Increasing Energy Awareness Through Web-enabled Power Outlets

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by
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The Small Scale Problem

Problem

- how to proof my energy bill
- how to reduce my energy costs
- how to monitor single consumptions
- ...

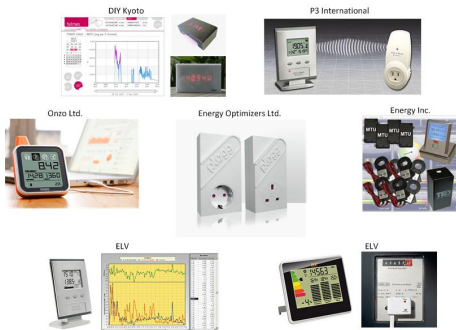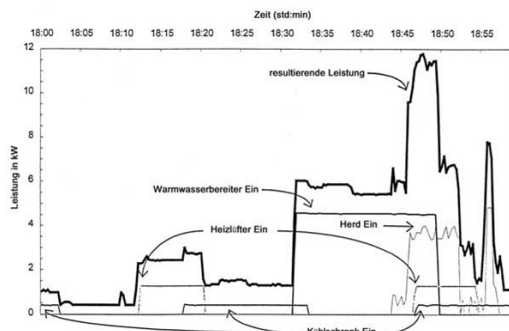## Dream

- plug based monitoring
- no wiring complexity
- easy to handle and maintain
- ...

Small Scale Solution

- most require a complex installation around
- not capable to motivate user for longer time periods
- measurement not in real time
- lack of possibility for aggregating the consumption of multiple sensors

The Medium/Large Scale Problem (globally)

Problem

- interoperability
- reliability
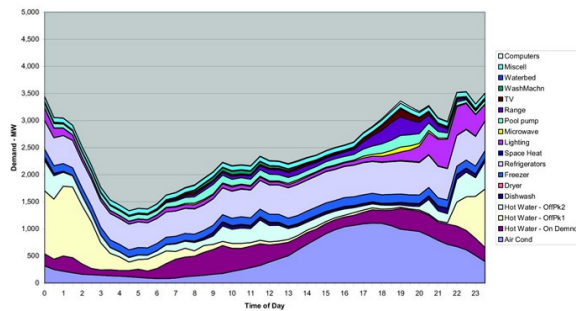- security
- . . .

Dream

- Web-Service based architecture
  - ease of integration with existing services, visualization tools, etc.
  - accessible to a large pool of developers (i.e., Web developers)
  - distribution, universal accessibility (e.g., from mobile phones, etc.)
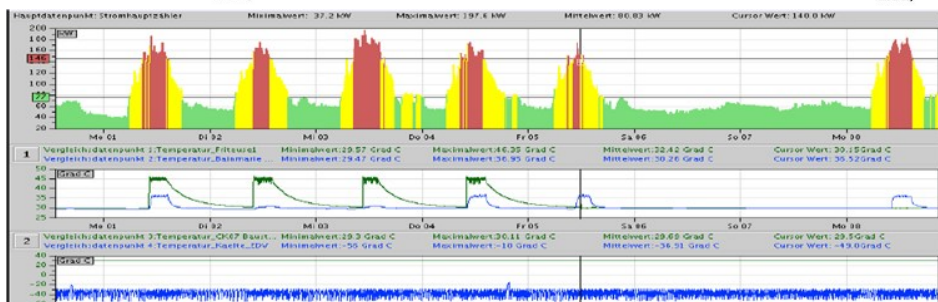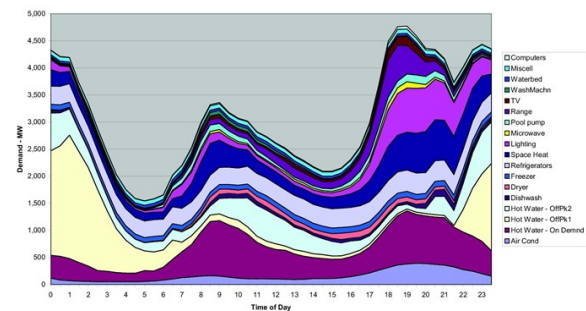- off the shelf products
- . . .

