

CURSO DE GESTIÓN DE REDES ELÉCTRICAS INTELIGENTES

4 – EXPERIENCIAS E INICIATIVAS EN EL DESARROLLO DE LAS REDES INTELIGENTES

4.2 - Smart Cities

ENEL group: an international energy operator

Presence

40 countries

Net installed capacity

99 GW

Customers

~61 million

Employees

71,394

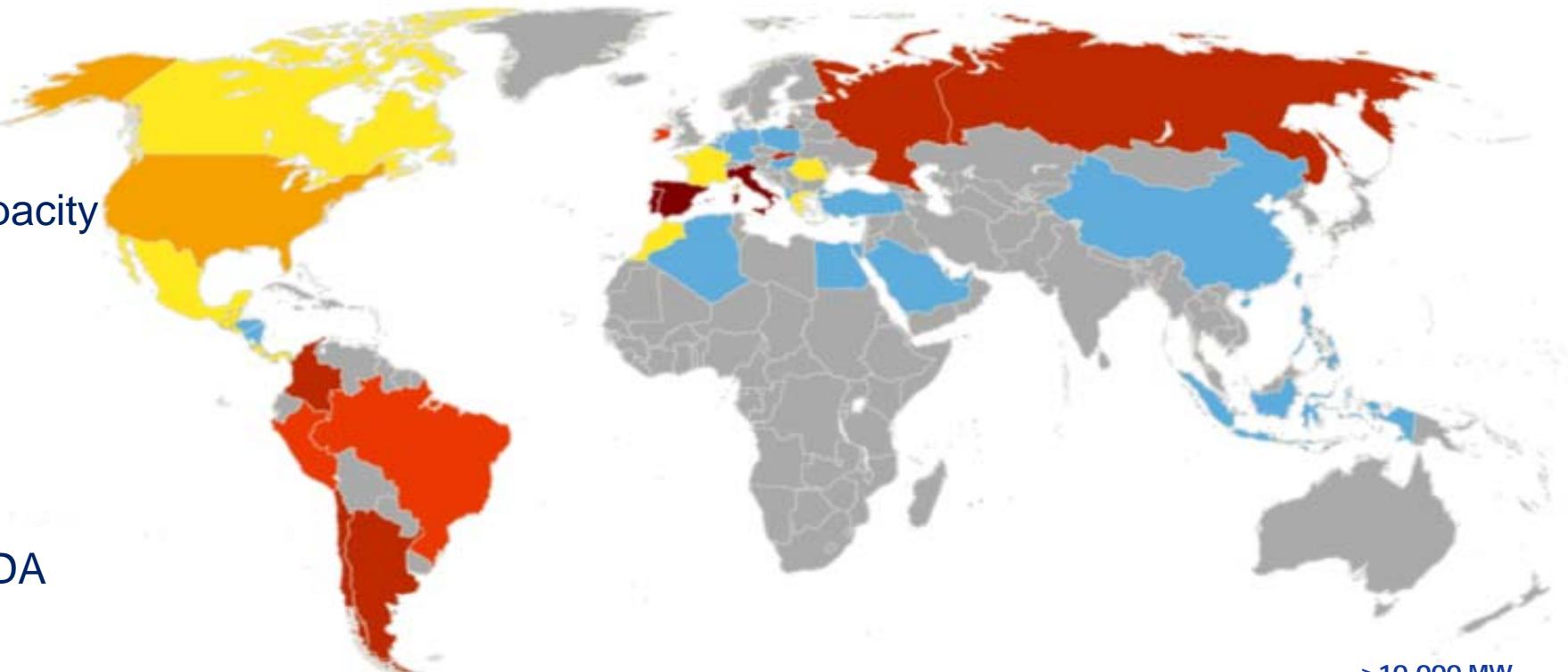
Recurring EBITDA

~16 €bn²

Net Capex Plan 2014-

2018

~26 €bn³



Italy's largest power company and one of Europe's main listed utilities

Present throughout the entire electricity and natural gas value chain

* Data updated to 31/12/2013

The most efficient city is electrical



The electricity is a particularly appropriate energy to supply the cities:

