



## Optimierung der Energiebilanzen im Smart Grid mittels Sensornetze

Optimizing the energy consumption and production in Smart Grid  
using sensor networks



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16-17.10.2014 – SENSORSYSTEME 2014

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609132



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microelectronics

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# Agenda

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1 e-balance project – introduction

2 Motivation

3 The solution

4 Conclusions

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# e-balance project introduction

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## The goal of the project

- Definition and implementation of an ICT solution for optimizing the energy efficiency by controlling the energy production and consumption. This system shall be defined for the people with the people, i.e., taking the socio-economic aspects into account.

## FP7 Framework (EU)

Duration: 01.10.2013 – 31.03.2017

## 11 Partner

- IHP, Germany
- INOV, Portugal
- EDP, Portugal
- Univ. Malaga, Spain
- CEMOSA, Spain
- Alliander, the Netherlands
- Univ. Twente, the Netherlands
- IPI, Poland
- Univ. Lodz, Poland
- Lesswire AG, Germany
- Efacec, Portugal

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# Motivation

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Energy efficiency becomes crucial for rational consumption of the available resources and reduction of the CO<sub>2</sub> production. But the reduction of energy consumption as the only remedy is only a partial solution. Similar, applying more environment-neutral or renewable energy sources without smart energy management systems may even cause failures in the energy grid or at least cause the energy to be wasted, on one hand and not available, on the other. Introducing intelligent solutions that combine the control of energy production and consumption helps to achieve the best efficiency.

However a successful application of such solutions faces problems due to human factors. The problem space is multidimensional, but can be structured as a combination of social, economic and technical aspects. The e-balance project will investigate their interdependencies and propose a solution that satisfies the defined requirements.

