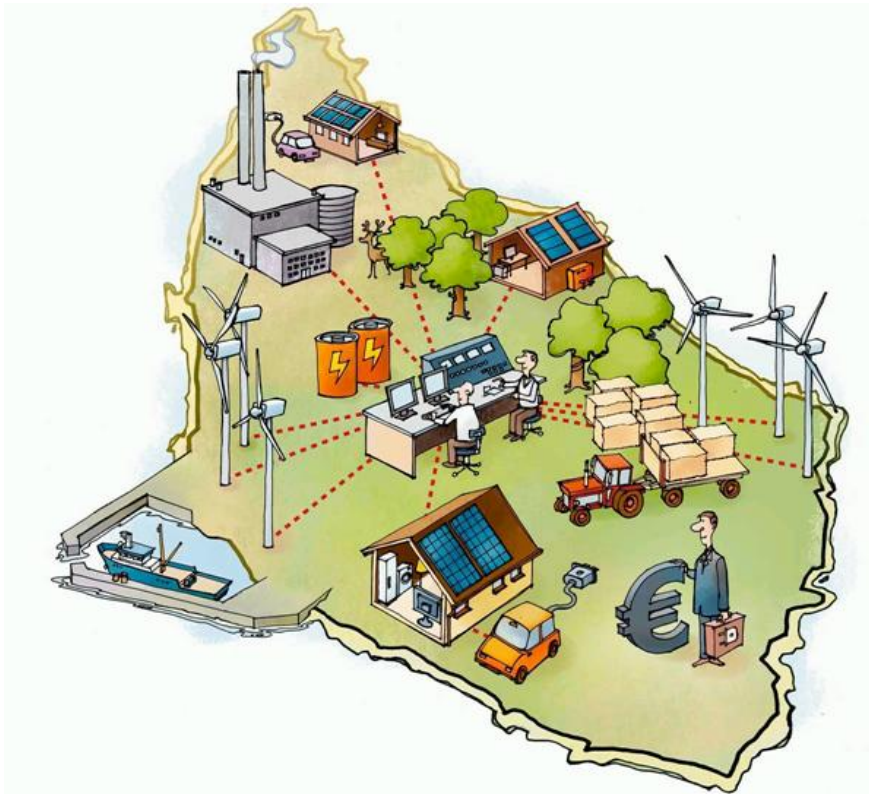


Quantifying the demand shift on the basis of statistical methods

# first evaluation

from the project EcoGrid EU

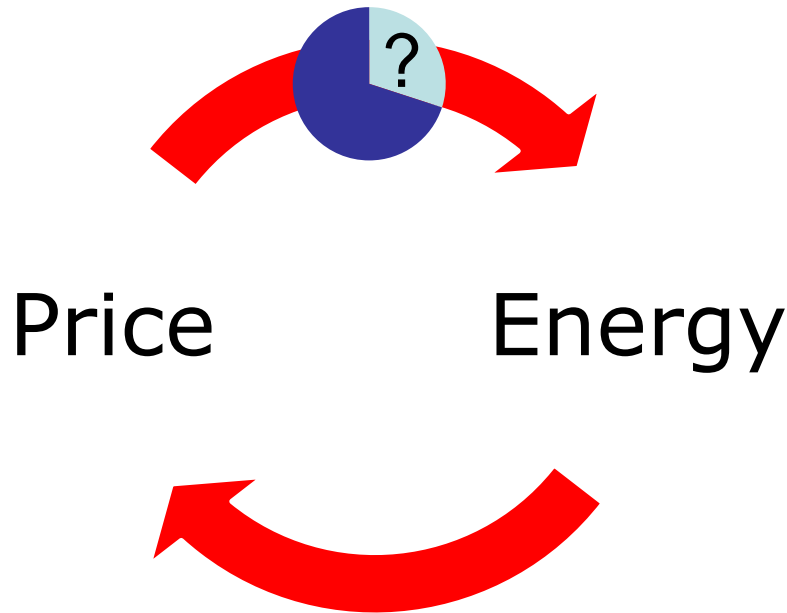


Presentation at: Workshop on DSM Potentials, Implementations and Experiences

Presentation by: Florian Judex

May 20<sup>th</sup> 2014

# Can we prove that the EcoGrid<sup>eu</sup> concept actually works?



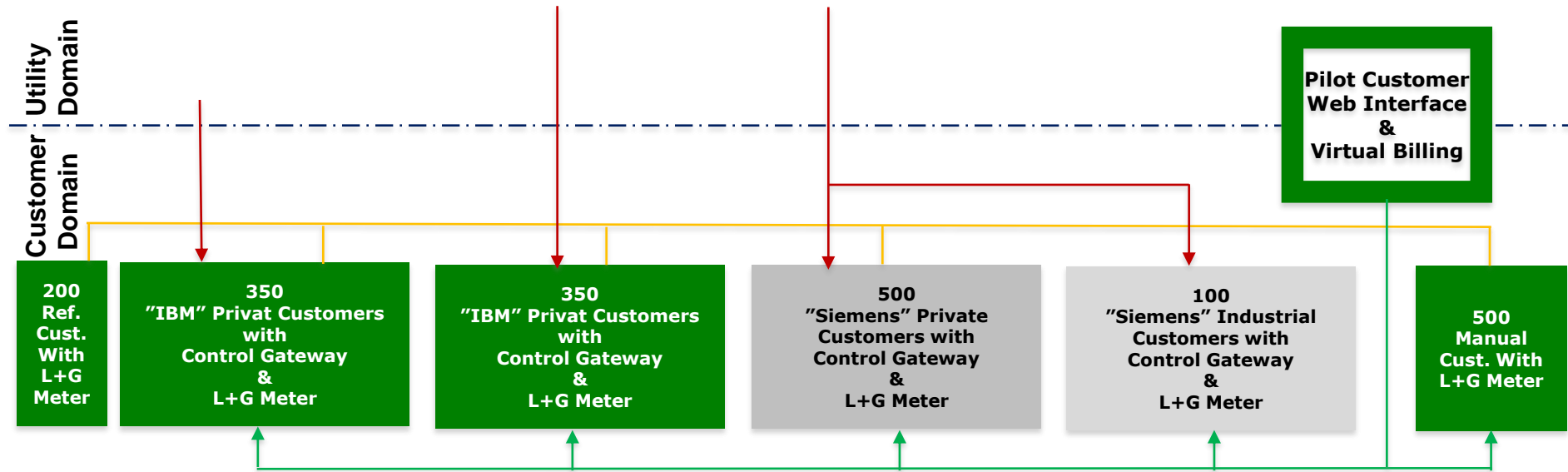