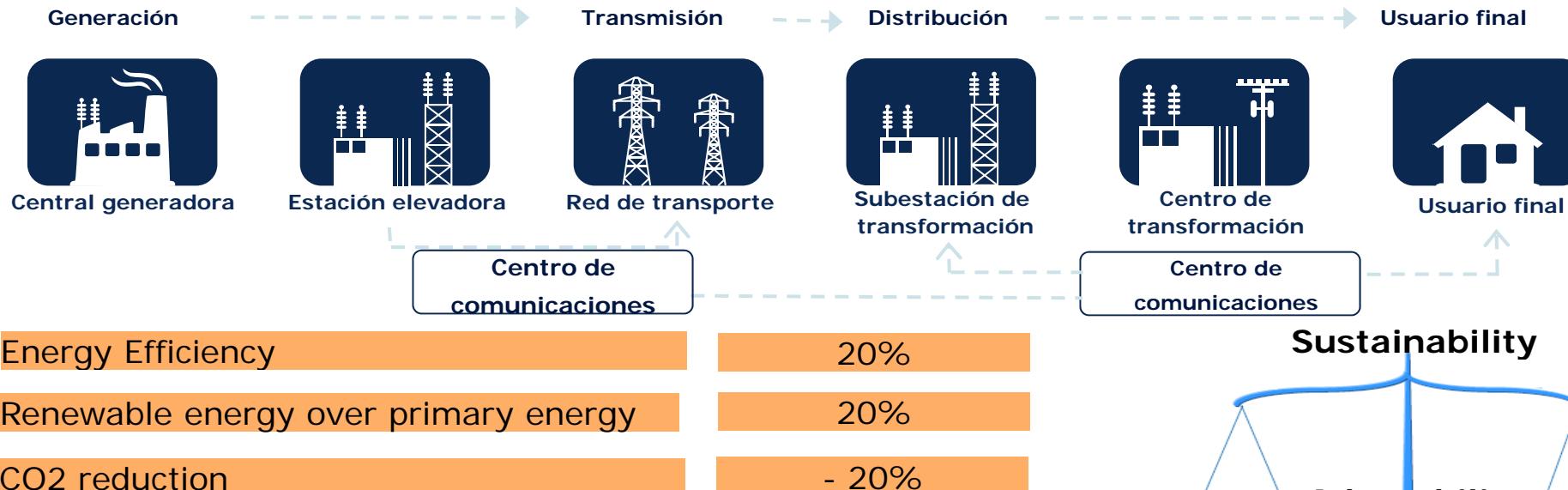
Efficient for people

Efficient for the environment

Efficient for the economy

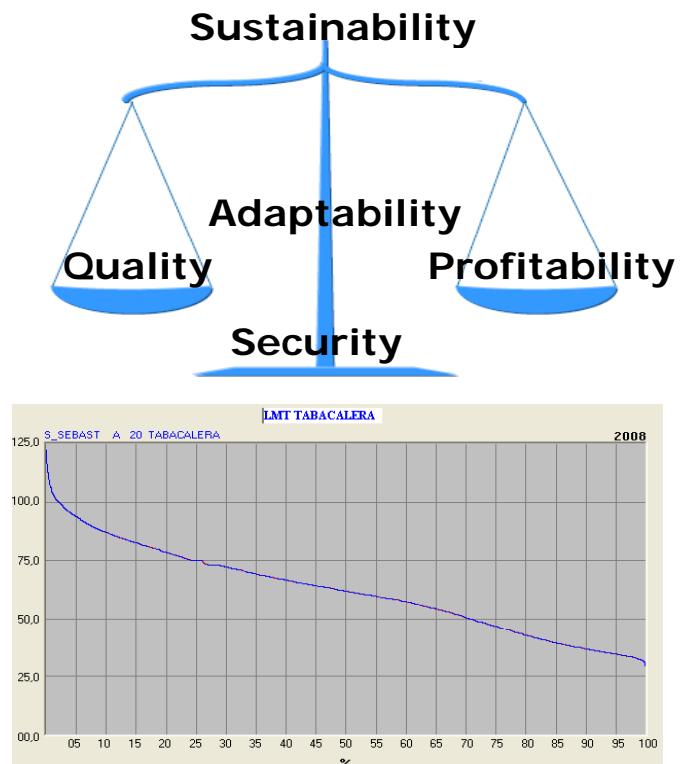
- Clean, no contaminant emission
- Each time with more renewable part
- Reliable
- Competitive
- Sustainable