# The key aspects of e-balance

Different stakeholder kinds

Legislative diversity

Diversity in energy sources

Respecting market rules

Respecting the privacy

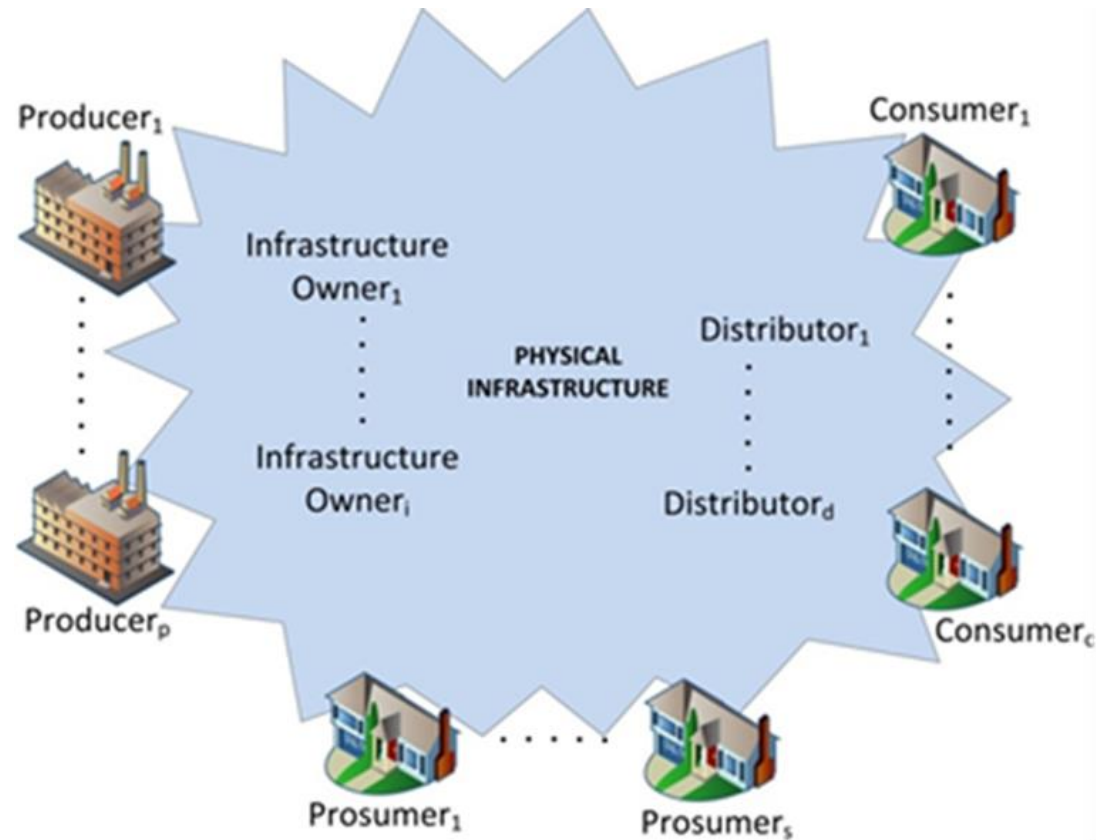
Satisfying needs and demands

Increasing the efficiency

Increasing the reliability

Exploiting the fact that the energy network is fractal-like

Realized as an flexible and innovative holistic approach



## The objectives of e-balance

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Research on real-life (economic and social) aspects of the energy efficiency obtained by distributed and decentralized energy control and management.

Integration of communication technologies for decentralized power management with increased local decision support.

Flexible control and management algorithms for intra-level and interactive multi-level energy production, consumption and distribution.

Multi-aspect, detailed, reliable and reproducible evaluation of the proposed approach in real life scenarios.



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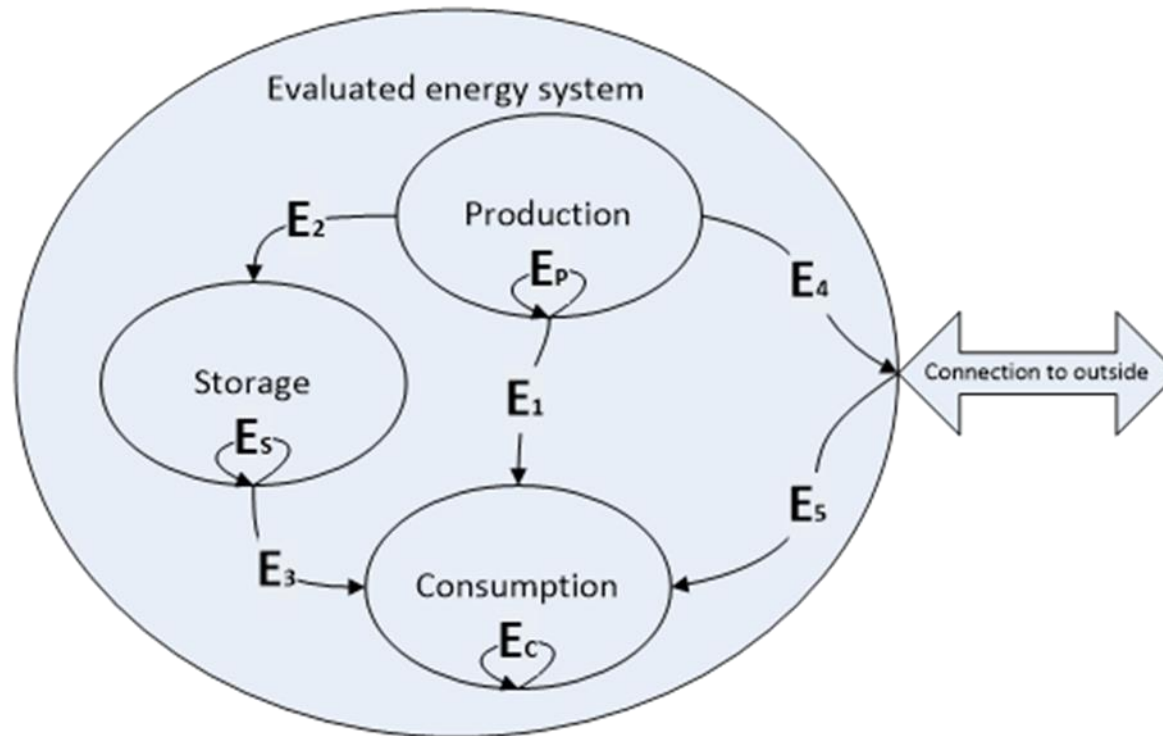
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# The hierarchical and fractal-like approach

