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Project overarching objectives

eBADGE: background and motivation

- On 11 September 2012, the European Parliament adopted the Energy Efficiency Directive (EED):
  - (29a) **Demand response** is an important instrument to **improve energy efficiency**, since it significantly increases the opportunities for consumers or third parties nominated by them to take action on consumption and billing information and thus provides a mechanism to reduce or shift consumption resulting **in energy savings in both final consumption and, through the more optimal use of networks and generation assets**, in energy generation, transmission and distribution.
- The eBADGE project baseline are ACER's **Framework Guidelines on Electricity Balancing** published on 18 September 2012:
  - One of the five **objectives** the specifications for national balancing reserve and balancing energy procurement and cross-border balancing exchanges shall pursue is:
    - **facilitating wider participation of demand response and renewable sources of energy**;

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Is this „VPP ready“ energy management?

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eBADGE: Objectives

- To propose an optimal **pan-European Intelligent Balancing mechanism**, piloted on the borders of A, I and SLO, that is also able to **integrate Virtual Power Plant Systems** that can assist in the management of the electricity Transmission and Distribution grids in an optimized, controlled and secure manner.

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eBADGE: Objectives

- Project objectives were:
  1. To develop the components: simulation and modelling tool; message bus; VPP data analysis, optimisation and control strategies; home energy cloud; and business models between Energy, ICT and Residential Consumers sector;
  2. To integrate the above components into a single system (Ebadge Pilot)
  3. To validate in lab and field trials: validation of simulation, modeling tool, message bus and pilot cloud.
  4. To make impact evaluation

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The consortium

About eBADGE

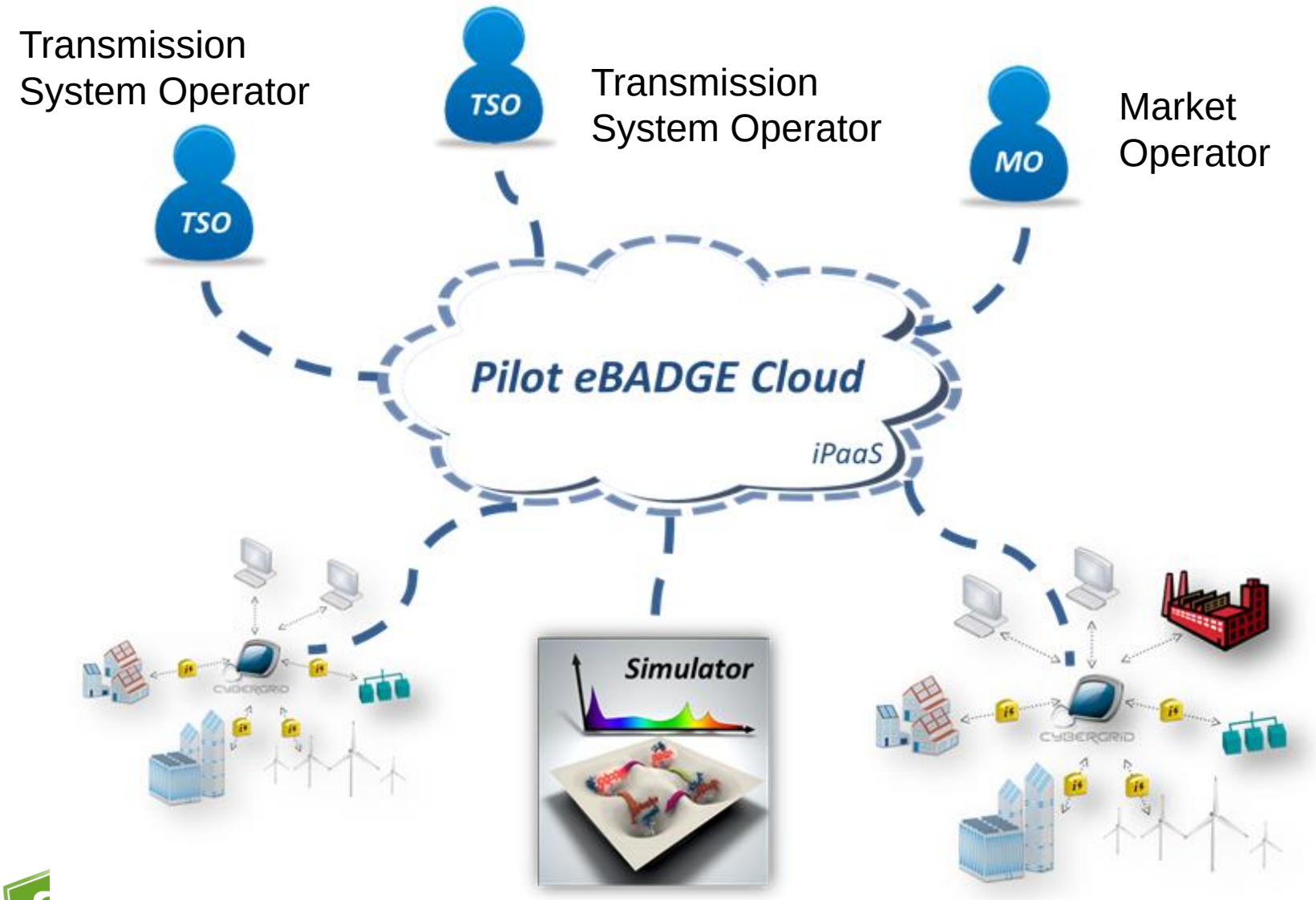
- Development of Novel ICT tools for integrated Balancing Market Enabling Aggregated Demand Response and Distributed Generation Capacity (http://www.ebadge-fp7.eu/)
- Coordinator: Telekom Slovenija d.d.
- Technical coordinator: CyberGRID GmbH
- Presented accomplishments are joint effort of 13 partners from 5 EU Member States
- Project duration: 3 years (1.10.2012-30.11.2015)
- Budget: 4.95 million EUR

