



***Enhancing energy efficiency solutions in the  
Mediterranean Region***

# **Innovative projects in energy efficiency: from IoT to user engagement**

**Federico Boni Castagnetti**

*May 18th, Turin*



# WHAT IS WHAT?

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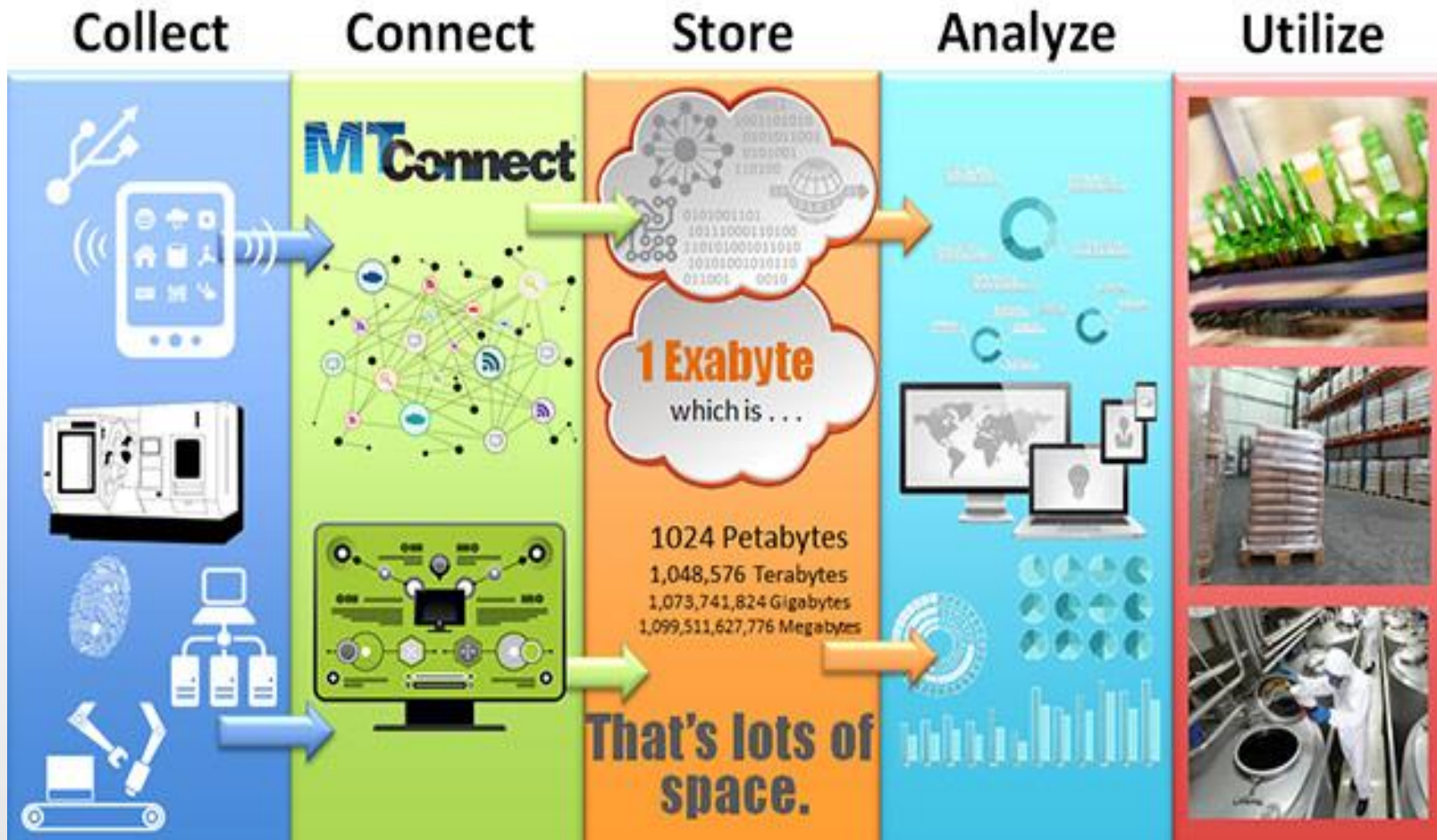