In the most of the cases the energy grid is a tree

At every level the grid branch can be regarded as an individual system

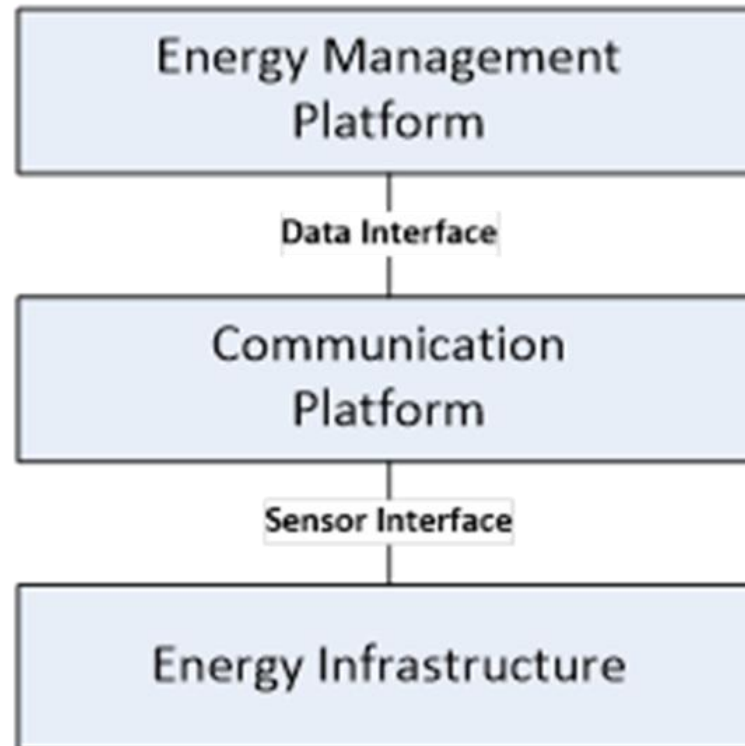


Controlling its components we can keep the system balanced

Done by data acquisition, exchange and processing – sensor and actuator network

# The ICT solution – the first approach

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Provides a split between logic and data exchange

Defines interfaces between layers

# The opportunities and obstacles

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The technical solution to be defined has to consider the socio-economic aspects

## The constraints:

- Legal issues
  - The system has to work within the legal context
- Social issues
  - Involving the customers is crucial, without them no energy balancing possible
  - Lack of user acceptance may close the market to a good technical solution

## New opportunities:

- New business concepts
- Increased reliability of the grid
- Increased service quality

# The user study

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Two user studies planned in the project duration

The main aim of the first user study

- To assess the preliminary potential of the system, unveil possible obstacles and determine the customers' requirements

Target groups

- Portugal
  - 1661 customers (248 prosumers, 1413 consumers)
- The Netherlands
  - 1647 customers (139 prosumers, 1493 consumers)
- Poland
  - 1632 customers (144 prosumers, 1503 consumers)

Technique: CAWI (online) questionnaires

Approx. LOI: 30 minutes per respondent









Sample demo structure correction

- Sex and education of respondents according to EUROSTAT reference data about internet users in Poland, Portugal and the Netherlands.

