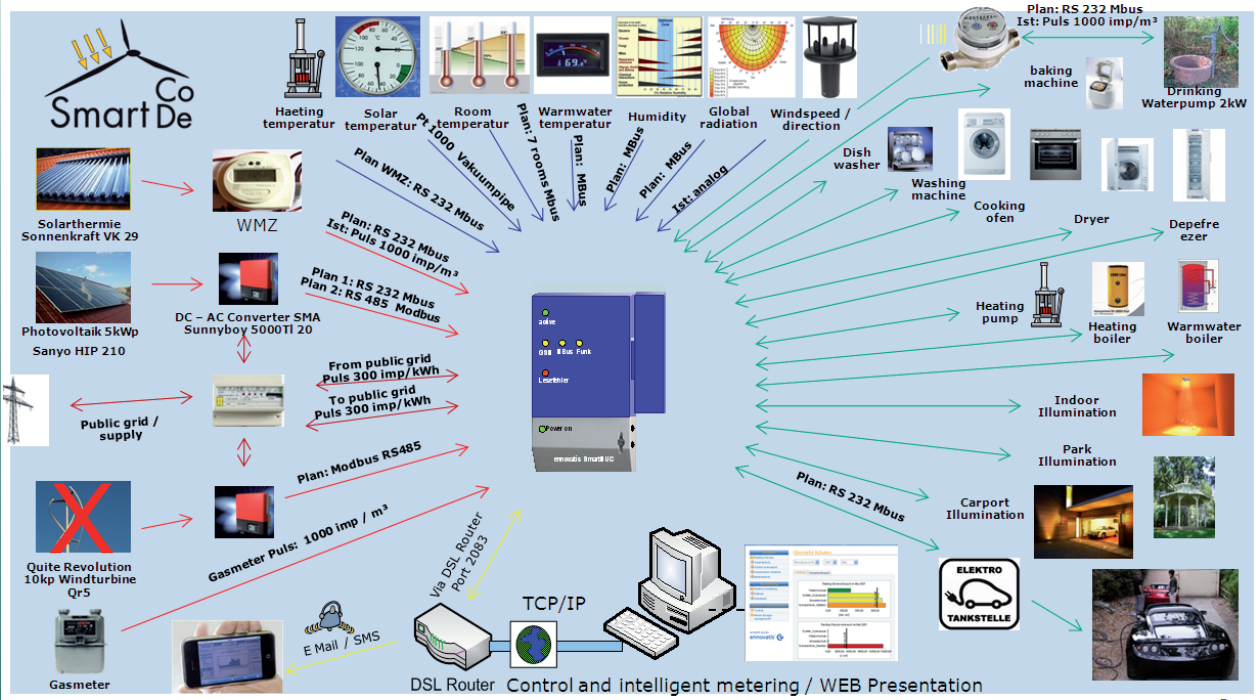
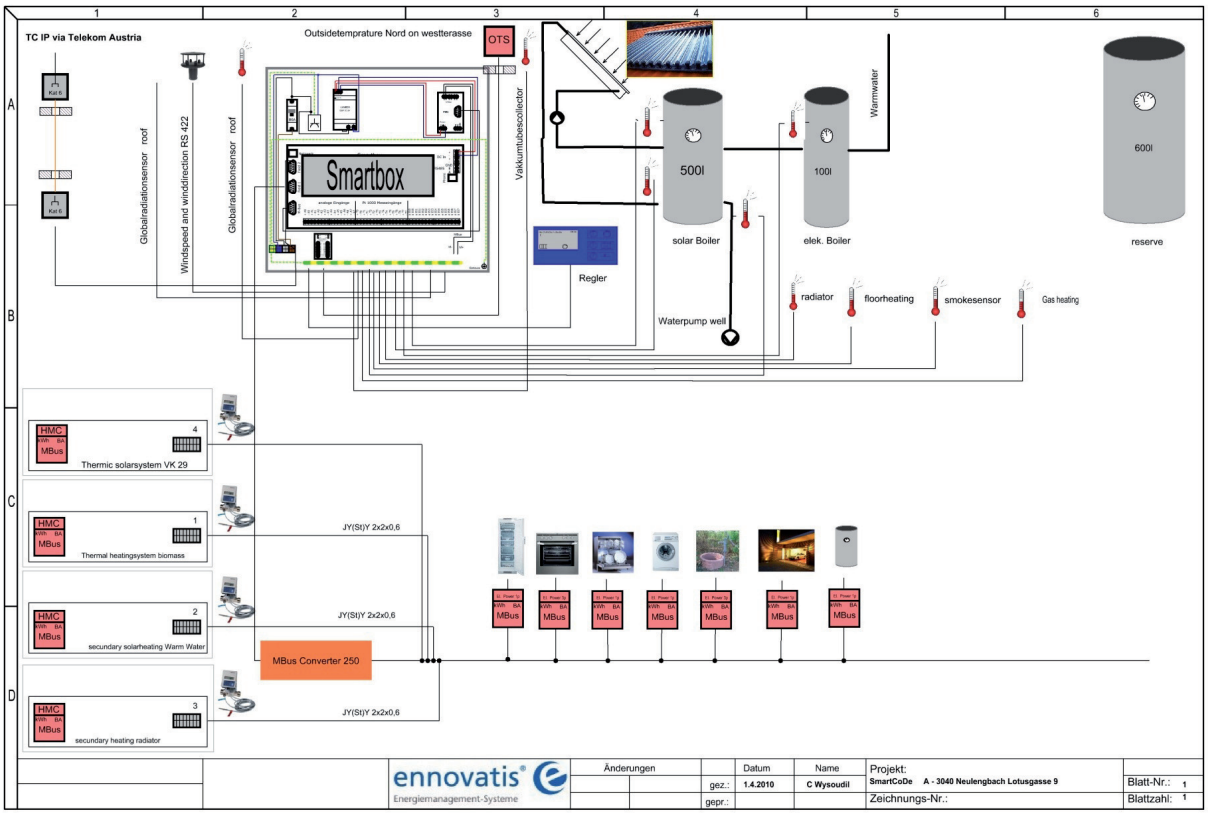
SmartCoDe Demonstrator Almersberg



SmartCoDe Demonstrator Almersberg



SmartCoDe Demonstrator - Expansion Buchberg

year	kWh	€
2006	45.873	5.817
2007	51.159	8.286
2008	54.802	9.125
2009	24.999	3.785

Electricity consumption at Buchberg side
note
gas for heating became available in 2008

Installation of wind turbine planned in 2011
expected contribution in the case of average wind speed of 6.5 m/sec
approx. 10000kWh

SmartCoDe Demonstrator - Buchberg EuPs

Energy using products (EUP)	aprox kW
Fridge	0,05
Deep Freezer & Icecream Freezzer box	0,4
Water pump Gardening	0,22
Heating pump	0,045
Illumination	4,5
Indoor upper floor (Living area)	
Indoor ground floor (restaurant area)	
Outdoor (Park, Terrace)	
Cooling Room	2
Washing machine	2
Dishwasher	2
Water supply pump 1 & 2	2
Circulation pump	0,25
Automat for drinks	0,1250
Electrical heaters for restaurant food warming	6
Ventilation (Kitchen)	0,6
Cooling system for drinks	1
Sightseeing tower (without automat for drinks)	1
Consumption in 2009	**25000 kWh**
Costs in 2009	**3785€**

Thank you very much for your attention

Questions please

contact

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