The Internet of Everything

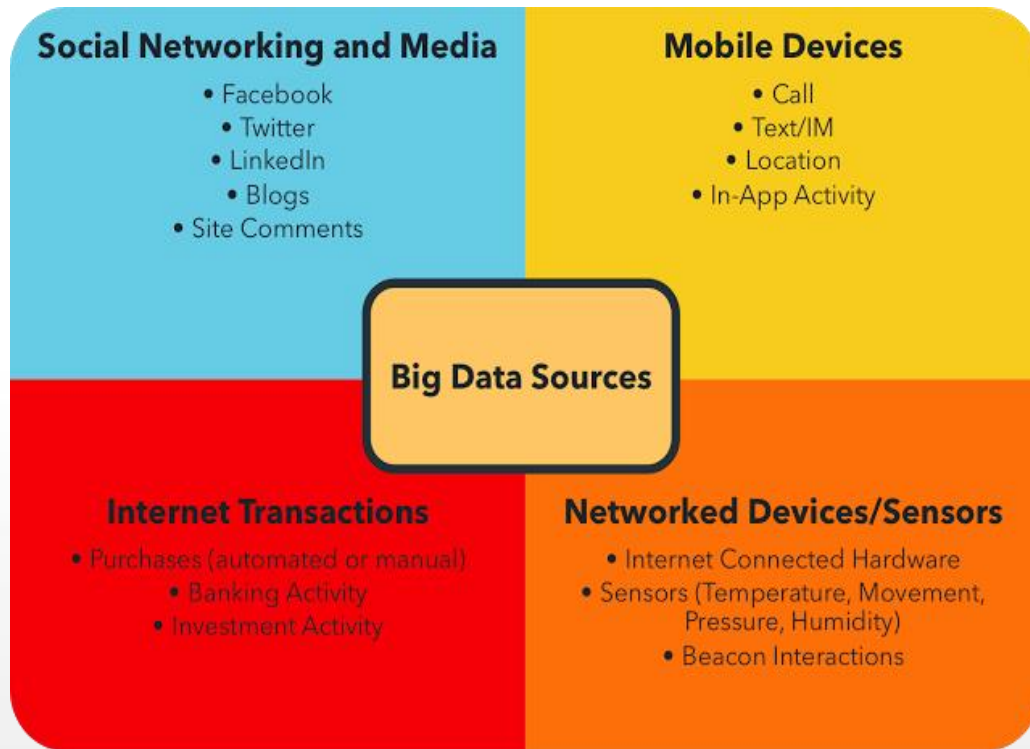


User engagement example

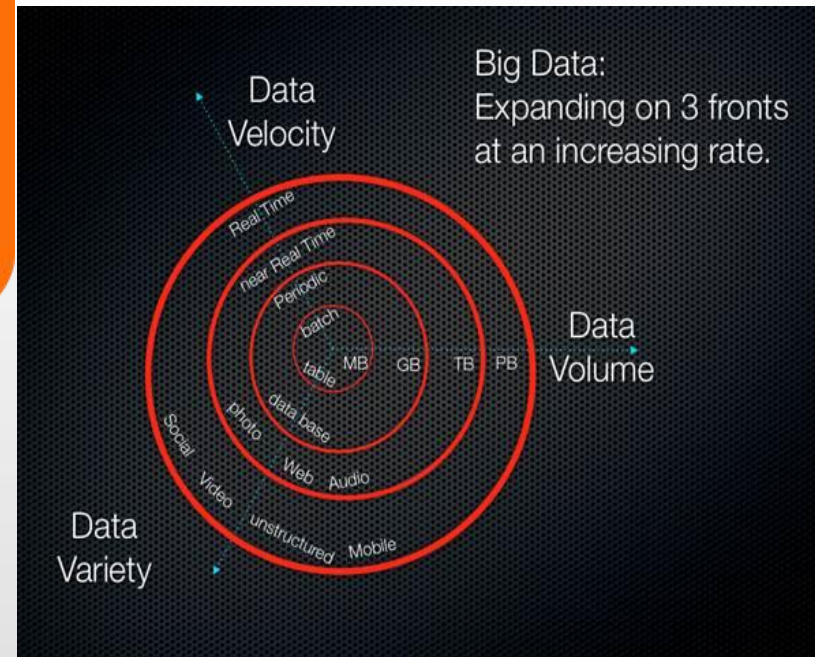
# «BIG DATA»: HOW TO DEAL WITH IT?



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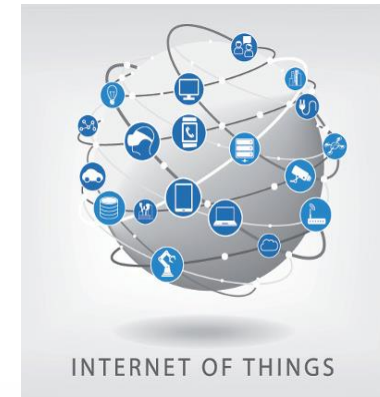
## BIG DATA: the 3 «V»





# TOWARDS A SMART CITY

- **Digitalization** will enable a **collaborative** and **smart city**;
- Today there are almost 10 billions «*smart objects*»
- By 2020 more than **50 billions** connected objects (human to human, human to machine, machine to machine).



## CITIZEN ROLE

- Citizens will become a **Prosumer** and not only a Consumer;
- Citizen: from services user to «**human *sensor and actuator***»;
- Also Cities will become «**producers**»



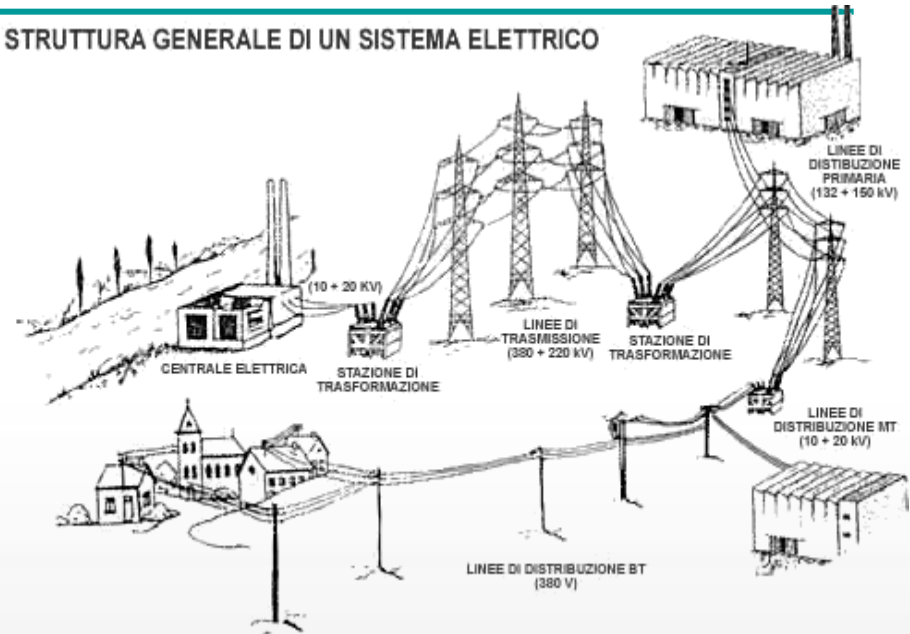
In order to reach these goals, the electrical networks need radical changes

# FROM A TRADITIONAL NETWORK TO A SMART GRID

## TRADITIONAL NETWORK

- One-way, localized network
- Producers VS Consumers
- A single level for one-way energy management

STRUTTURA GENERALE DI UN SISTEMA ELETTRICO



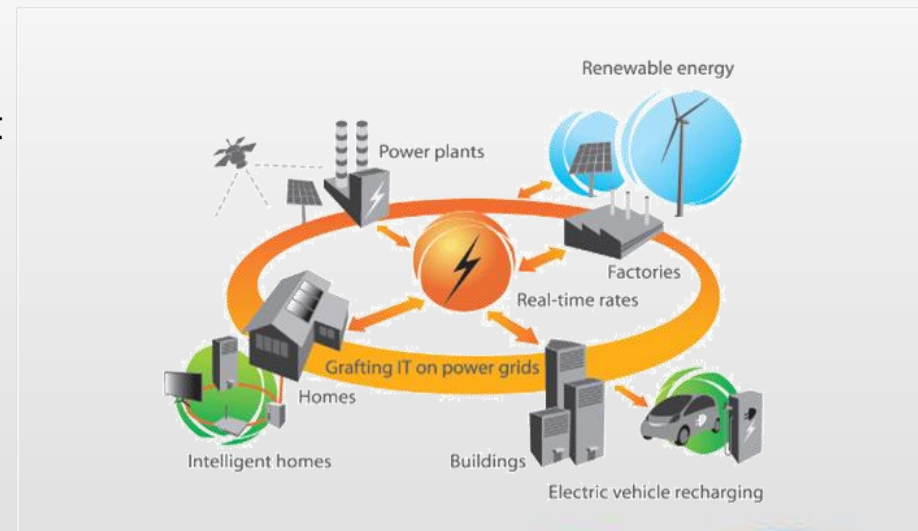
## WHAT ABOUT A SMART GRID?