Smartgrids: The traditional business, future changes

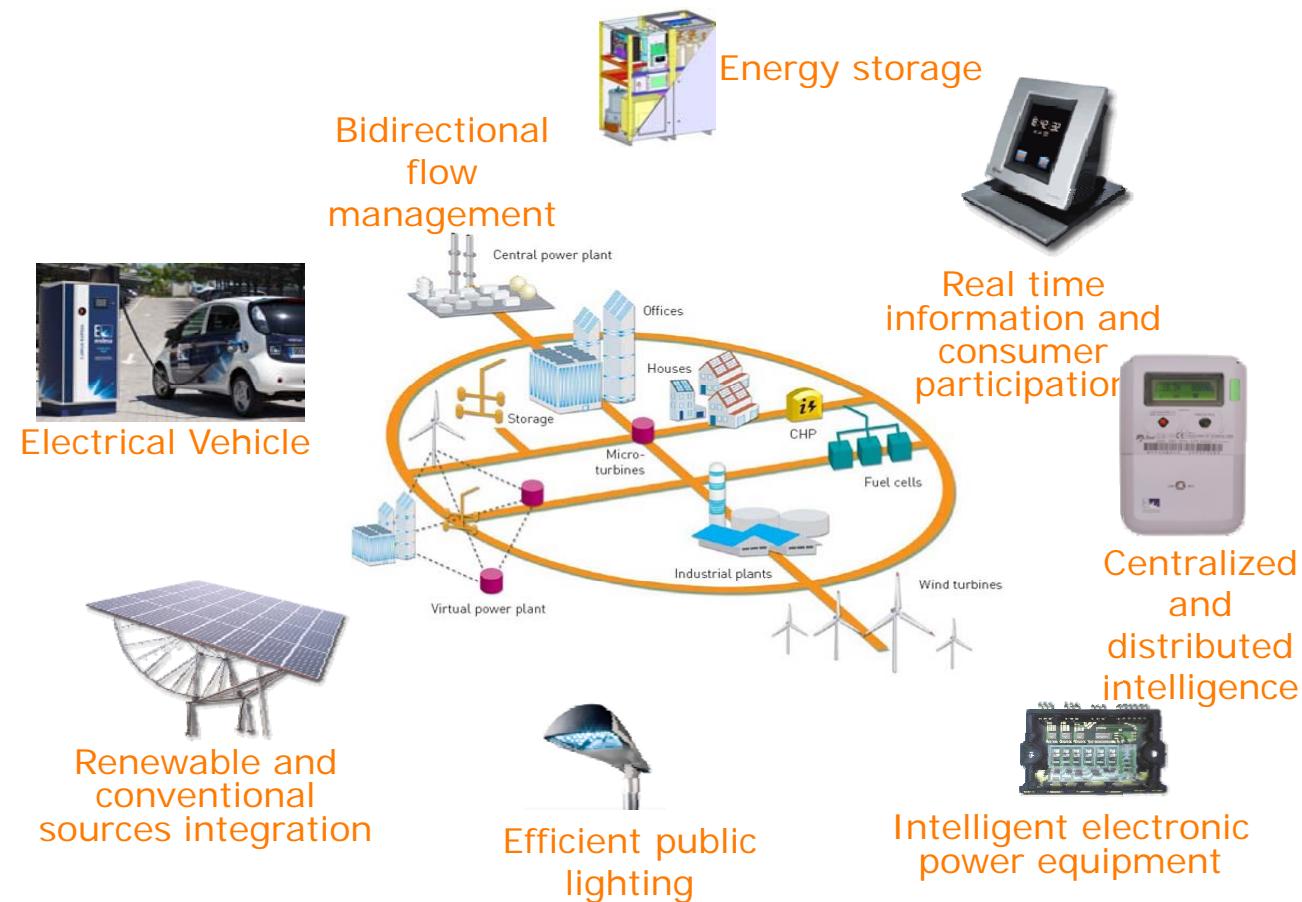


New players and services

- + Prosumers
- + Energetic services enterprises
- + Integrators: Microgrids and Virtual Power Plants
- + Electric vehicle charge
- + Flexibility markets



A Smart Grid is one that integrate efficiently all users actions



Advanced services of an Smart Grid

- + Allow users to integrate new requirements
- + Improve the efficiency to the system operation
- + Ensure the safety, control and quality supply
- + Allow a better planification and optimize the inversions
- + Improve the market operation and the costumer service
- + Promote the customers participation in the consumption management

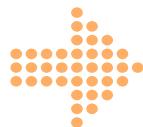
Smartcity Málaga. Scope of the project



31 million budget for companies and research centers



4 year and fully functional, technology in the field and important involvement of final customers



Design and deployment, analysis of results, final reports, and dissemination activities



“Living lab” to test new products and services, proof of concept

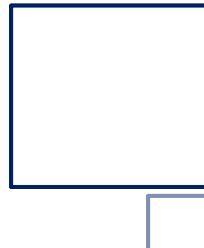


“Demo projects call other projects”, new opportunities will arise as a consequence of this project

Location: Malaga, new seawalk



- MV and LV generation
- MV grid automation, new grid
- Friendly customers **form demand response applications**
- New expansion area **residential**
- Possibility to incorporate other local initiatives **Smart House, G4V, Green Emotion**
- Support from the governments