13 Consortium partners, 5 countries

- Cybergrid
- Telekom Slovenije
- AIT
- APG
- TU Wien
- XLAB
- EUDT
- ELES
- Vaasa ETT
- SAP
- Borzen
- Elektro Ljubljana
- RSE
- Austria
- Slovenia
- Italy
- Germany
- Finland

The main lessons learned and barriers to innovation deployment

eBADGE: Concept



Requirements for VPP ready solutions at prosumer locations

- Real time energy metering
- Real time communication of instantaneous power measurements
- Secure communication channel
- Sub minute reporting periods
- One-2-One connection between prosumer and VPP or DSO
- User interface for tracking energy profile
- ON/OFF manual or automatic capability
- Integration with other smart grid market stakeholders
- Upgrade path: meter $\Rightarrow$ smart meter + energy hub

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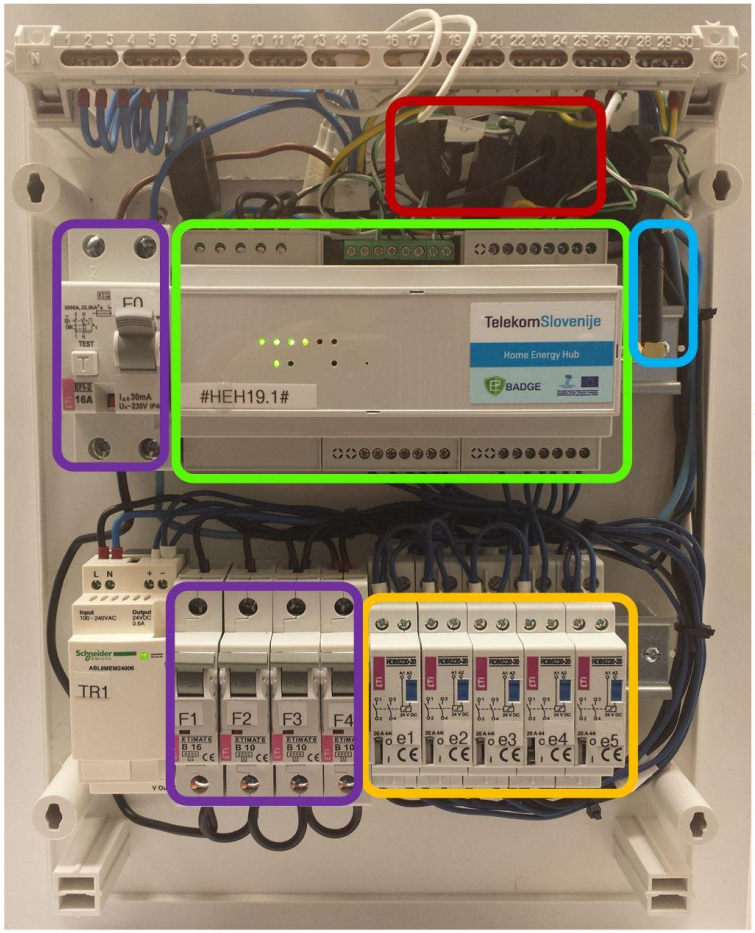
Energy management device: Home energy hub