At least 2 levels:

- 1° level for bi-directional energy management
- 2° level for information

Smart Grid should also be:

- more Flexible
  - More Efficient
- than traditional networks



# HOW WILL ENERGY MARKET CHANGE?

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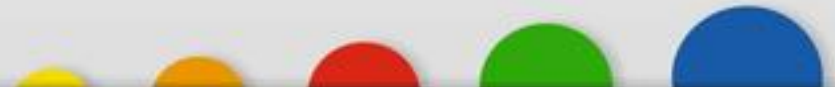
ONLY CLIENTS AVAILABLE INSTRUMENT



# HOW WILL ENERGY MARKET CHANGE?



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# WHAT IS THE ROLE OF CITIZEN?

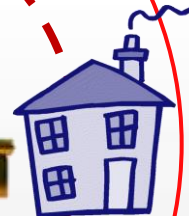
Citizen plays even more a major role in energy market

From  
dispatching  
service user to  
grid balancing  
actor

from **Consumer**  
to **Prosumer**

from **passive**  
consumer to  
**active**  
consumer

From  
**monopoly**  
client to  
**liberalized**  
market client



# HOW WILL ENERGY MARKET CHANGE?

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Is He ready to play as protagonist?



Technological  
evolution

Regulatory and  
legislatives  
interventions

Commercial offers

They will provide new instruments to modify its behavior

# THE ENERGY FOOTPRINT

The **empowerment process**, beyond being justified by technological evolution and market contest, is highly promoted by authorities.

The authorities intervened on such subjects at different levels:

- Directive 2021/27/UE on energy efficiency
- AEEGSI 232/2014/R/com: "Technological opportunities in order to place at disposal to low voltage final users their electric energy consume data"
- D.Lgs. 102/20144 that implement the EU Directive
- AEEGSI 186/2015/R/eel: **"Energy Footprint: make historical electric energy consumption data available to low voltage final users"**



# THE BILL

## PRESENT

OFFICIO DI TORINO C.SO SVIZZERA 5

**MERCATO LIBERO**

IREN MERCATO S.p.A.  
Sede Legale e Direzione Via S.S. Giac. Lillo di Torino, C.so Svizzera 55 - 10121  
Inscritta nel Registro delle Imprese di G. 01170500087

Docedel con sede unita Iren S.p.A. - Sede coordinamento di IREN S.p.A. - C.F. n.

**Sintesi bolletta**

**Euro**

Totale Servizi di vendita	25,83
Totale Servizi di rete	14,20
Imponibile Iva 10%	42,03
Iva 10%	4,20
Saldo arrotondamenti	0,77
<b>Totale Bolletta</b>	<b>47,00</b>

Nelle pagine successive trova il dettaglio degli importi della bolletta.

**Letture del contatore e consumi**

Matricola del gruppo di misura: 069695

Energia Anzica

Consumo misurato nel periodo dal 1/9/2014 al 30/9/2014

Fascia oraria	Letture precedenti rilevata	Letture attuale rilevata	Consumi rilevati (kWh)	Percentuale
F1	2.401	2.431	30*	22%*
F2	3.207	3.262	100**	76%**
F3	3.587	3.640		
<b>Totale Consumi rilevati</b>			<b>130</b>	<b>100%</b>

Consumo stimato per il periodo dal 1/10/2014 al 31/10/2014

Fascia oraria	Letture precedenti rilevata	Letture stimata attuale	Consumi stimati già fatturati (kWh)	Consumi stimati fatturati nella presente bolletta (kWh)	Percentuale
F1	2.431	2.442		31*	22%*
F2	3.242	3.318		112**	76%**
F3	3.640	3.696			
<b>Totale Consumi stimati</b>			<b>0</b>	<b>143</b>	<b>100%</b>

Legenda:  
\* Nella casella e' riportato il Suo consumo in fascia F1, ad alto costo (dal lunedì al venerdì dalle ore 8.00 alle ore 19.00)  
\*\* Nella casella e' riportata la somma dei Suoi consumi nelle fasce F2 a basso costo (dal lunedì al venerdì dalle ore 7.00 alle ore 8.00 e dalle ore 19.00 alle ore 23.00, il sabato dalle ore 7.00 alle ore 23.00) e F3 a basso costo (dal lunedì al sabato dalle ore 0.00 alle 6.00 alle domeniche e festivi) tutte le ore della giornata

**Consumi fatturati nella presente bolletta**

	kWh
Consumo dal 1/9/2014 al 31/10/2014 in Fascia F1	61 (22%)
Consumo dal 1/9/2014 al 31/10/2014 in Fascia F2	220 (78%)
Consumo dal 1/9/2014 al 31/10/2014 non distinto per fasce	281

**Consumo annuo fatturato**

	kWh
Consumo dal 1/1/2013 al 31/10/2014 in Fascia F1	332 (18%)
Consumo dal 1/1/2013 al 31/10/2014 in Fascia F2	1.500 (82%)
Consumo dal 1/1/2013 al 31/10/2014 non distinto per fasce	1.832

Il consumo relativo alla fascia F23 e' composto dalla somma dei consumi delle fasce F2 e F3.

**Andamento consumi medi giornalieri**  
Nella seguente tabella sono riportati i consumi medi giornalieri degli ultimi periodi.

Inizio Periodo	Fine Periodo	Consumo medio Giornaliero Fascia F1	Consumo medio Giornaliero Fascia F2	Consumo medio Giornaliero Fascia F3
01/09/2014	30/09/2014	1,0 kWh (22%)	1,8 kWh (40%)	1,8 kWh (38%)
01/09/2013	30/09/2013	0,9 kWh (18%)	2,0 kWh (38%)	2,3 kWh (44%)
01/09/2012	30/09/2012	0,8 kWh (17%)	1,9 kWh (41%)	2,0 kWh (42%)

4,0 kWh



## FUTURE

**Servizio di maggior tutela**

**\***

**Bolletta per la fornitura di energia elettrica**

**Mario Rossi**  
Via del Lorem Ipsum, 23  
00195 San Pietro in Vincoli  
Roma

Dati di fornitura  
Cda S. Tommaso 25 - 83100 Avellino  
Codice di fornitura POD IT001E8217560703  
c.f. SDFCUP15203ITU103

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**Totale spesa AGOSTO - SETTEMBRE 2013**

Fattura del XX ottobre da pagare entro il XX OTTOBRE 2013  
Le confermiamo che tutte le bollette precedenti risultano pagate

**SPESA PER L'ENERGIA**

Totale €AB

**IVA**  
SU IMPONIBILE DI XXX

Totale €F

**IMPOSTE**

Totale €F

**ONERI DI SISTEMA**

Totale €E

**SPESA PER TRASPORTO E GESTIONE DEL CONTATORE**

Totale €CD

**TOTALE DA PAGARE FG,00 €**

Costo medio della spesa per l'energia xxx centesimi di euro per kilowattora

**CONSUMI E LETTURE**

Fascia oraria	Letture effettive 30/09/2013	Letture effettive 30/09/2013	Letture stimata 03/10/2013	Consumo YYY
F1	XXXX	XXXX	XXXX	YYY
F2	XXXX	XXXX	XXXX	YYY
F3	XXXX	XXXX	XXXX	YYY