1) the price should influence energy consumption

1a) in many cases automation should do this

2) the entity issuing price should know how a certain price will influence energy consumption to determine the right price at the right time

2a) ideally, this should be on a very finely grained level

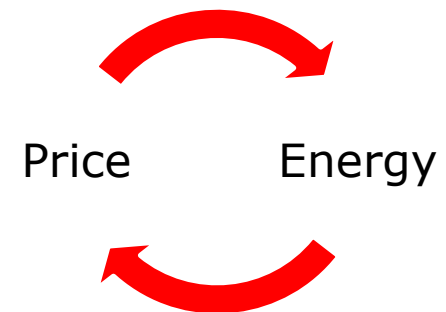
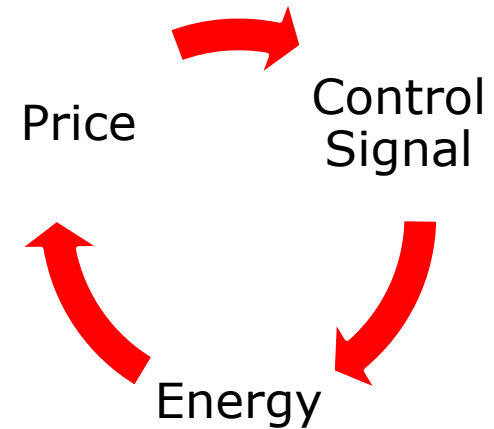
# short overview