- Installed at 120 test locations



Installation panel box

AC current sensors

Wireless link

Home Energy Hub

Power load control

Circuit breakers

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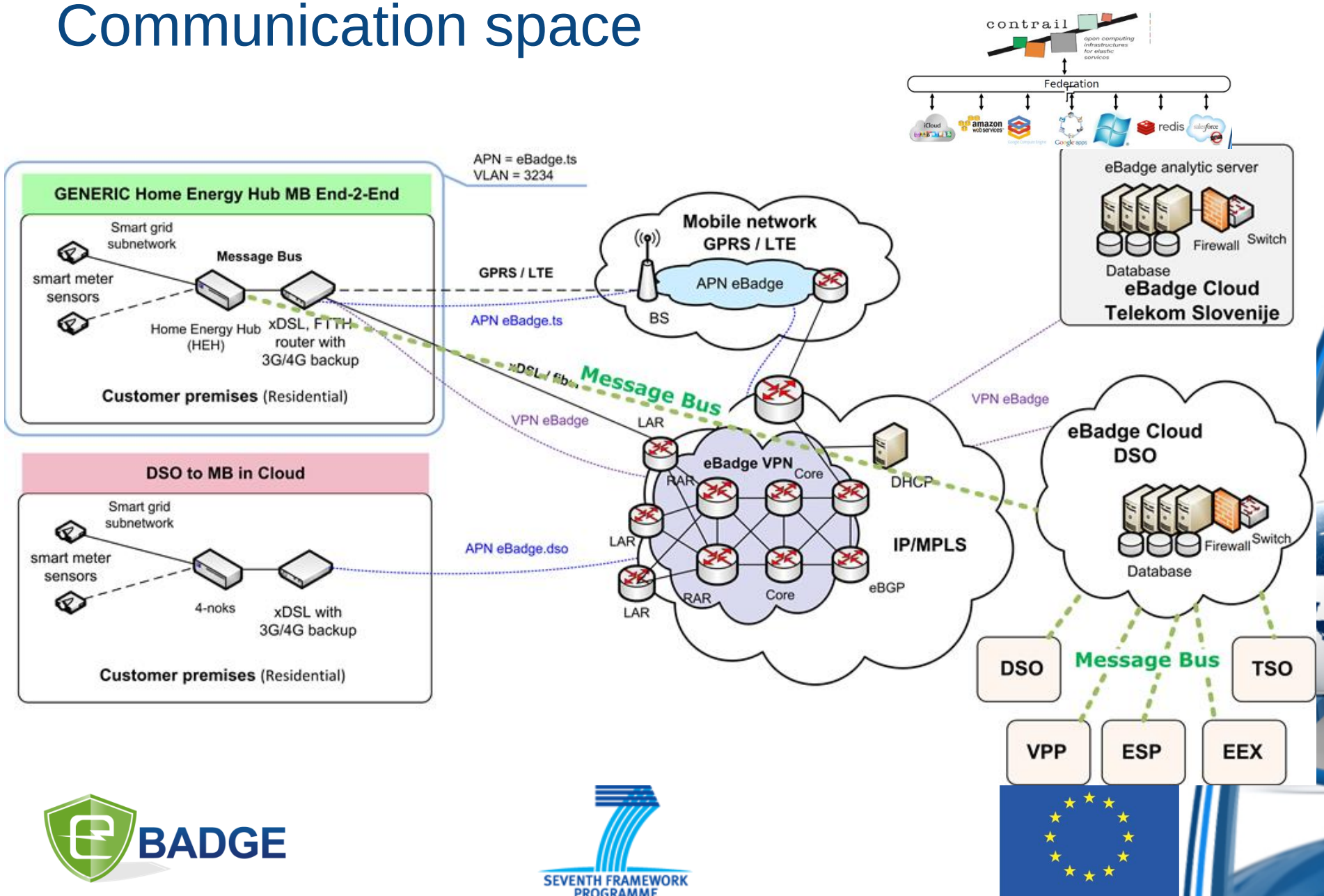
Communication space