**RICALCOLI\*\***

Periodo di riferimento: xx/xx/13 - xx/xx/13  
Motivo: XXXX (p.es. errore di lettura, malfunzionamento contatore, code di fatturazione, lettura stimata)  
Importo: xxxxx euro già considerato nel totale spesa

**CONSUMO FATTURATO ABC kWh**

01/09/2013 XXXX  
30/12/2013 XXXX  
10/01/2014 XXX smc

Importo: xxxxx euro già considerato nel totale spesa

# MEASURING DEVICES

## PAST



- Only 2 or 3 data collection per year
- Billing based on estimations
- No info on failures or malfunctioning

## PRESENT

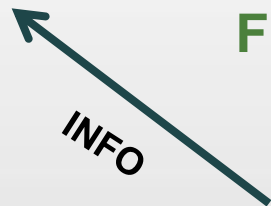
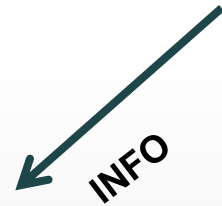


- Monthly data collection
- Real consumption
- Effective maintenance



# MEASURING DEVICES

## PRESENT



## FUTURE

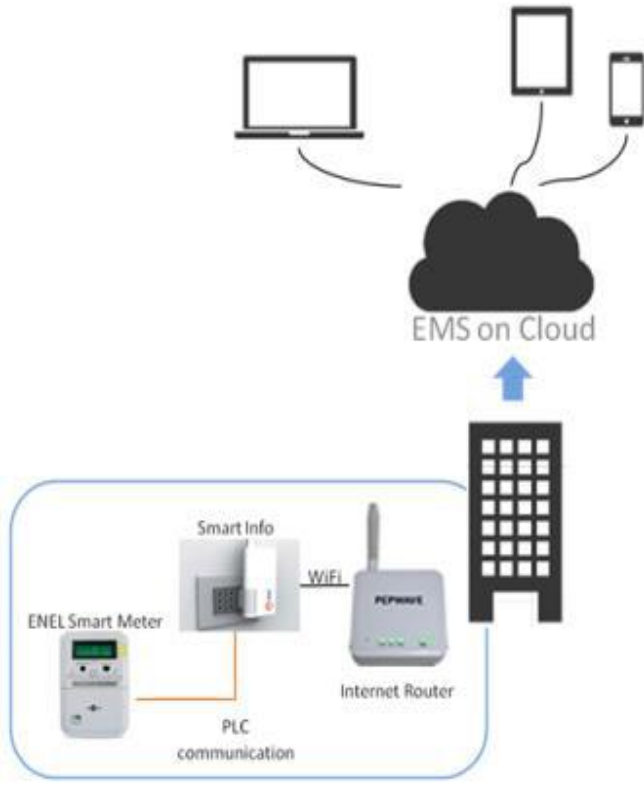


- Real time data
- Energy services available
- Demand Side management

# WAITING FOR METERS 2.0: SOLUTIONS FOR CONSUMER DATA AVAILABILITY

## SMART INFO

This solution provides (PLC from meter to smart info, WI-FI from smart info to home router) consumption data with 1-10Hz frequency that can be displayed and managed on web interfaces and smartphones

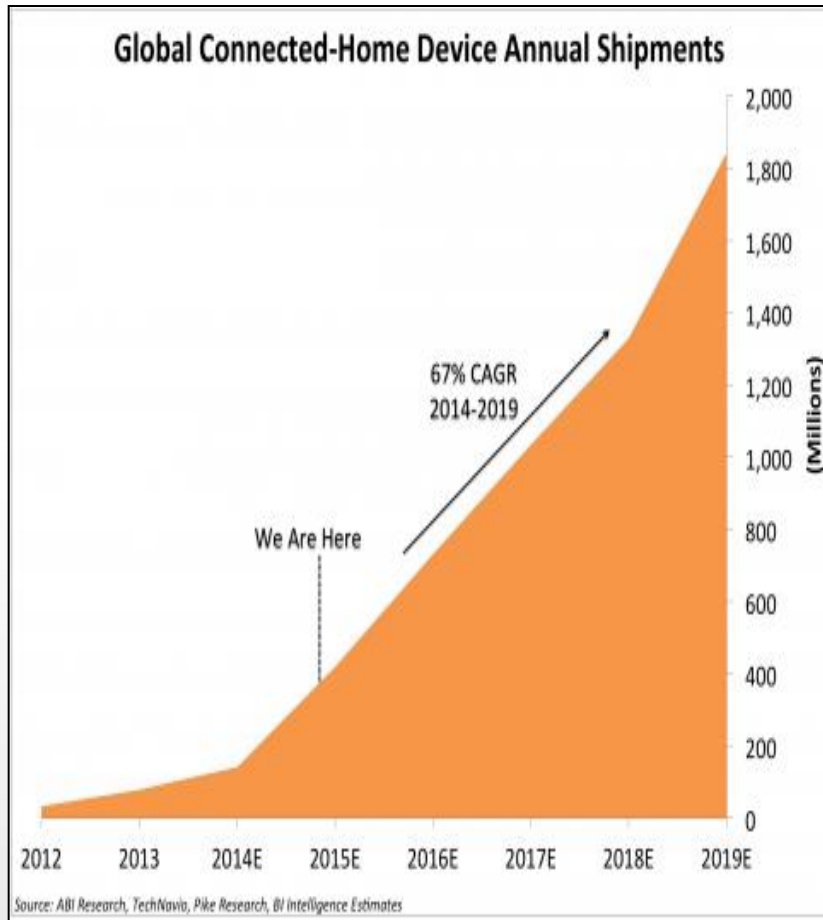


## OPTICAL SENSOR

An optical sensor couple with the present meter, able to «read» the meter led (each led blink is equivalent to the consumption of 1 Wh)