Participants



UNION EUROPEA

Una manera de hacer Europa



Centro para el Desarrollo
Tecnológico Industrial



GOBIERNO
DE ESPAÑA

MINISTERIO
DE CIENCIA
E INNOVACIÓN



JUNTA DE ANDALUCÍA

CONSEJERÍA DE INNOVACIÓN, CIENCIA Y EMPRESA

Project coordinators



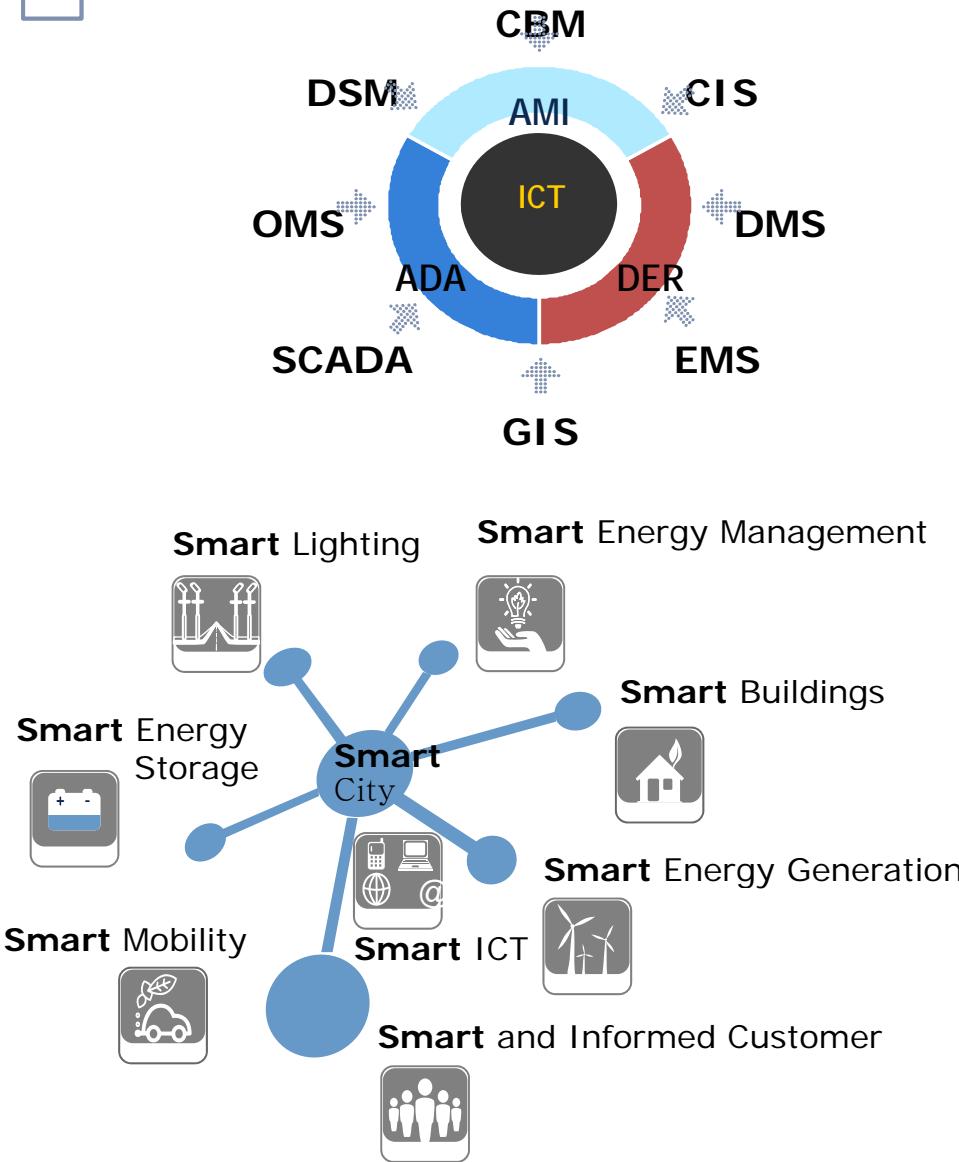
Research centers



UNIVERSIDAD
DE MÁLAGA



SMART GRIDS The electric company of the future.



Communications

- Real-time IP network

AMI (Advanced Meter Infrastructure)

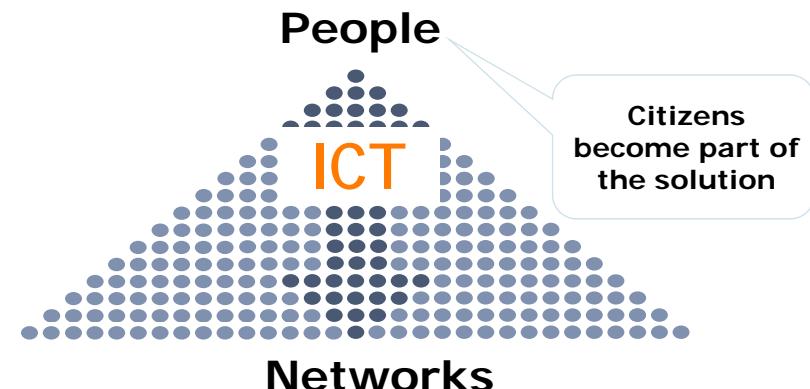
- Smart meters (electricity, water and gas)
- Demand response
 - Smart buildings and homes
 - Smart and informed customers

ADA (Advanced Distribution Automation)

- Real-time monitoring
- Network failure and recovery
- Network automation

DER (Distributed Energy Resources)