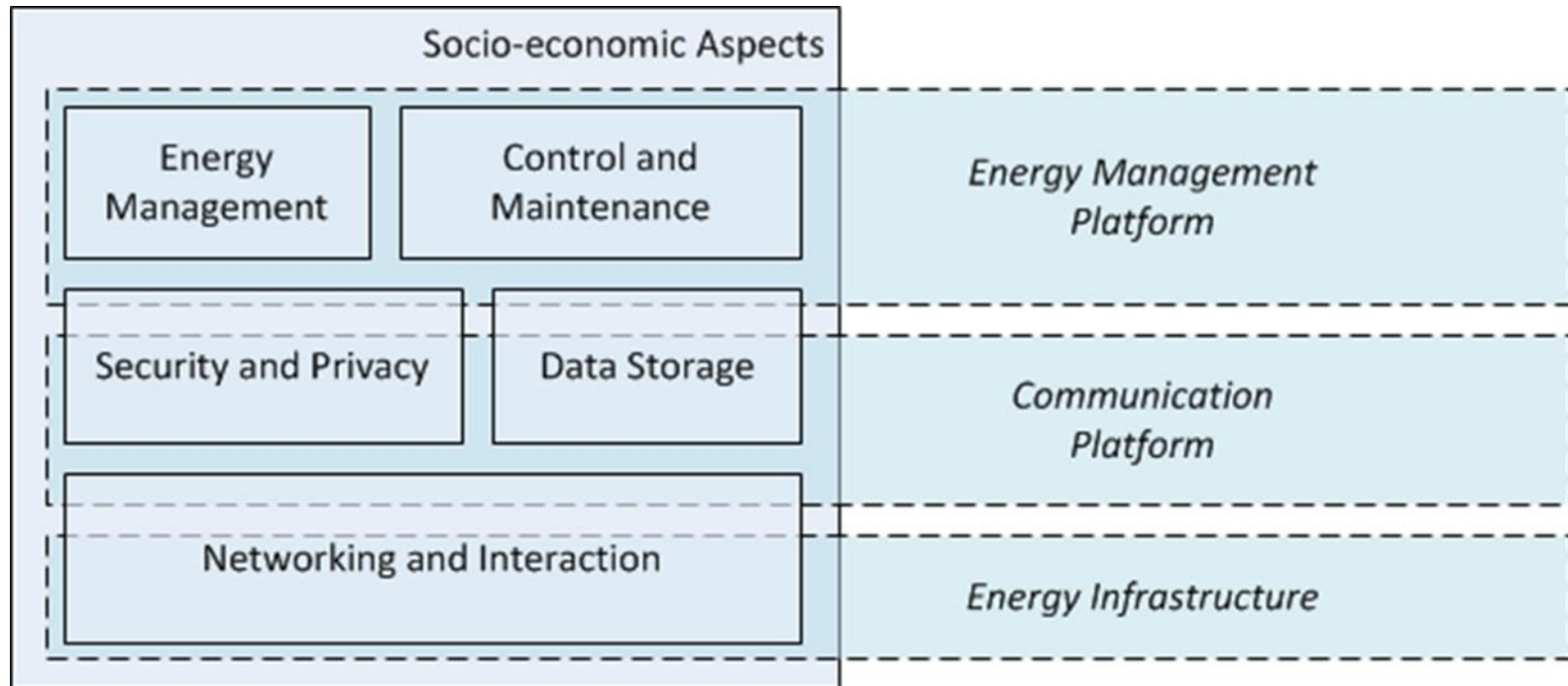
# The user study, cont.