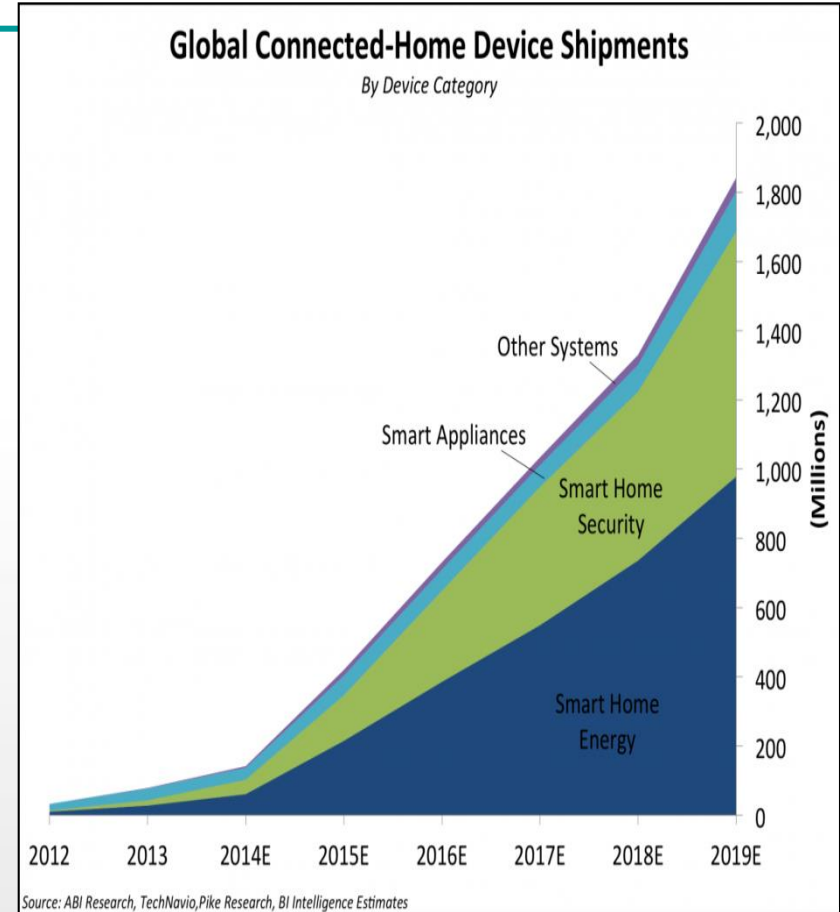
# SMART HOME MARKET



Home device number currently increases with a **67%** annual rate.

It has been forecasted that in 2020 there will be globally around **2 billion home devices**.

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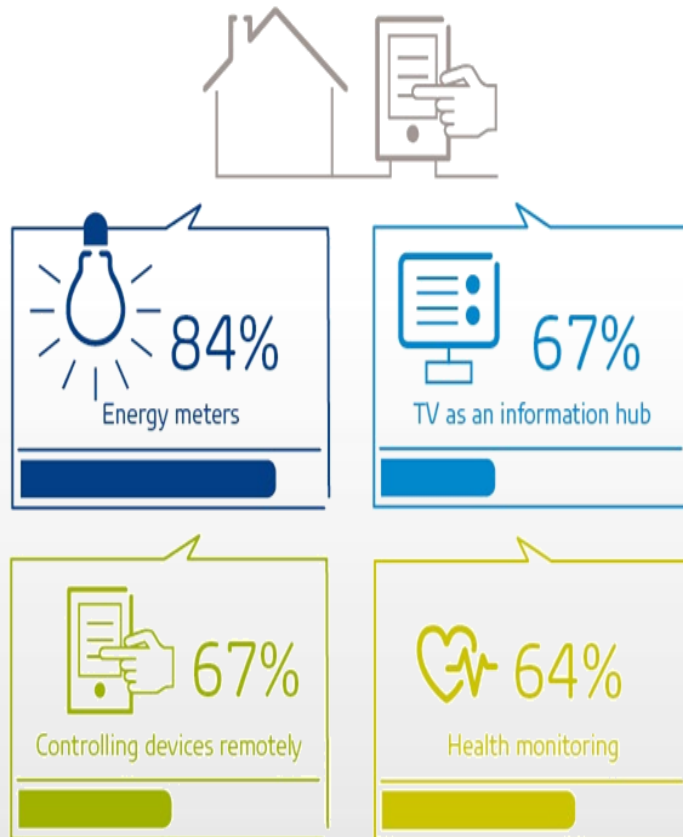


Over 90% of such devices belong to **Smart Energy and Smart Security**

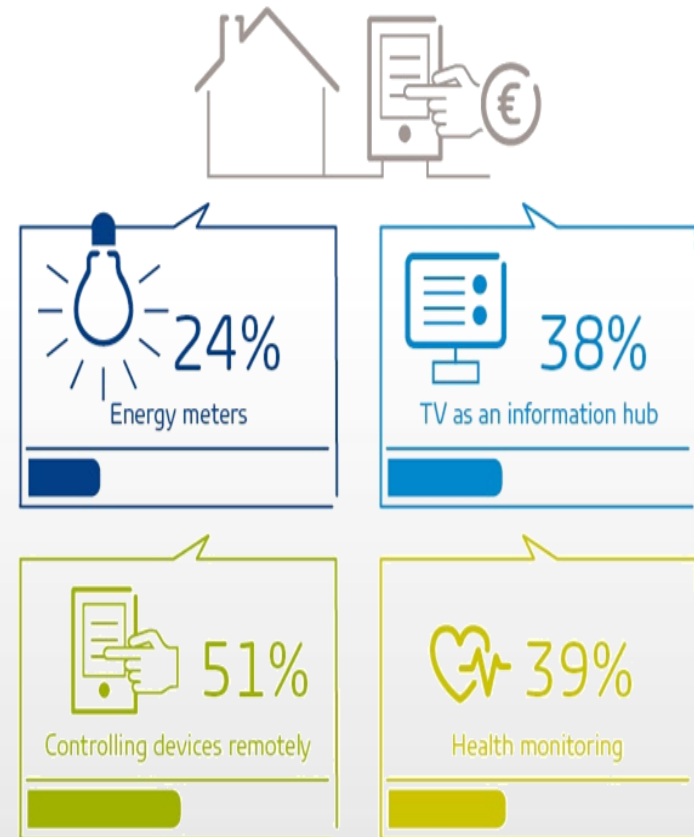
Safety and energy saving will be qualifying parameters for Smart Homes