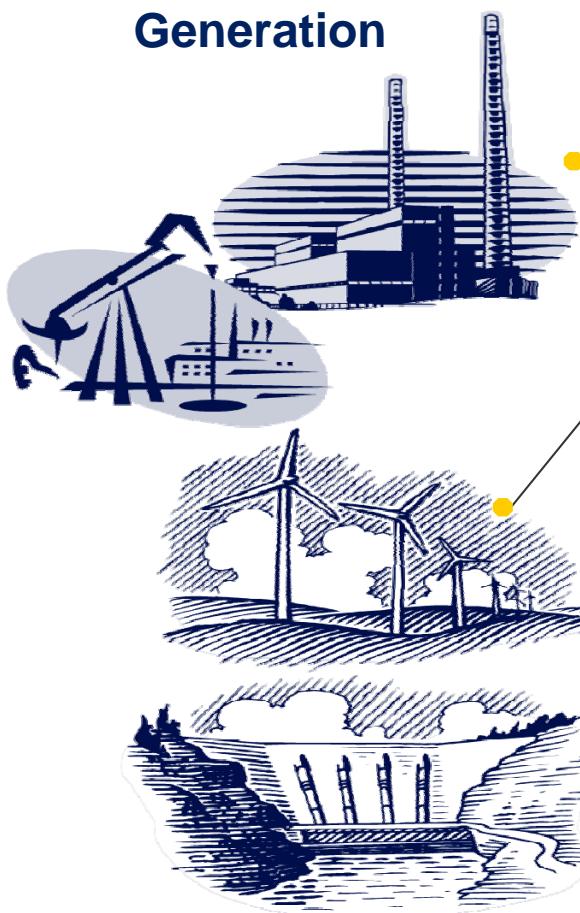
- Electric vehicles
- Energy storage
- Distributed generation of renewable sources



The electricity model: traditional grids

The traditional electricity model is strongly unidirectional

Generation



Transportation & Distribution



Consumption

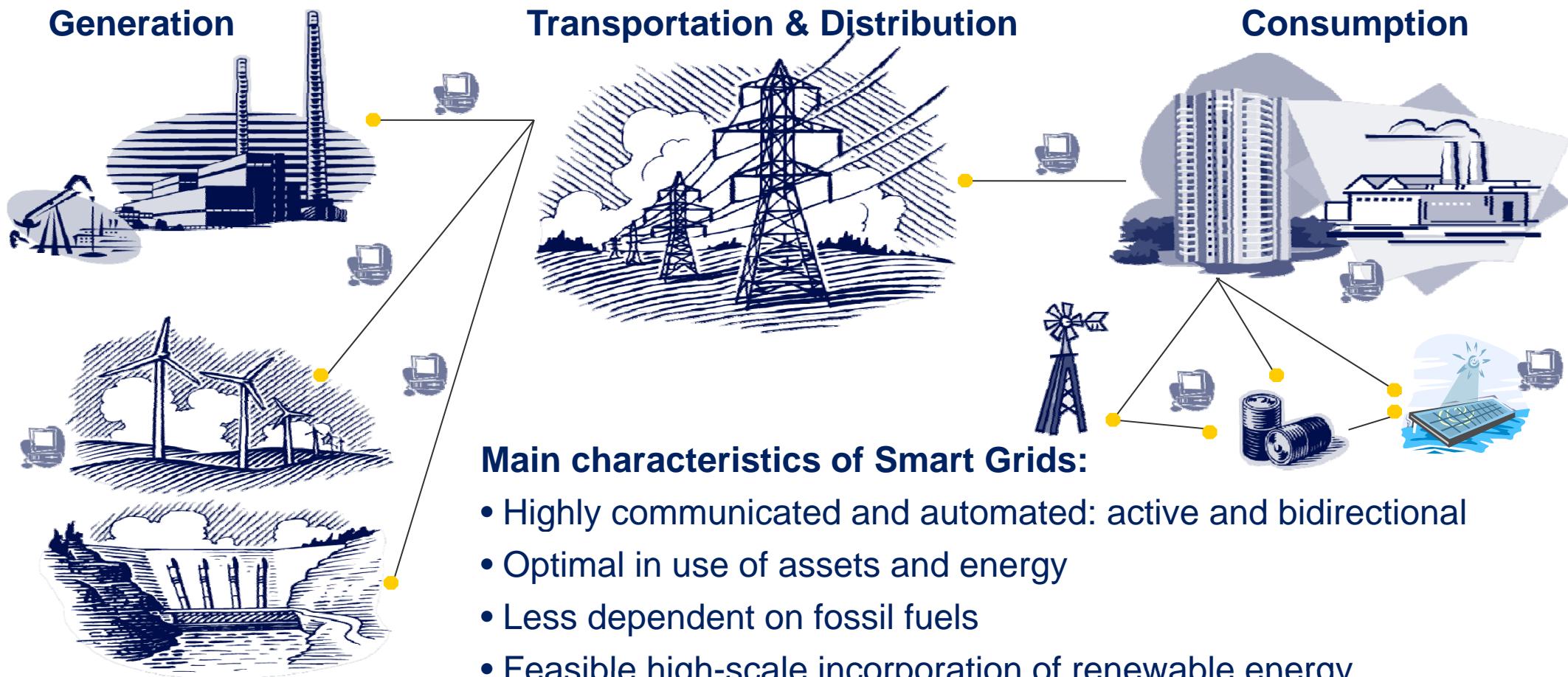


Main characteristics of actual grids:

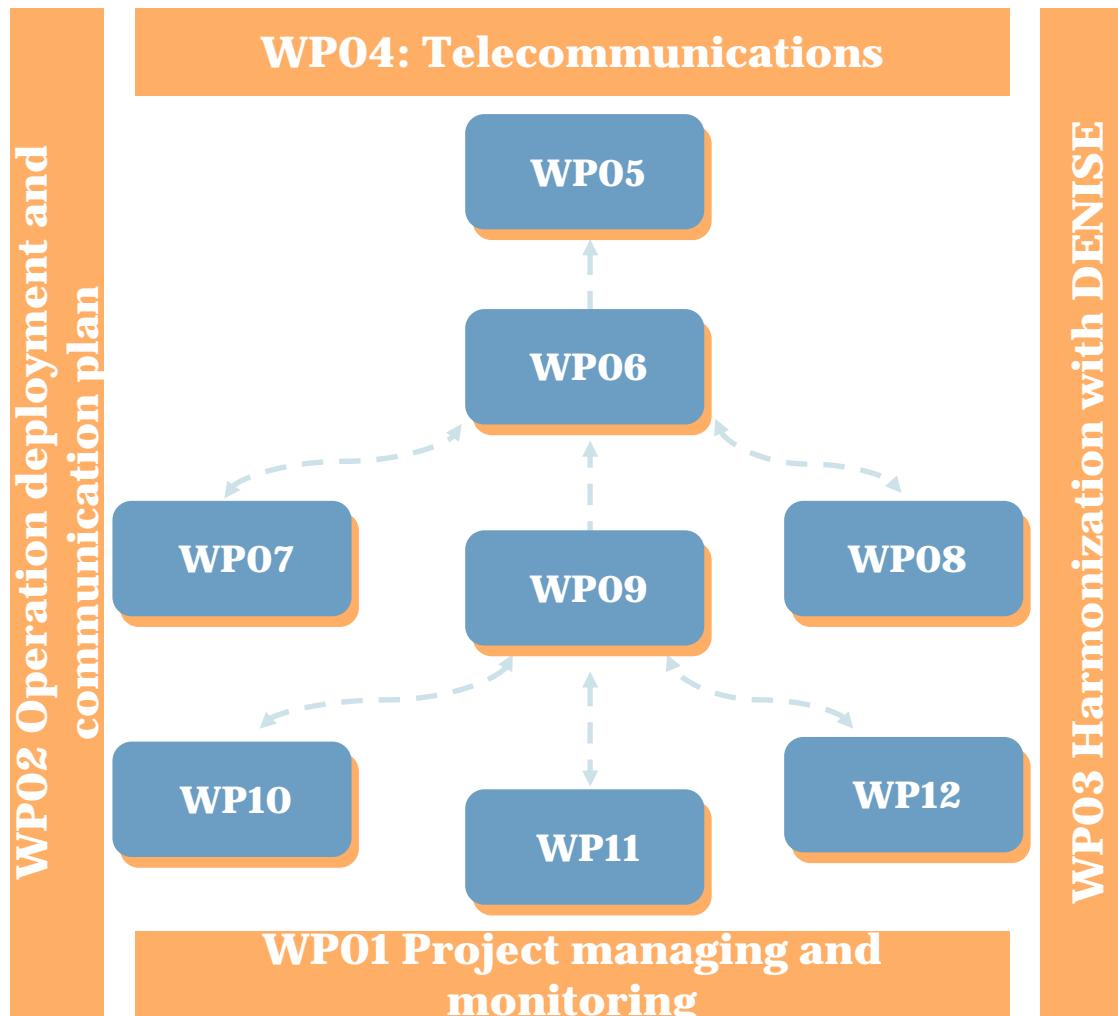
- Strongly unidirectional
- Passive
- Oversized
- Highly dependent on fossil fuels
- Difficult high-scale incorporation of renewable energy

The electricity model: Smart Grids

The Smart electricity model is strongly multidirectional



WorkGroups



- WP01** – Project Management
- WP02** – Deployment and Communication
- WP03** – Coordination DENISE
- WP04** - Telecommunication
- WP05** – Information Systems
- WP06** – MV Automation
- WP07** - Mini generation and storage (mDER)
- WP08** – Energy Efficiency and Demand Response
- WP09** – LV Automation
- WP10** - Micro generation and storage (μ DER)
- WP11** - SmartMeters (AMI)
- WP12** – Electric Vehicles (G2V)