1900 participants are recruited as of March 2014

## Currently: step one works for the automated customers

- price signals are fed to the customers
  - realistic
  - extreme
  - flat



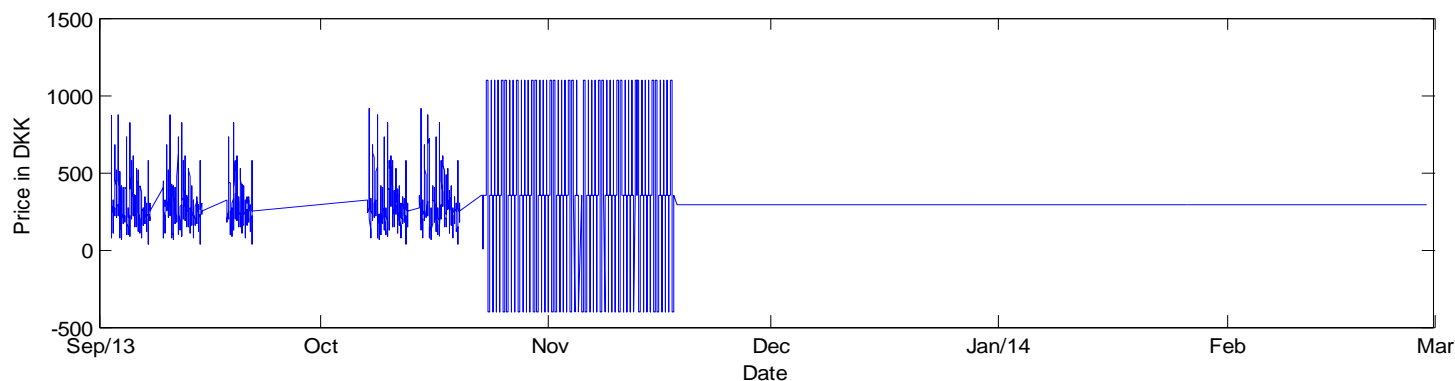
## Methods

- Analysis of Variance (ANOVA)
- Question: is mean value of two samples really different or just an effect of the random sampling
- prerequisites: normal distribution
- answer: yes or no with probability
- two sided Kolomogorov-Smirnoff test
- Question: are two empiric cumulative probability density functions different
- perquisites: none
- answer: yes or no with probability
- why not always: higher rate of false negatives



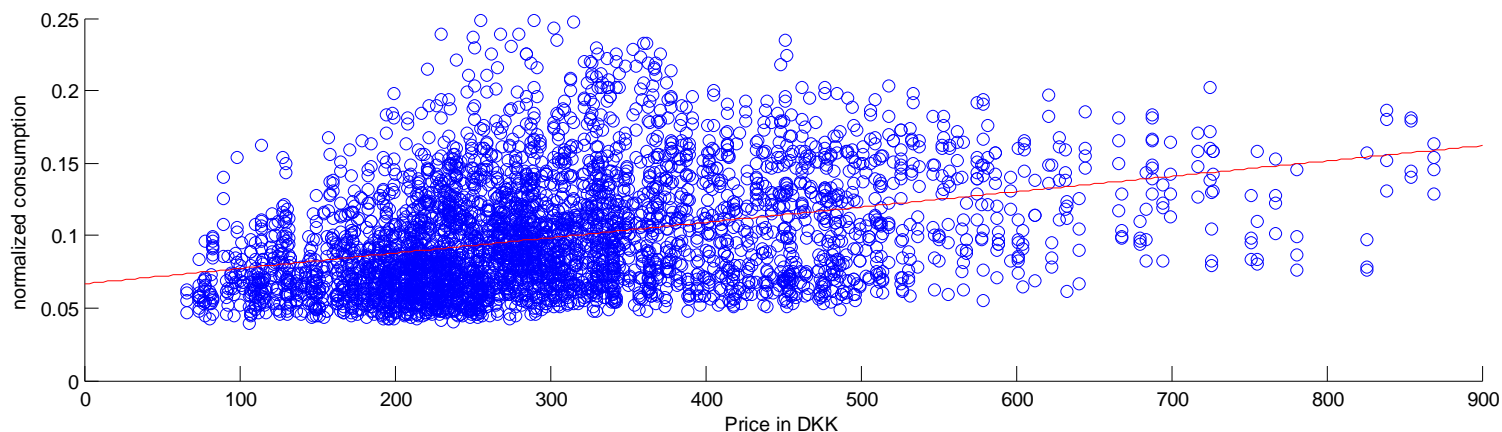
## Manual Control of the Energy Use

- Customer has an online Feed Back System informing them about the price and price forecast
- Customers for evaluation were chosen based on their ability in the feedback system
- price signal up until now came in three phases