# SMART HOME: CUSTOMER NEEDS

## Smart home functionalities of interest



## Smart home functionalities consumers are willing to pay for



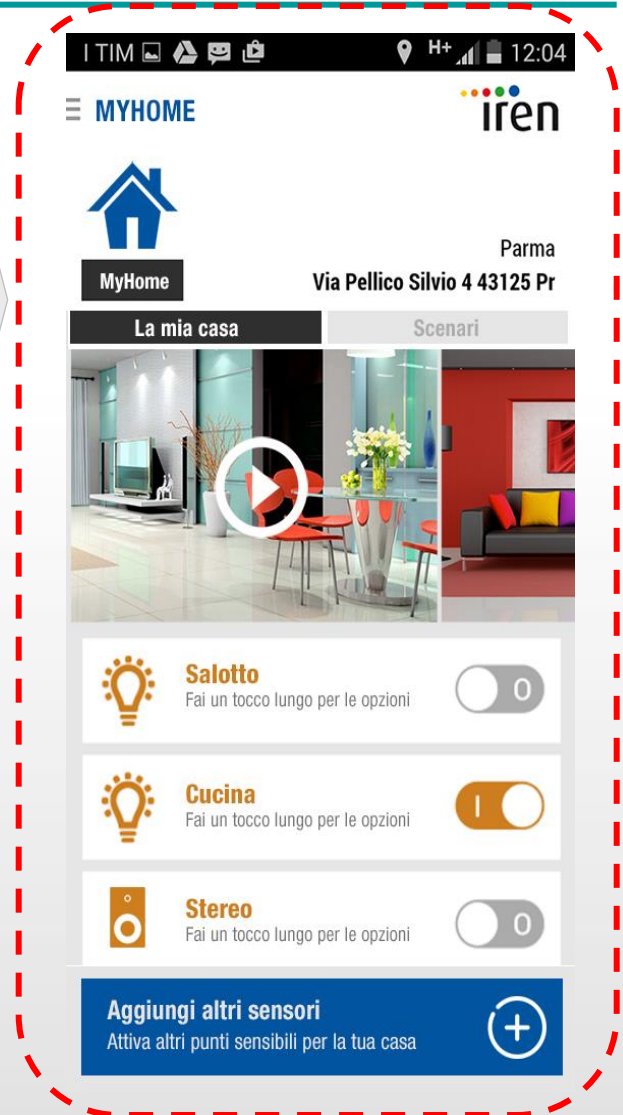
<http://www.gfk.com/news-and-events/press-room/press-releases/pages/smart-home-uk.aspx>

# SERVICE FOR CITIZENS: SMART HOME ECOSYSTEM





# REMOTE CONTROL INTERFACE



# 10 TECHNOLOGICAL TRENDS IMPACTING MAJORLY ON THE UTILITIES IN 2015

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**Advanced analytics**

**Advanced metering infrastructure**

**Mobile technology**

**Asset Performance Management**

**Energy Storage**

**Big Data**

**Internet of Things**

**Cloud Computing**

**IT/OT Convergence and Integration**

**Context-aware Computing**

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## **Some IREN Projects**



# THE BILL: EUROPEAN PROJECT

## OBJECTIVES

- ☐ Achieve measurable energy saving
- ☐ Increase clients awareness and motivation toward energy efficiency

## HOW?

### ■ Energy information

- ☐ Comparison between similar clients, comparison with own previous consumption
- ☐ Clearer performance output

### Test sites in Italy:

2000 electricity clients in Turin;

500 TLR clients in Turin;

600 TLR clients in Reggio Emilia

A real **example**



# For the citizens of the future: EDEN project for PA and business clients

## PROJECT DETAILS

- **Focus area:** energy efficiency for public authorities
- **Funding:** POR/FESR Regione Piemonte 2007/2013 (EU Regional funds)
- **Period:** 1 September 2014 – 31 July 2015
- **Pilot:** 3 primary schools in Turin
- **«Innovation community»:** Tech Enterprises, Academia, SMEs
- **Stakeholders :** school staff, professors, students, families, Energy Manager, ESCOs

## PROJECT CONTENTS

Development of a multi-level system able to **collect energy data** from the field and produce **tailored visualization platforms**





# Project EDEN example for 3 schools in Turin



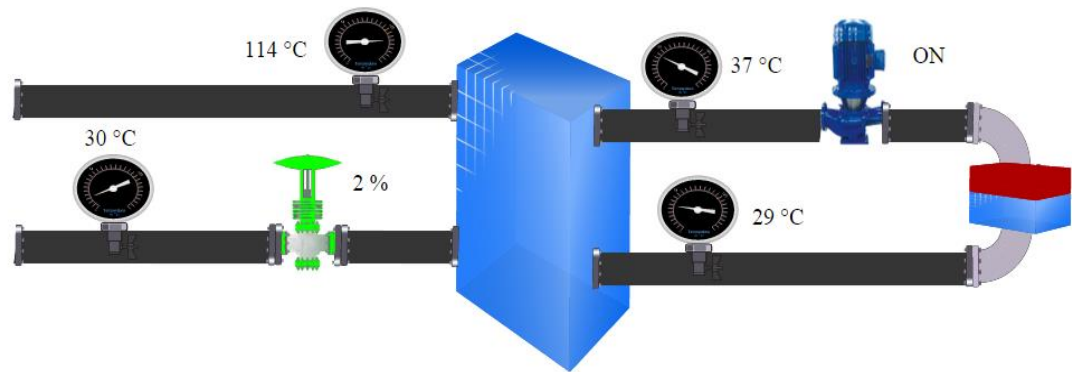
Effettua il login per procedere

Username:

Password:



REGIONE PIEMONTE

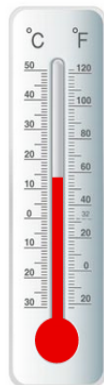


Condizioni ambientali interne

Posizione	Sonda Temp	Temperatura (°C)	Setpoint (°C)	Differenza da setpoint (°C)	Sonda umidità	Umidità (%)	Temp Percepita (°C)
PIANO T CORRIDOIO CENTRALE	CAP_MIS_03	22,84	24,00	1,16	CAP_MIS_18	34,16	22,55
PIANO T CORRIDOIO LATO VIDUA	CAP_MIS_05	21,87	24,00	2,13	CAP_MIS_20	32,69	21,07
PIANO INT MENSA	CAP_MIS_09	21,33	24,00	2,67	CAP_MIS_24	39,59	21,35
PIANO 1 AULA 3C	CAP_MIS_10	24,24	24,00	-0,24	CAP_MIS_25	37,63	25,00
PIANO 1 AULA 3B	CAP_MIS_11	23,48	24,00	0,52	CAP_MIS_26	37,56	23,95