## DEMOGRAPHIC COMPARISON BETWEEN THE CLUSTERS



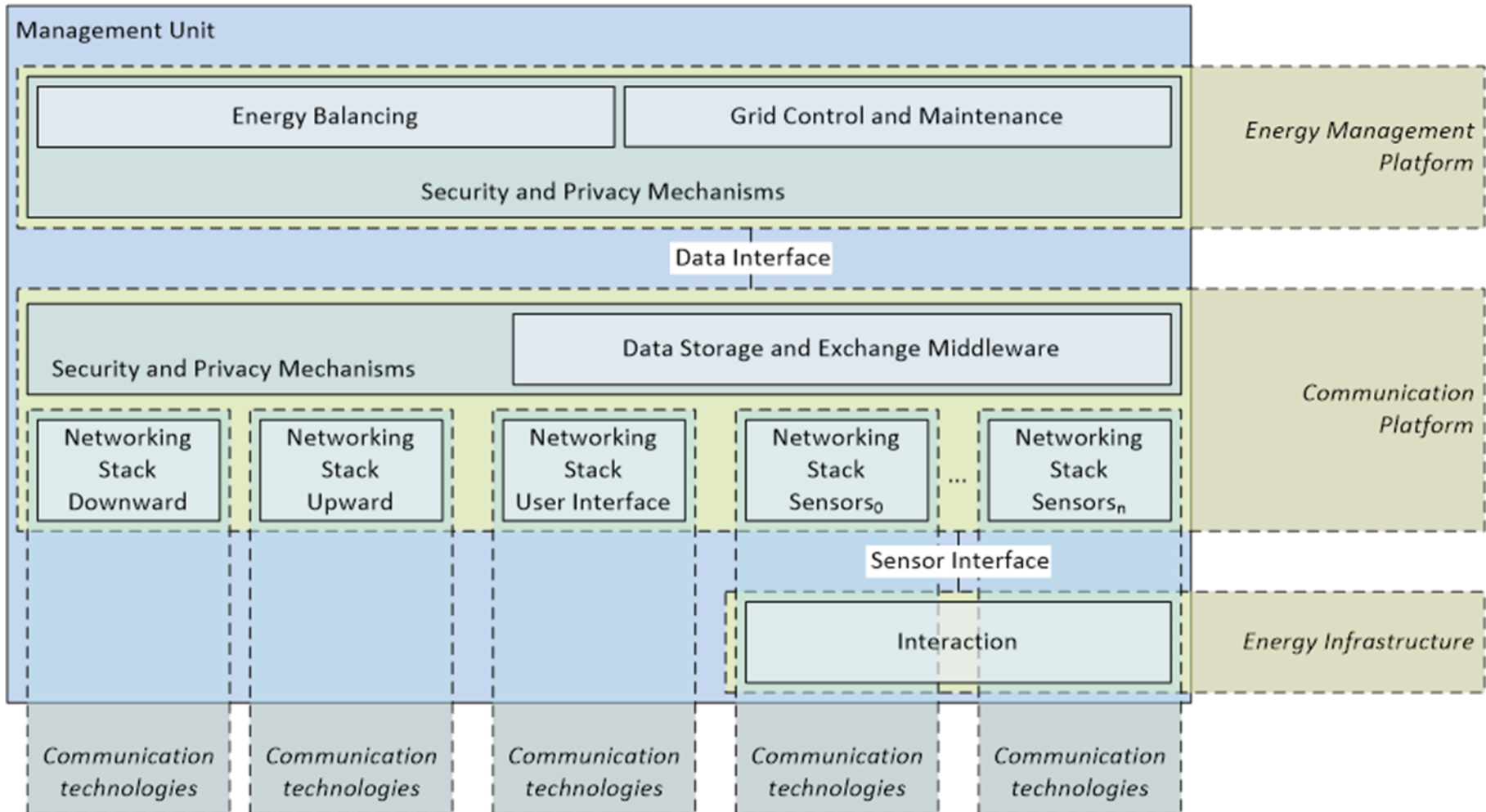
	UNWILLING 28%	ENTHUSIASTS 34%	CAUTIOUS 22%	CURIOUS 16%
AGE	Young adults (up to 40 y.o.)	Mature (40-55)	Seniors (55+)	Young adults (up to 40 y.o.)
PLACE OF LIVING	 			?
NO. OF PERSONS IN HOUSEHOLD	Big households (5+) or singles	2 - 4 persons	2 - 3 persons	3 - 4 persons
GENDER				
ATTITUDES TOWARDS NEW PRODUCTS	Late majority Laggards	Innovators / early adopters	Majority, Lower education	Innovator / early majority
INCOME & WORK	Stable job but poorly paid \$	Stable well paid job (eng./corp.) \$\$	Often retired, non-workers \$	Social ladder climbers \$
HOUSING	Non-owners apts./ house	Owners Spacious apt./ house	Non-owners Apts.	Non-owners smallest apts.