## Phase One - outcome

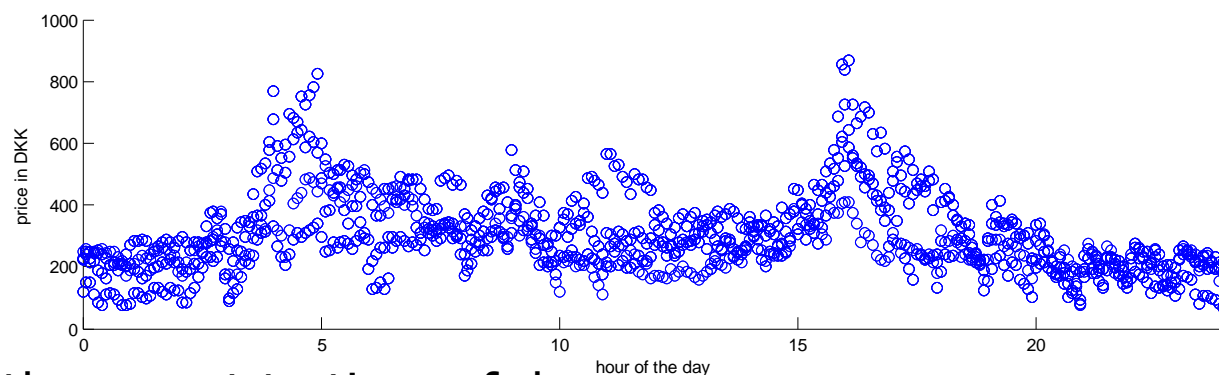
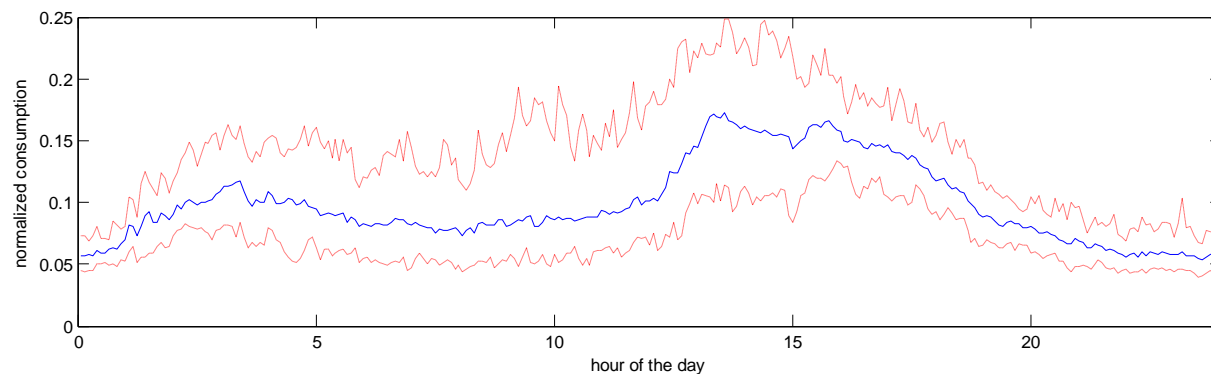
- Realistic Price Signal from the market



- consumption lower at lower prices and higher at higher prices
- why?