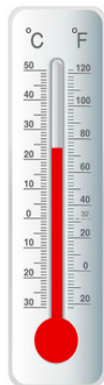
1 - 5

Temperatura esterna



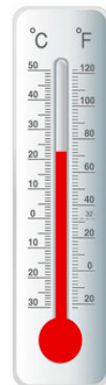
14 °C

Temperatura set point



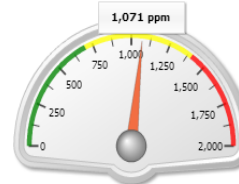
24 °C

Temperatura interna media

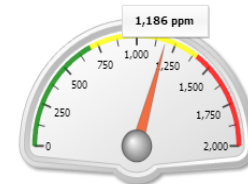


22.75 °C

Sonde CO2



1,071 ppm



1,186 ppm



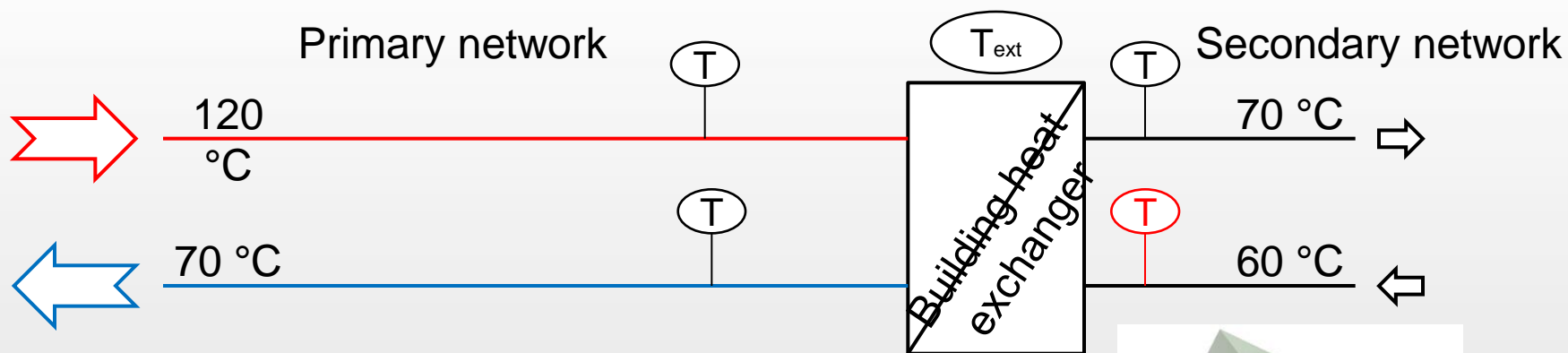
# : district heating system improvements

*ICT project developing management and predictive systems for energy efficiency at district level. Two pilot in Manchester and Turin.*

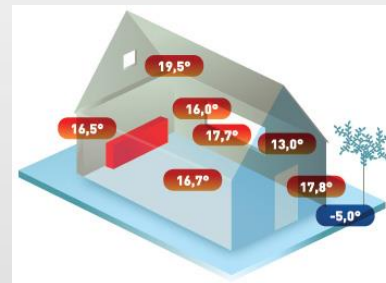
## TURIN

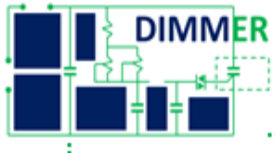
Focus on district heating remote control system upgrade for more efficient management of the network:

- All buildings will be equipped with secondary return temperature sensor (5 sensors at building level)



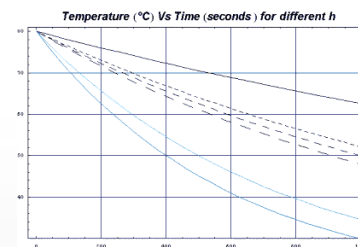
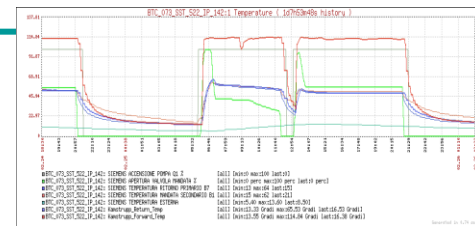
- Some buildings equipped with several indoor temperature sensors (“reference customers”)





# Main Objectives

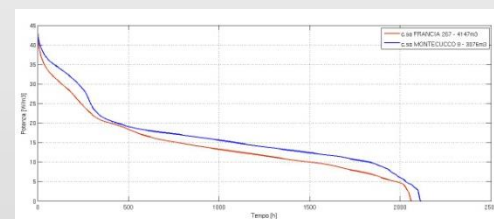
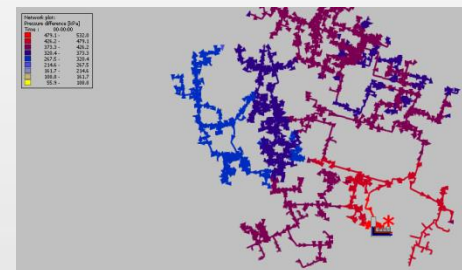
- **Detailed definition of thermal energy consumptions** of «reference customers» based on:
  - Sensors
  - deep architectural and energy efficiency knowledge of the buildings themselves.
- For all the other buildings not equipped with indoor sensors, «**indirect energy efficiency definition**»
- **implementation of energy-savings actions** on the buildings heat exchangers;
- **Dynamic modelling of the DH hub network** in order to identify changes and optimizations.



$$h = \frac{Q}{A \cdot \Delta T}$$



Casa clima Oro	≤ 10 kwh/m²a
Casa clima A	≤ 30 kwh/m²a
Casa clima B	≤ 50 kwh/m²a
Standard minimum C	≤ 70 kwh/m²a
Standard case existent D	≤ 90 kwh/m²a
Standard case existent E	≤ 120 kwh/m²a
Standard case existent F	≤ 160 kwh/m²a
Standard case existent G	> 160 kwh/m²a



# Flexmeter

- Design and test of a **multiservice smart meter system** (focus on the electrical ones) based on a common IT and telecom infrastructure (similarities with AEEGSI's Delibera 393/2013).
- Test of **post-fiscal meter devices** (waiting for the Italian smart meter 2.0) enabling collection, analysis and dissemination of near-real time consumption data and exploiting existing or under-development concentrators/gateways.
- Evaluation of **NIALM (Not Intrusive Appliance Load Monitoring)** algorithms about disaggregated loads analysis in a real pilot – **residential users** and **MV/LV substations**.

*Partner: IREN, Politecnico di Torino, E-On, Grenoble University, Siveco, Bucarest University, Telecom Italia, Bologna University, ST Microelectronics.*

## Project results/feedback

- ✓ User engagement services development
- ✓ Hardware e software multiservice platform testing
- ✓ NIALM vs Smart Plug (possible synergies)
- ✓ Demand Side Management: modelling and future scenarios analysis