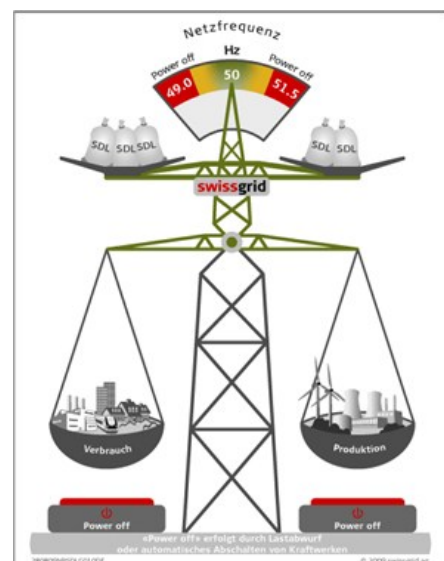# Why globally? Profile Aggregation

Summer

Winter

[1] http://www.solarchoice.net.au/blog/how-do-i-use-electricity-throughout-the-day-the-load-curve.html?replytocom=6376
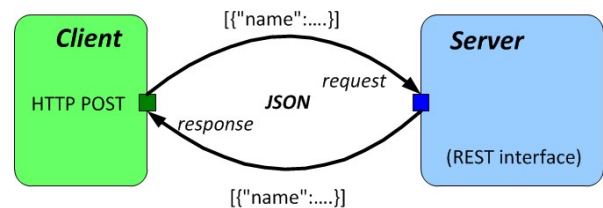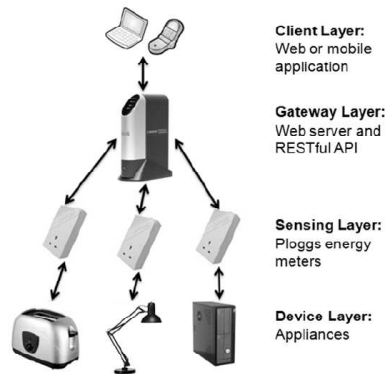
Why globally? System Service

- Transmission System Operator (TSO): Continuous balance of production and consumption by *system services*.
- TSO buys *system service*.
  - Market for *system service*.
  - Auction of different products.
- *system service* is EXPENSIVE, because reproach of power station is necessary (high operation and opportunity costs).

Example:
primary and secondary service: 10-40kCHF/MW

The Layer Architecture

Client Layer:
Web or mobile application

Gateway Layer:
Web server and RESTful API

Sensing Layer:
Ploggs energy meters

Device Layer:
Appliances

Smart Gateway

1. scans for available energy meters and makes them available as web resources
2. makes the functionality available through simple URLs based on a small footprint webserver

Example:

1. *http://[GatewayAddress]/energievisible/ploggs/roomLamp* is bound to a method
2. method first initiates a Bluetooth connection through a low level call
3. connection to Plogg named "roomLamp"
4. polls the Plogg reading current load of energy measured

Representation State Transfer (REST)
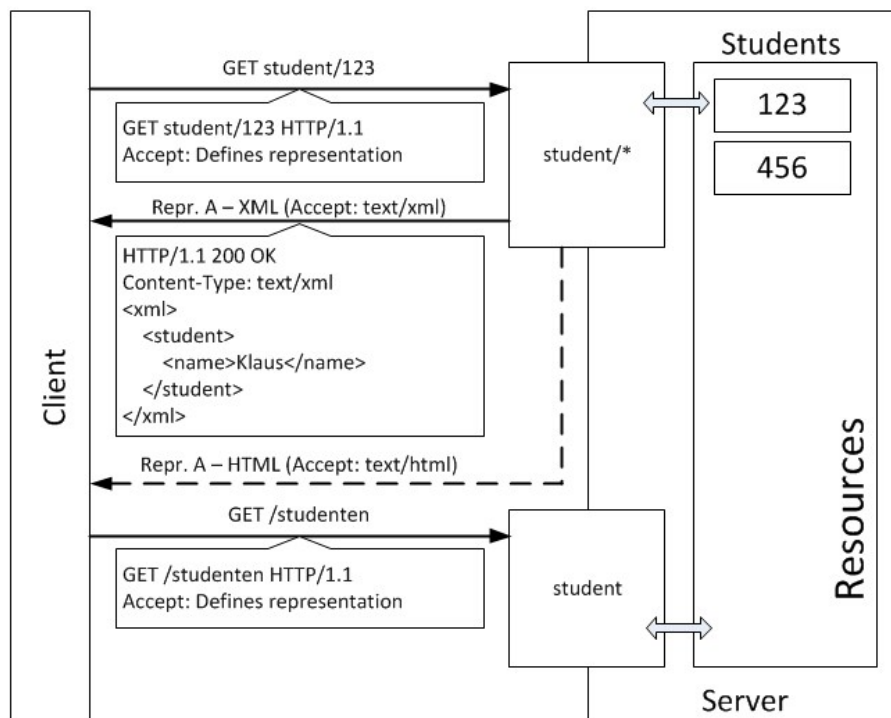
RESTful Methods