## Phase One – possible reason

- Consumption over time of day averaged

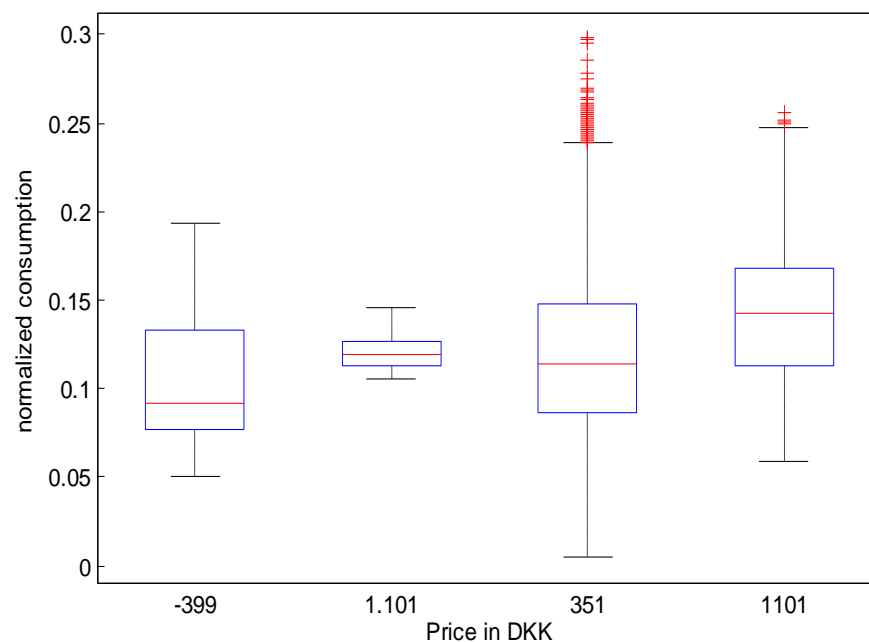


- Price with respect to time of day



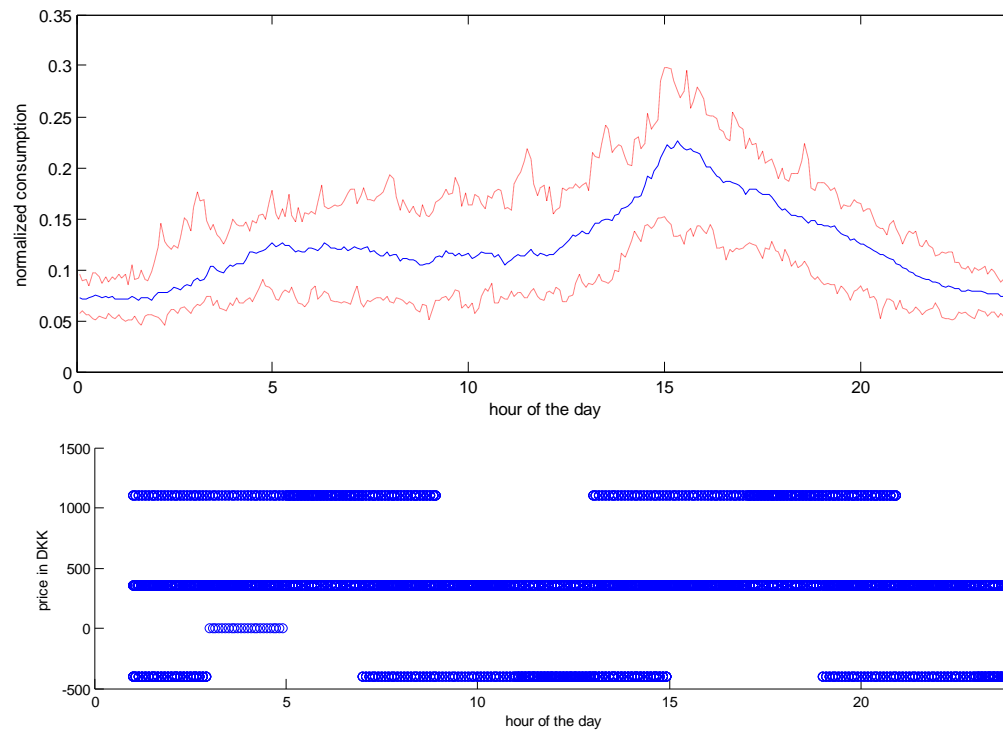
## Phase 2 – outcomes

- only four distinct price levels
- ANOVA possible
- positive outcome
- again the consumption is actually lower at times lower prices