# The enhanced ICT solution



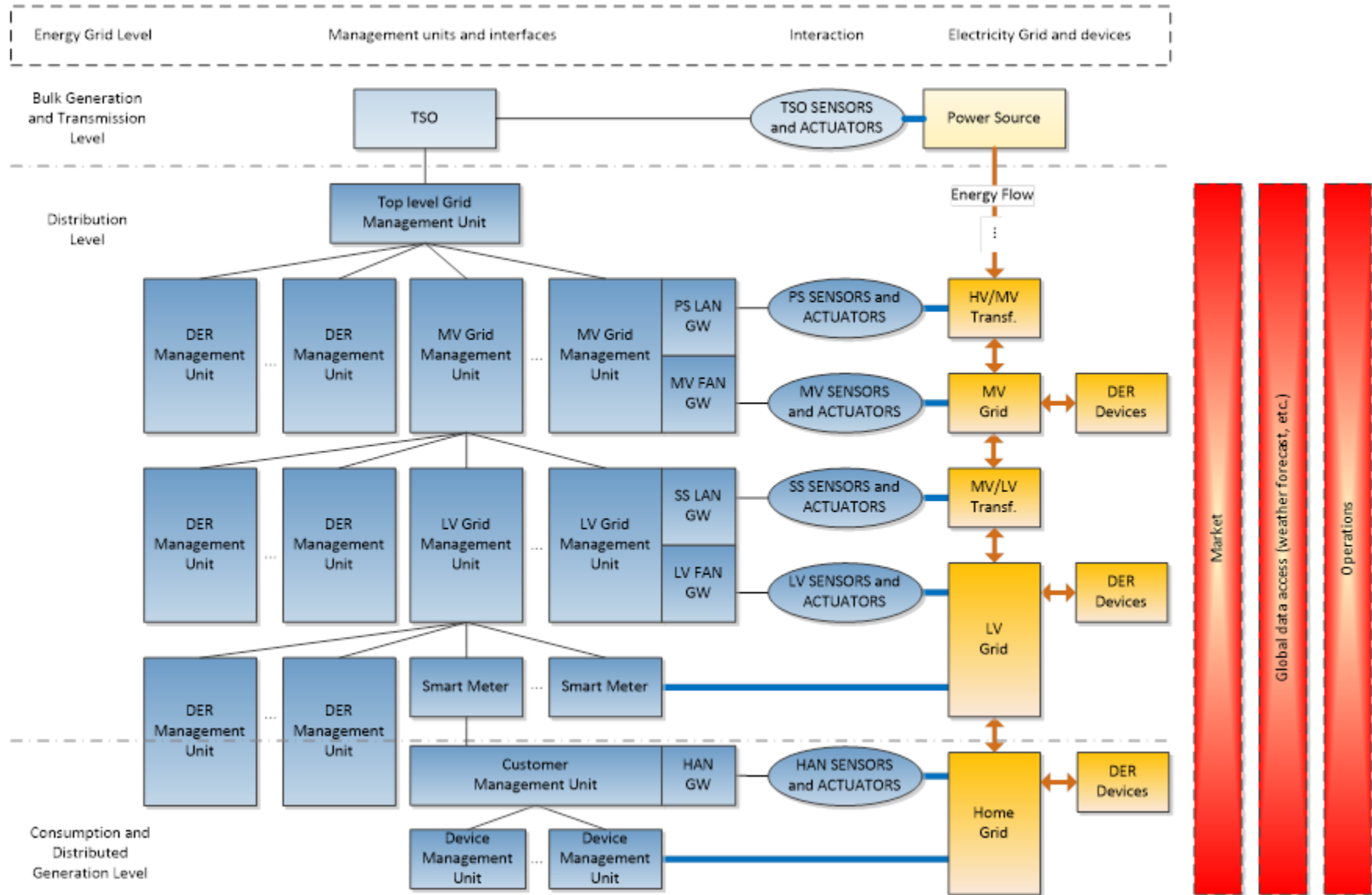
ICT solution for hierarchical energy balancing respecting socio-economic aspects