URI	HTTP Method	Description
/energievisible	GET	Index page
/energievisible/ploggs	GET	Lists all the available Ploggs in range
/energievisible/ploggs	POST	Create new Plogg on discovery
/energyieisible/ploggs/all	GET	Show consumption of all Ploggs
/energievisible/ploggs/[NAME/ID]	GET	List the consumption of Plogg [NAME/ID]
/energievisible/ploggs/[NAME/ID]	PUT name	name Set the name of the Plogg
/energievisible/ploggs/[NAME/ID]/status	GET	Displays the current status of the Plogg
/energievisible/ploggs/[NAME/ID]/status	PUT on/off	on/off Switches Plogg on or off
/energievisible/ploggs/[NAME/ID]/[RESSOURCE]	GET	Measured value of RESSOURCE (e.g., power, current, and voltage) of Plogg [NAME/ID]

Web User Interface
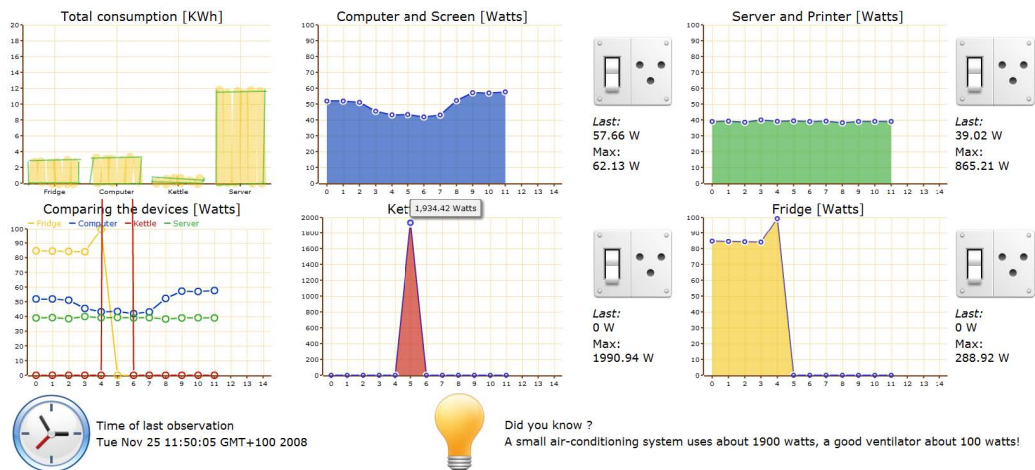
- aggregated energy consumption per device
- power curves per device
- actuation of appliances
- Tips and Hints
- . . .

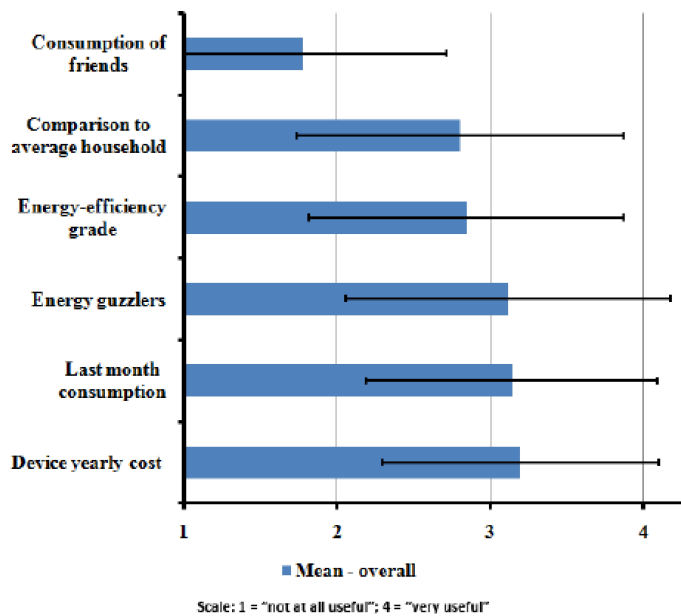# Mobile User Interface

overall power meter with level indicator

power meter per device

details per device:

- power and energy meter
- costs
- actuation
- . . .

User Assessment

Scale: 1 = "not at all useful"; 4 = "very useful"

Summary

- A RESTful API has been implemented using off-the-shelf components which is easy to install and demonstrates easy extendability.

- Outlook
  - Feedback to user has to be combined with other concepts of marketing and consumer research:
    - clear value of proposition
    - goal settings
    - budgeting
    - . . .
  - implementing engagement strategies
    - e.g. competition

References I

Weiss, Markus and Guinard, Dominique
Increasing energy awareness through web-enabled power outlets.
Proceedings of the 9th International Conference on Mobile and Ubiquitous Multimedia, Cyprus, 2010.