## Phase 2 – possible reason

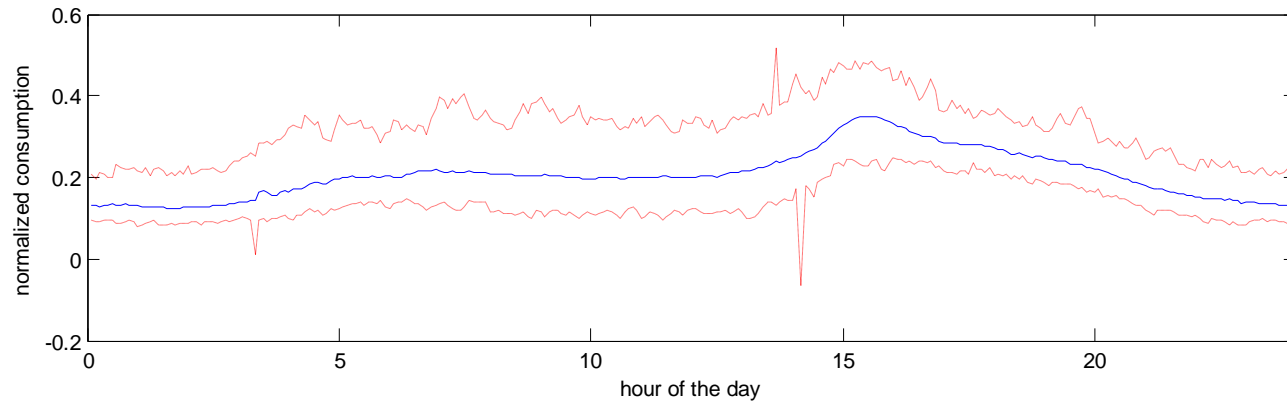
- Consumption over time of day averaged



- Price with respect to time of day

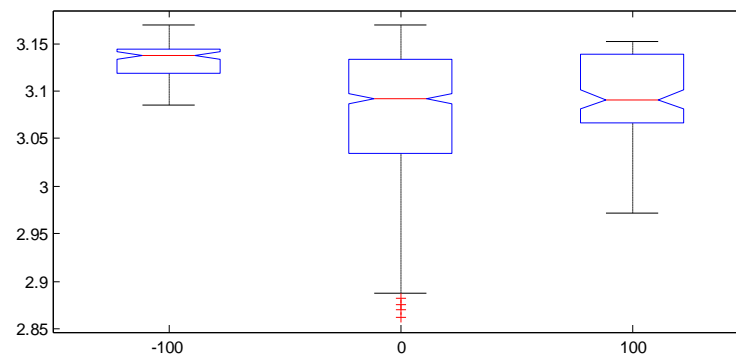
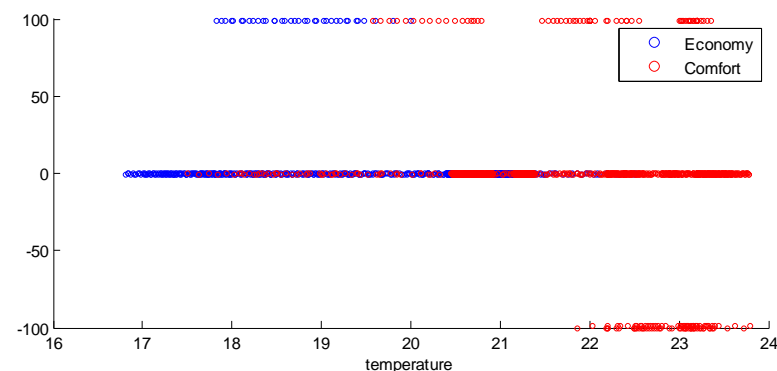
## Phase 3 – outcomes

- qualitative identical behaviour to the other two phases



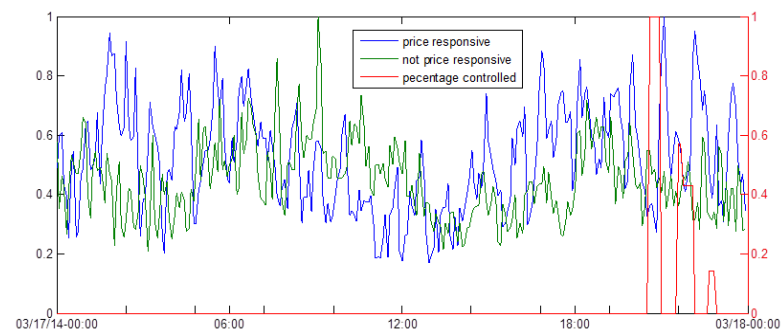
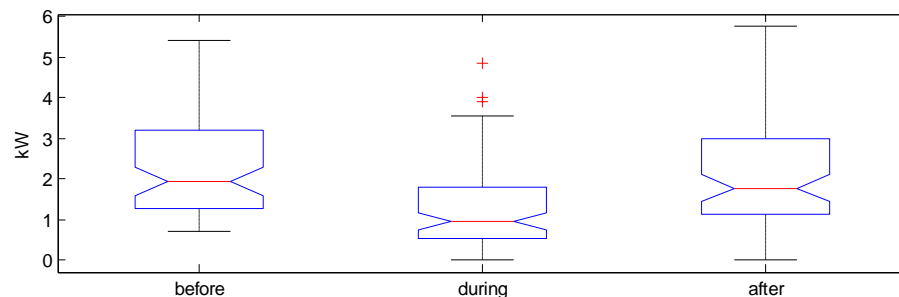
# Siemens Control - temperature