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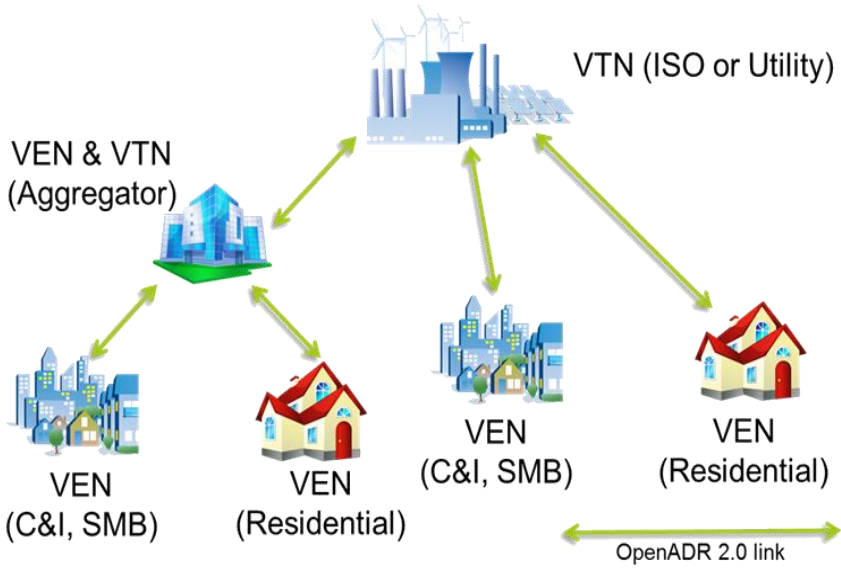
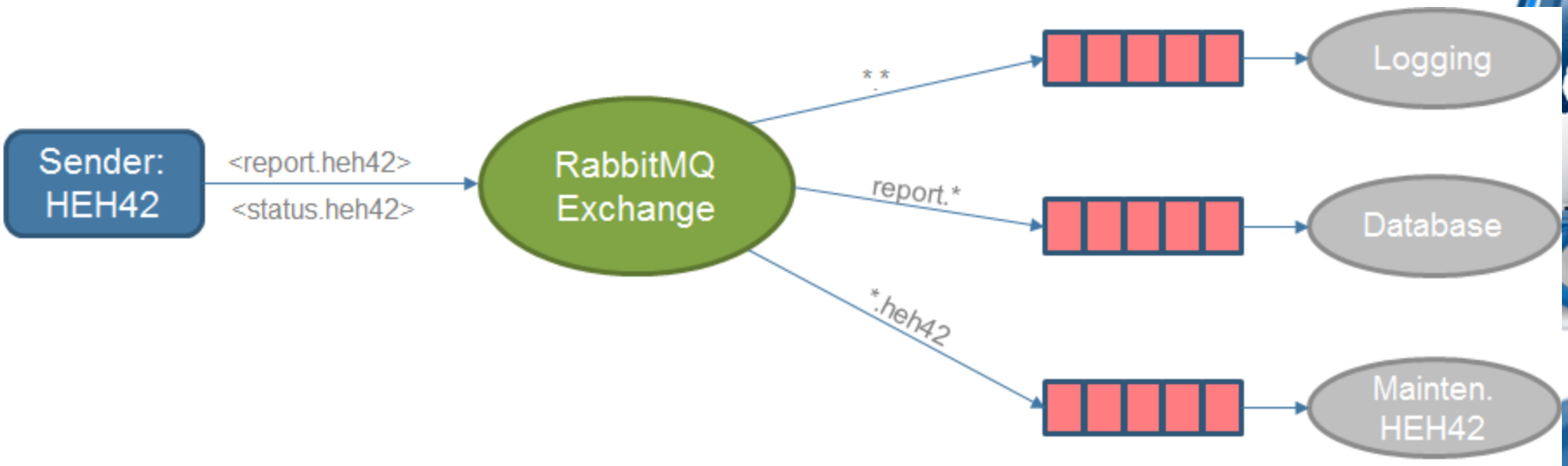
Some existing standards

- OpenADR 2.0
  - popular in USA
  - in California, automatic demand response obligatory in new commercial buildings
  - XML messages
  - transport: HTTP or XMPP-based message bus
- IEC 61850
  - parts still under development
  - complex to implement



eBADGE message bus with RabbitMQ

- Based on RabbitMQ
  - two-way communication through firewalls
  - high performance, reliable, secure
- Short messages (JSON)
  {"msg":"report", "from":"2013-07-21T10:00:00", ..., "values":{"el.p":[0.12,0.17,0.33,0]}, "heh_id":"HEH42"}
- Configurable communication patterns



HEH ↔ VPP messaging example

Message type: get_load_report

Meaning: request for an individual load report (sent by VPP).

Field	Description/comment	Example value
from	start of period for which the report is to be returned	"2013-07-21T10:00:00.000Z"
to	end of period for which the report is to be returned	"2013-07-21T10:30:00.000Z"
resolution	in seconds	120
device	the ID of the device to report for; use null for "total"	"WaterHeater01"

Raw JSON example: {"msg":"get_load_report", "from":"2013-07-21T10:00:00.000Z", "to":"2013-07-21T10:30:00.000Z", "resolution":120, "device":"WaterHeater01"}