Relevant Information



WP04 Telecommunication. ICT

-  μStorage
-  mStorage
-  Public Lighting

GOAL

To deploy an intelligent system for MV automatization with optimal solution -- economic, functional and operative – for the new network requirements (distributed generation, electric vehicles, storage, renewables integration, etc)

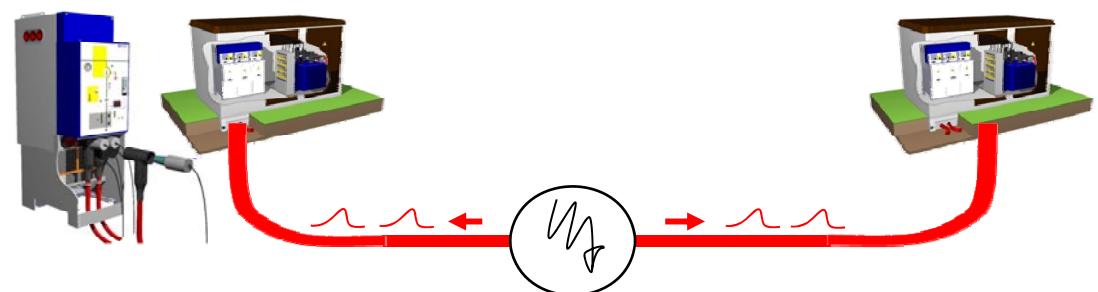
72 transformers communicated using **PLC, WIMAX** and other technologies.
Redundant ring architecture. **Advanced monitoring and control**