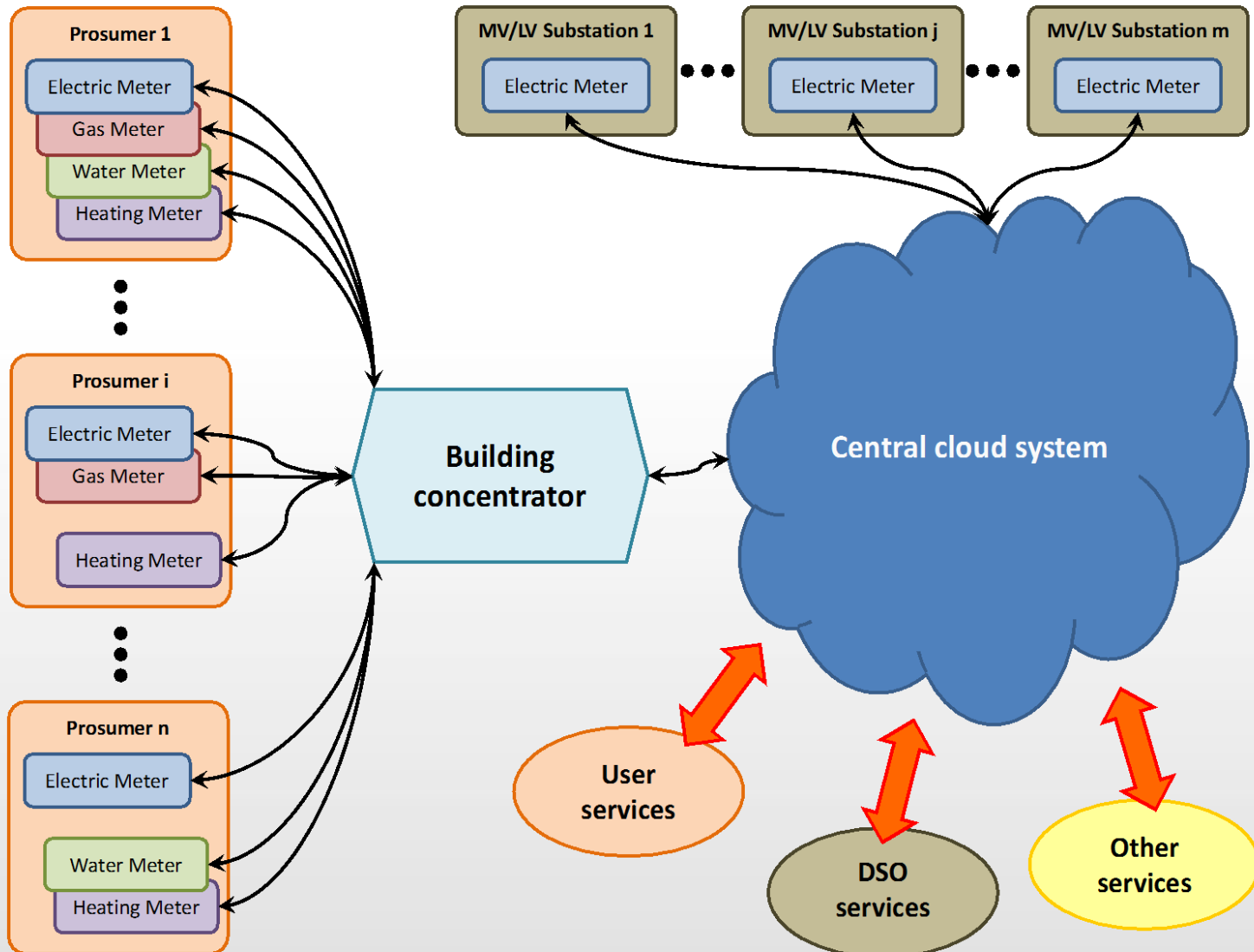


Co-financed by:





# The idea





# BACKUPS

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# OTHER INTERVENTION TO MAKE CONSUMERS FEEL RESPONSIBLE

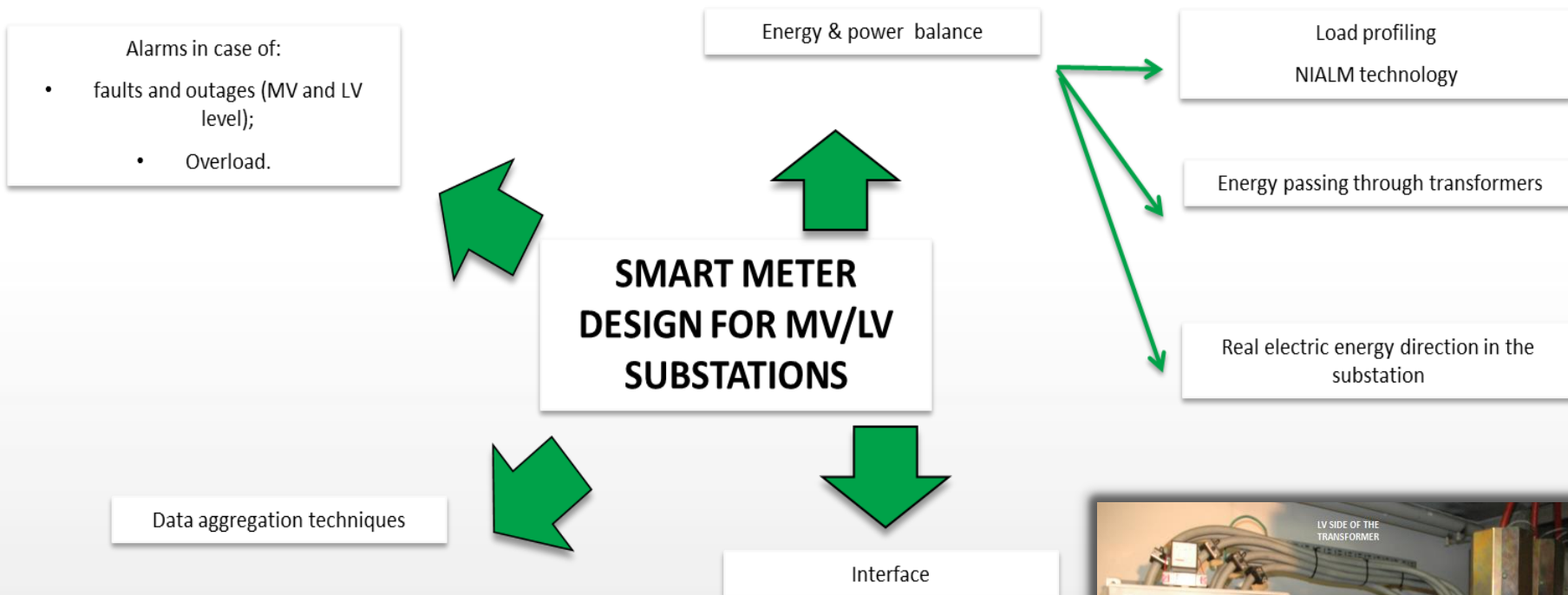
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The authorities intervened with other regulations in order to rise consumers awareness of their consumptions

1. "**Bolletta 2.0**" (AEEGSI 69/2014/R/com):
  - Identify instruments alternative to the bill to place historical data at disposal
  - Data set with higher granularity than invoicing data
2. Recon on how to make historical e.e. consumption data available for clients (AEEGSI 232/2014/R/eel): subdivision among
  - Historical data referring to invoicing period
  - **Historical data corresponding to consumption time trends**
  - Identify client Energy Footprint (even through simplified energy audit)
3. **Electric energy tariffs reform** (AEEGSI 34/2015/R/eel):
4. Electric energy **second generation metering devices**



# MV/LV substation smart meters for network management



Smart meter installation in the BT side of the transformer