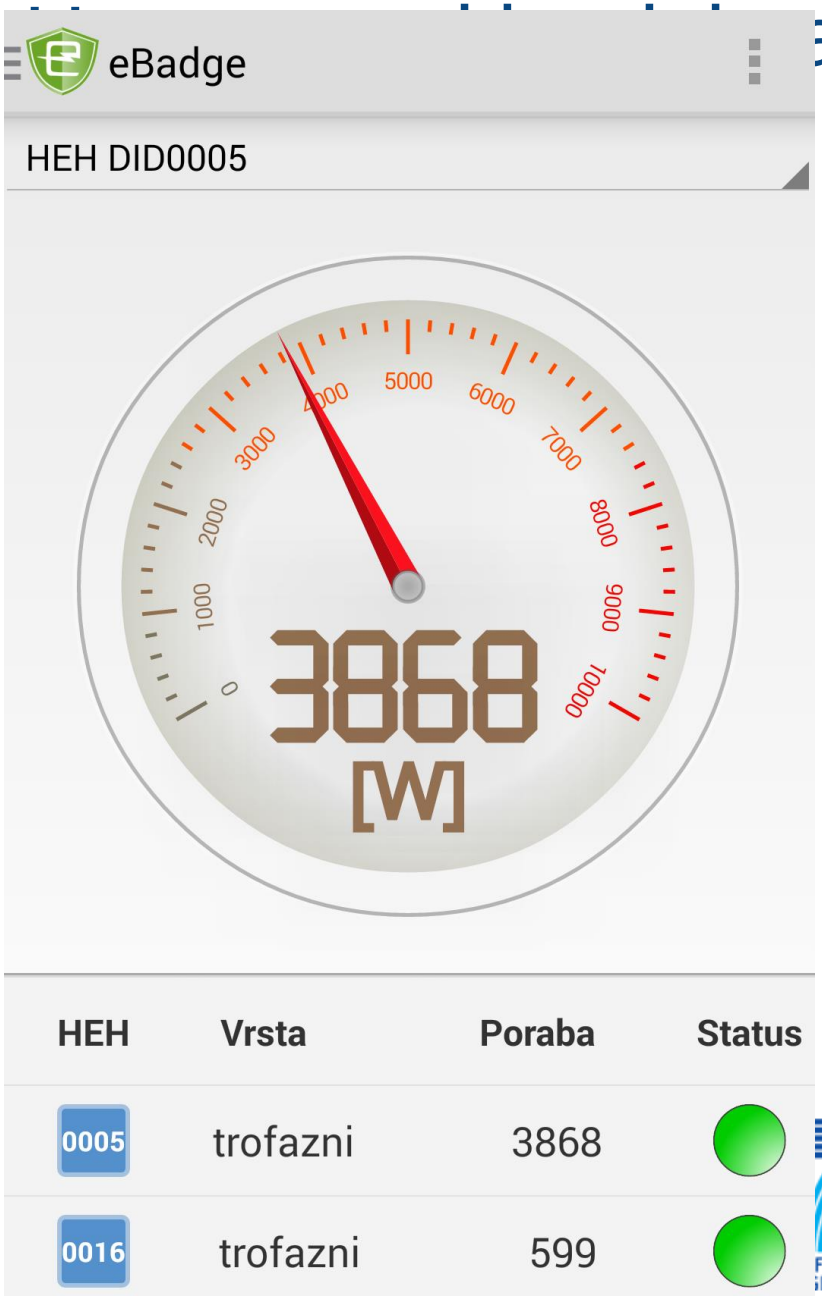
Message type: load_report

Meaning: load report, sent either as response to individual request or periodically (sent by HEH).

Field	Description/comment	Example value
from	start of period covered by this report	"2013-07-21T10:00:00.000Z"
to	end of period covered by this report	"2013-07-21T10:30:00.000Z"
resolution	in seconds	120
device	the ID of the device this report is for; null for "total"	"WaterHeater01"
load	each value is average load in kW for last "resolution" seconds	[0.12,0.17,0.33,0]