- Siemens Control directly influences the indoor temperature setpoints, depending on the price, using a control signal
  - does this work?
- Evaluation by comparing indoor temperatures at different control signals
  - Method: Analysis of Variance
- Sample on the right side



## Results – IBM direct control

- IBM control influences the heating unit directly
  - tries to find the optimal period for turning it off
  - depending on the state of the dwelling and the heating unit, this may or may not happen
  - does it work?
- Evaluation: correlate the control signal with the energy consumption
  - Method: Kolmogorov–Smirnov test



## And now the numbers

- SIEMENS
- Power depending on signal
- IBM direct control
- average consumption with respect to the load shifting event

	power in kW		
Statistic	high	normal	low
Mean	4,82	2,55	1,60
Variance	1,506	1,591	0,770

	power in kW		
Statistic	before	during	after
Mean	2,22	1,29	2,16
Variance	1,41	1,07	1,95

## Outlook: Industrial Customers

- Still being recruited
  - manure mixers
  - fork lifter loading stations
  - cold storage unit
- higher power, clearer constraints



slurry pump, source: project GAVE



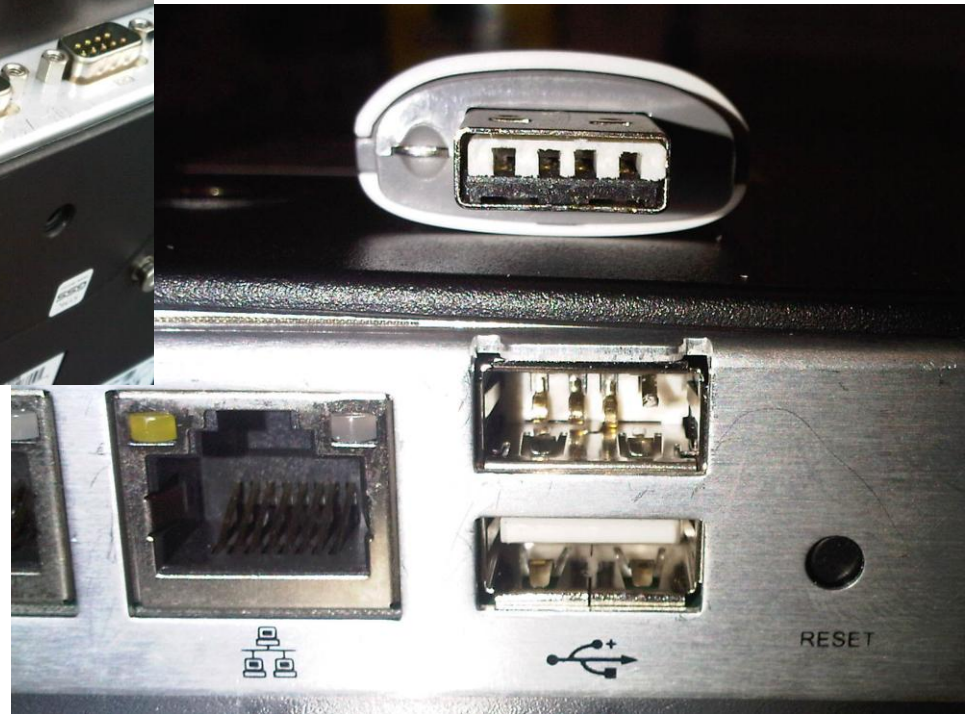
sludge turner, source: project GAVE

finally: never forget, it is a field study



source: project C2G

source: project C2G



source: project C2G



# Thank you for your attention

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