# Management unit architecture

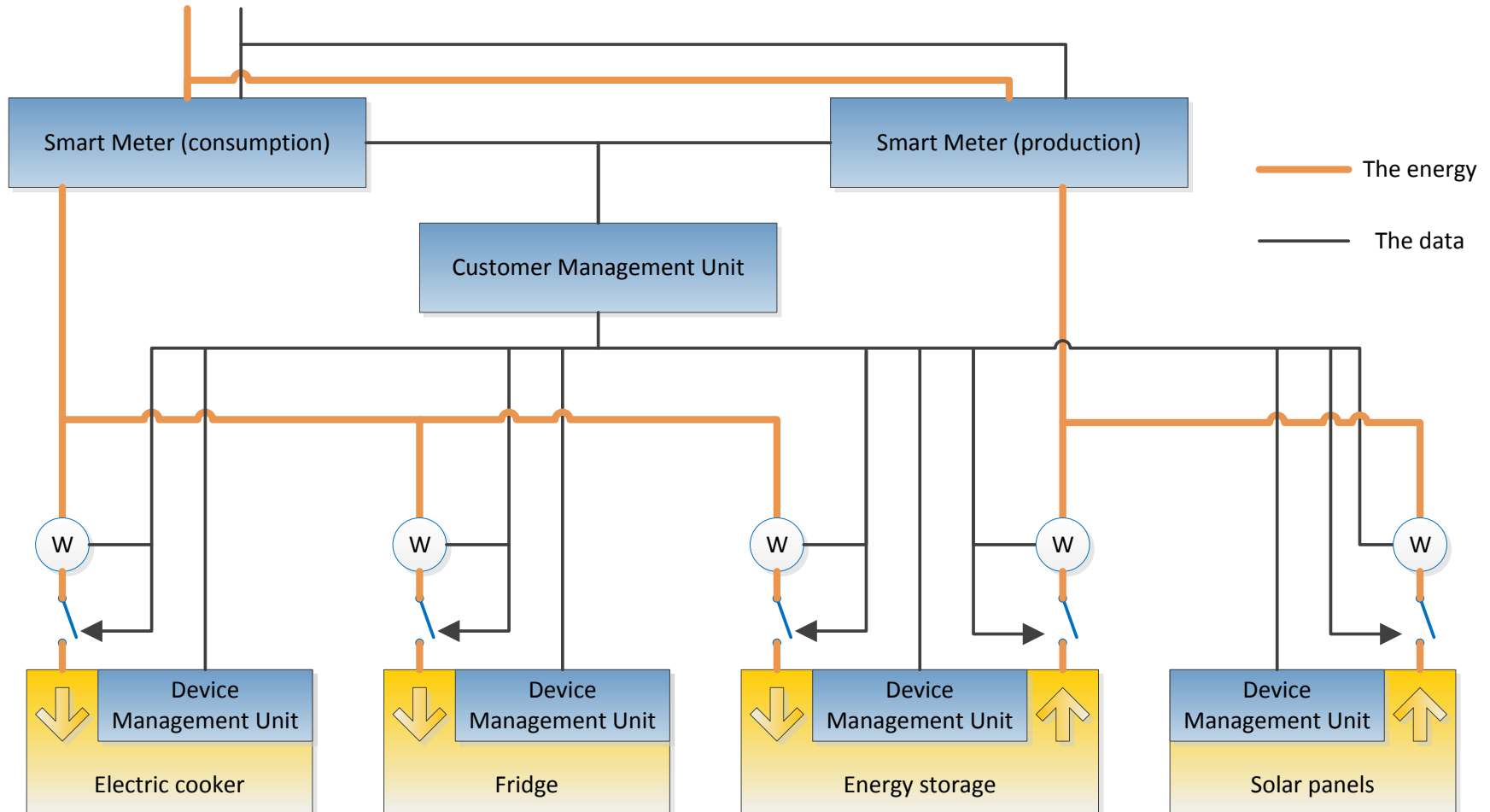




# Management units within the grid



# Management units within the grid – HAN example



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# Conclusions

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The e-balance project has just reached its first year

Some technical details still to be defined

Future energy grid has to go into the smart direction



# Thank you for your attention!

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