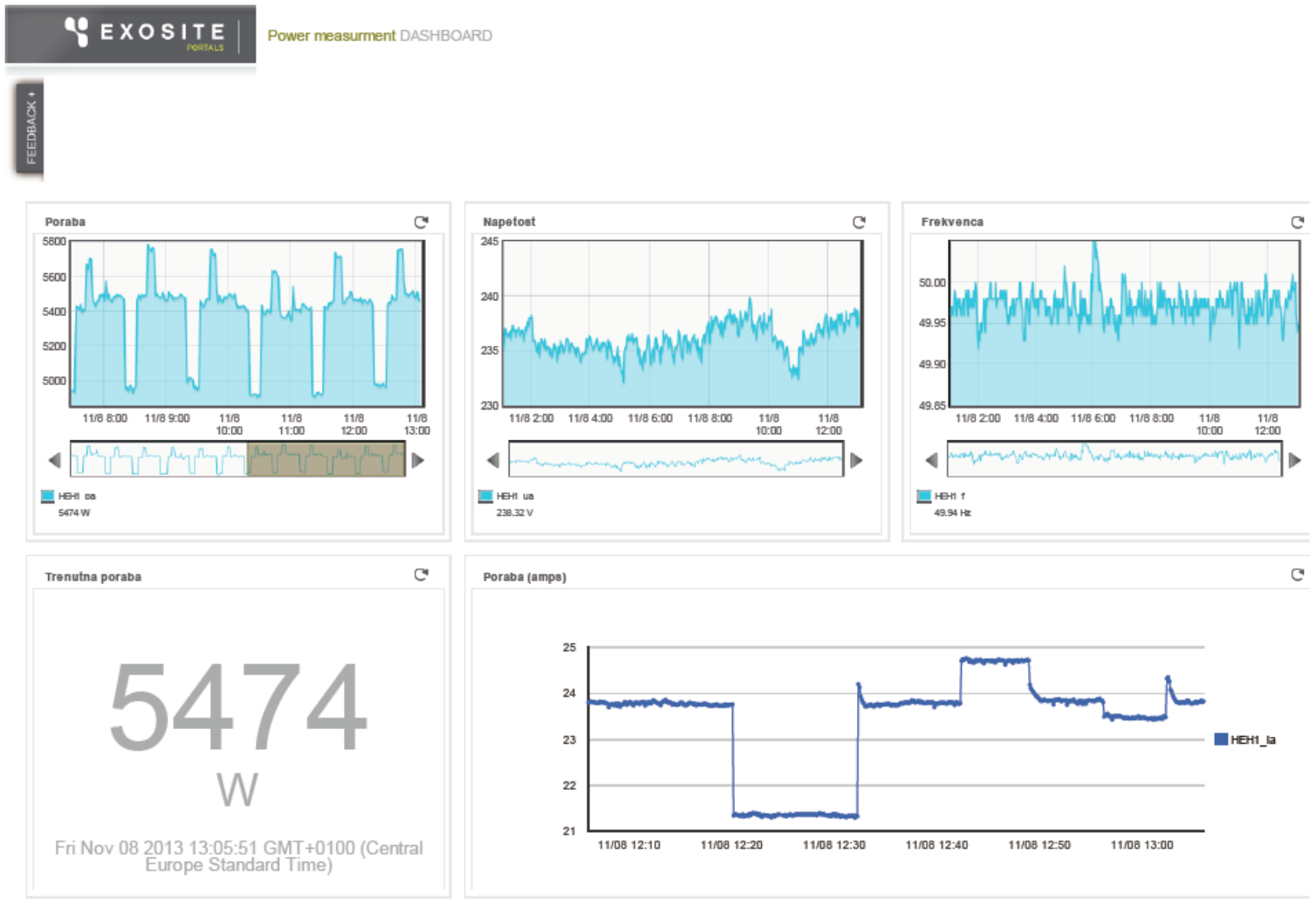
Raw JSON example: {"msg":"load_report", "from":"2013-07-21T10:00:00.000Z", "to":"2013-07-21T10:30:00.000Z", "resolution":120, "device":"WaterHeater01", "load": [0.12,0.17,0.33,0]}

alistic


eBadge
HEH DID0005
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
3868
[W]
HEH
Vrsta
Poraba
Status
0005
trofazni
3868
0016
trofazni
599


eBadge
Naziv:
HEH1
Preimenuj
Status:
Deluje
Režim:
Ročno
Vrsta
Trenutna poraba
Ročno
Avtomatsko
Drugo...
Naprava 1
0 kW
Naprava 2
7 kW
Naprava 3
3 kW
Naprava 4
15 kW
Naprava 5
1 kW
Naprava 6
4 kW
Ostalo
3 kW

Power measurement dashboard on open portal



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Balancing market simulations

Scenario: 7 January 2015

- Timeframe: 15 minutes
- 96 Independent simulations (24 Hours*4 quarters)
- Using historical values for imbalances and bids

SCENARIO 1	SCENARIO 2
Base Case	**Common Balancing Market**
each zone solves the imbalances with its own resources	each zone solves the imbalances with all the resources available

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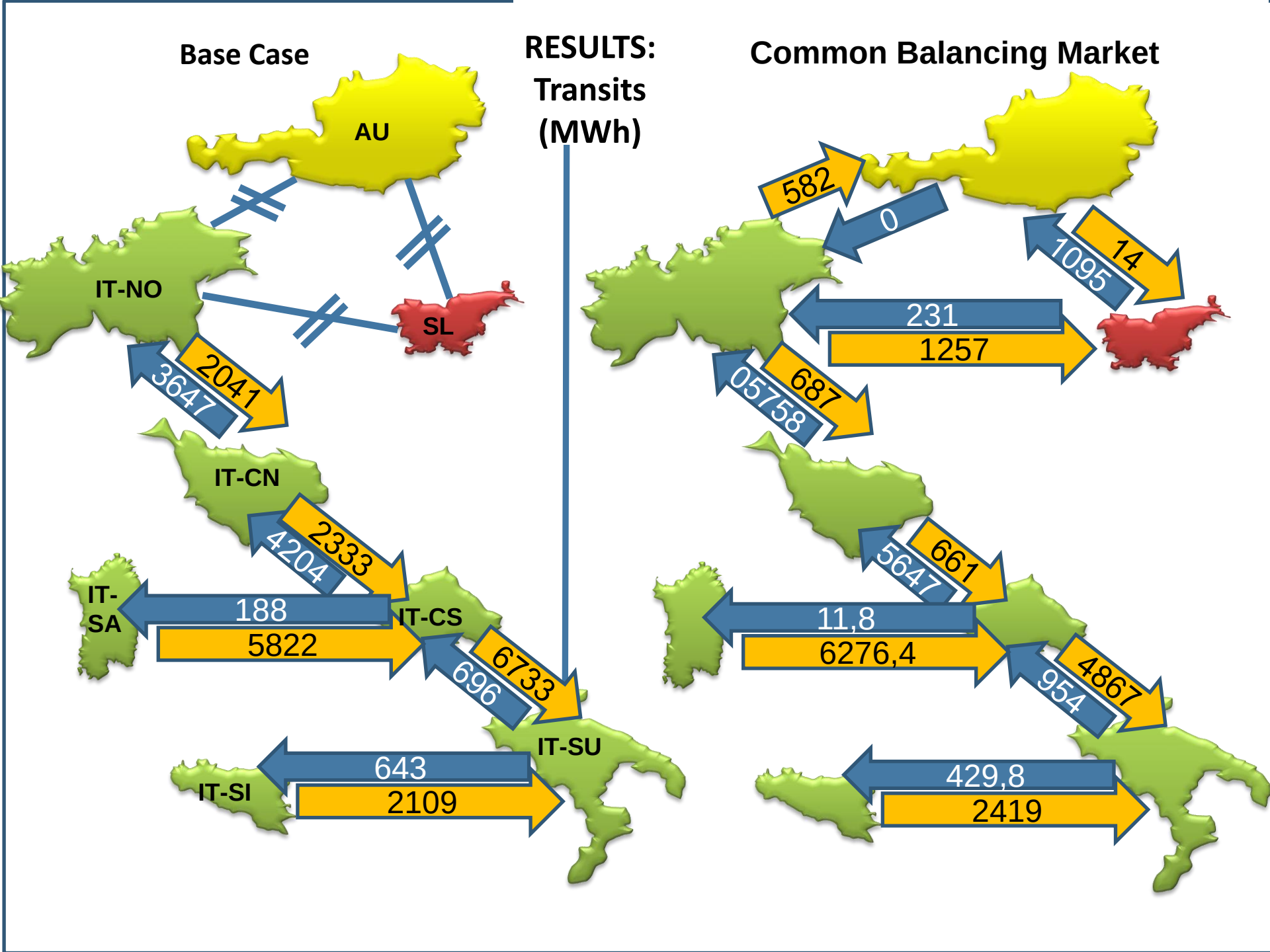
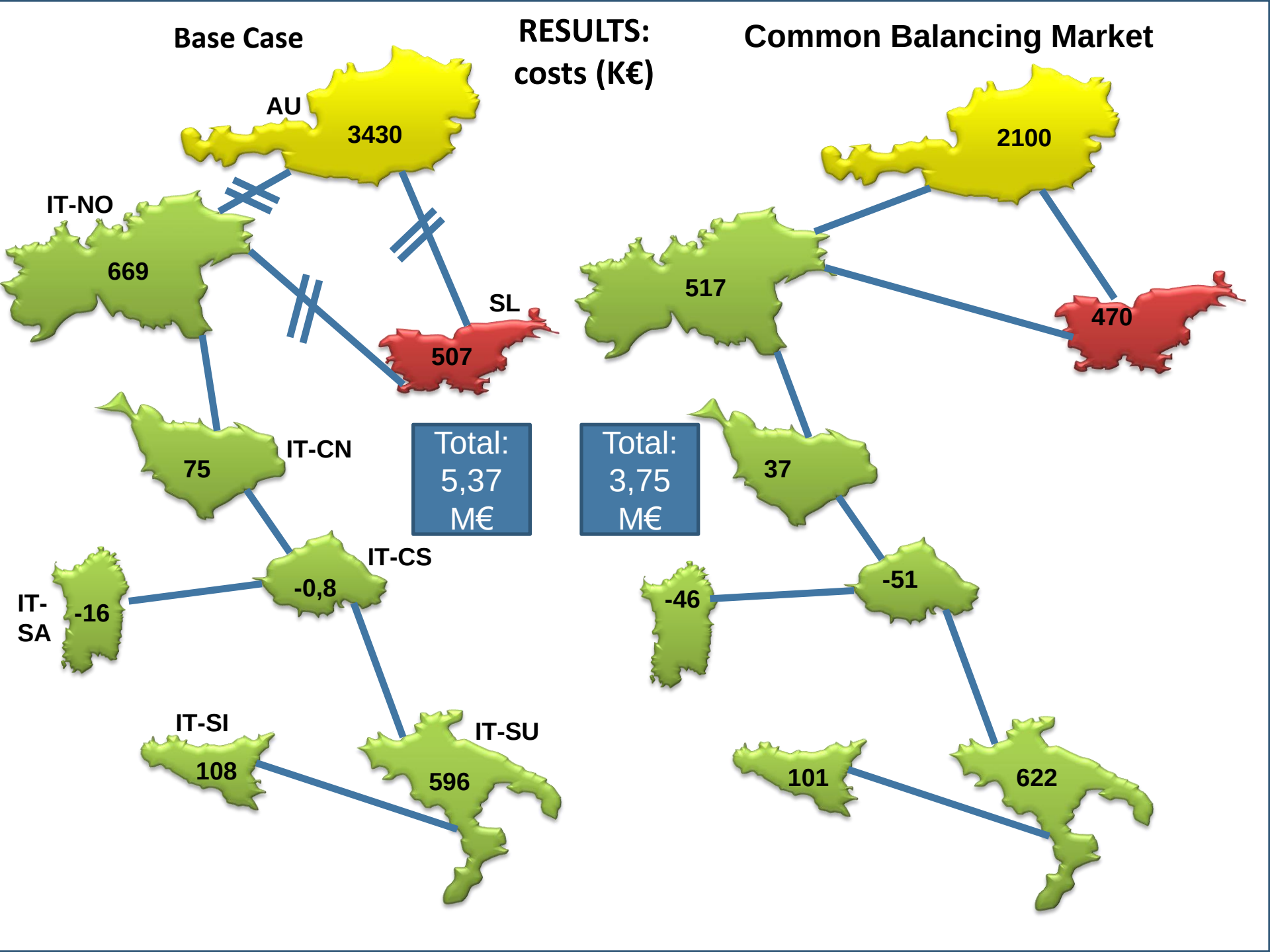

Base Case
RESULTS: Transits (MWh)
Common Balancing Market
AU
IT-NO
SL
IT-CN
IT-SA
IT-CS
IT-SU
IT-SI
3647
2041
4204
2333
188
5822
696
6733
643
2109
582
0
1095
14
231
1257
05758
687
5647
661
11,8
6276,4
954
4867
429,8
2419


Base Case
RESULTS:
costs (K€)
Common Balancing Market
AU
3430
IT-NO
669
SL
507
IT-CN
75
IT-CS
-0,8
IT-SA
-16
IT-SI
108
IT-SU
596
Total:
5,37
M€
2100
517
470
37
-51
-46
101
622
Total:
3,75
M€

Conclusions

- Simulation results highlight great benefits for the integrated system of a common management of the balancing energy market
- The system cost is in case of common balancing market decrease of 43%, passing from 5,37 M€ (no balancing market) to 3,75 M€ in case a transnational balancing market is implemented;
  - For Austria the cost reduction is 63%
  - for Italy the cost reduction is 21%;
  - For Slovenia the cost reduction is 8%;
- Transits between Italy, Austria and Slovenia in case of common balancing market reach 3,17 GWh.
- In common balancing market scenario Transits from Austria to North-Italy remains equal to zero; this is due to the fact that the transits limits do not allow an energy flow in this direction;
- Sardinia is a net exporter of energy: this is due to the fact that, for security system, the generation in DAM for Sardinia is overestimated, this is following markets (MSD+MB) the market operator has always a negative imbalance (so has to accept negative bids).

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Succesful project conclusion

- Project final review on January 19th 2016 was very successful
- More objectives were reached than originaly planned
- Extended but within original budget

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Deployment prospects of the most promising solutions

Exploitation plan

- A new value-add service: Adaptation of consumption on the market for distributed generation (renewables).
- An energy efficiency value add service on top of telco multimedia offering and smart home services (internet-tv-voice + energy management).
- Enrichment of smart home services
  - Security, safety, video surveillance, home automation, intelligent light bulbs + energy management and efficiency
  - measurement of appliances (air conditioning, freezer, washing machine)
- Balancing demand response market service with enhanced “Self care management portal” and 4th screen intuitive user interface with social media apps (Twitter, FB)
- Building energy efficient households and local communities.

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