PowerLine Communications tests

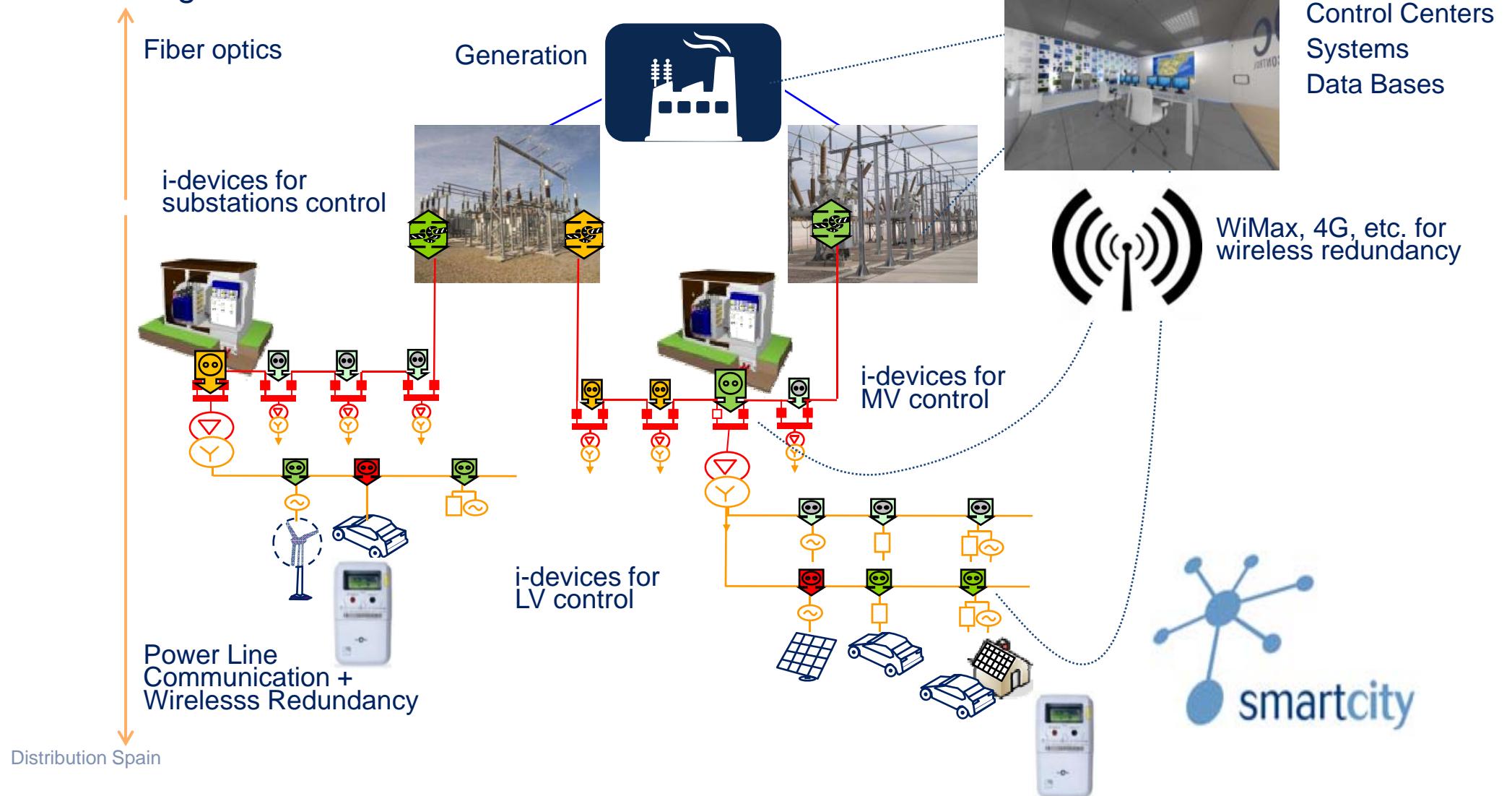


Communications network of Smart City Málaga



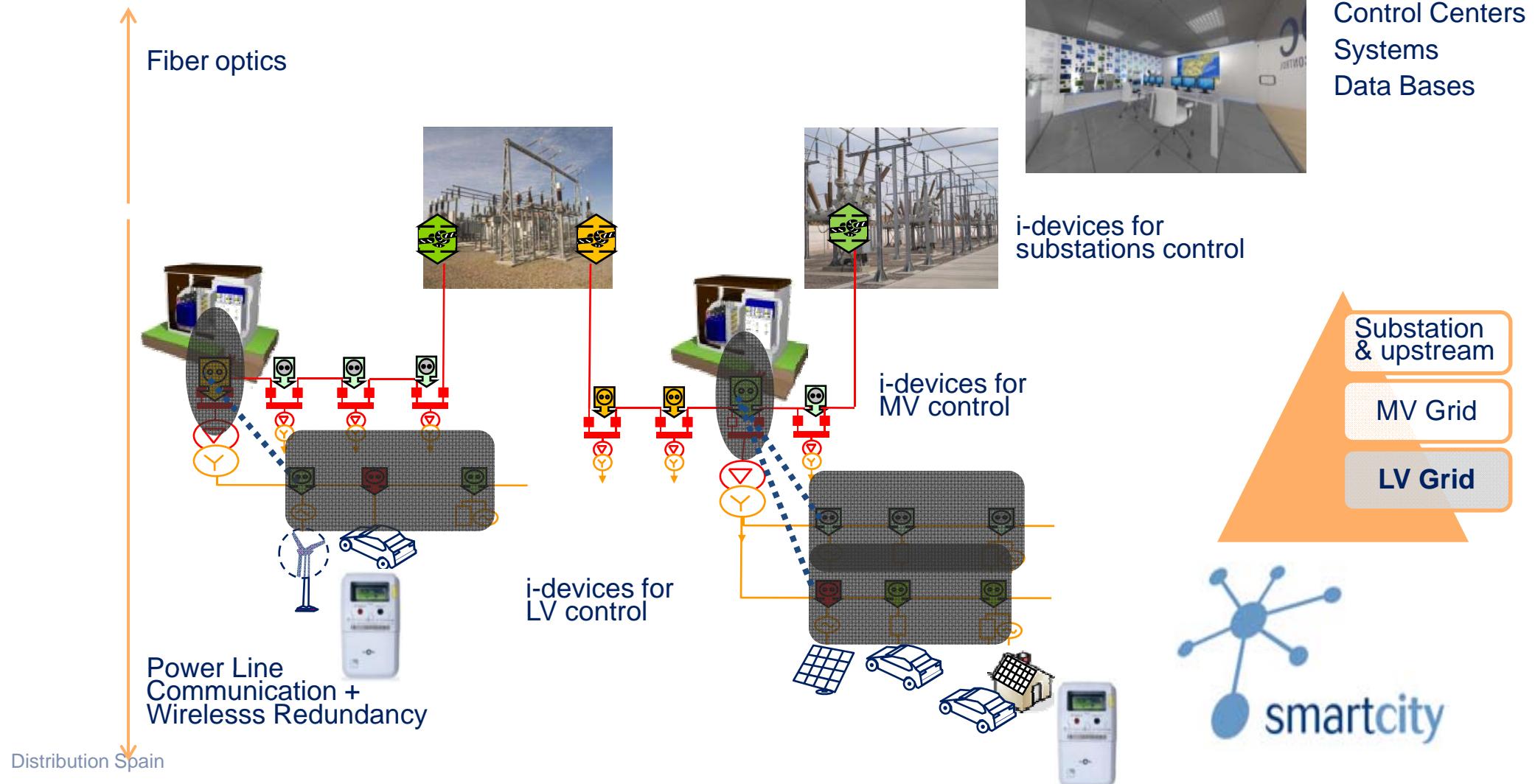
Smart Grid Architecture

Real-time communications and Intelligent Electronic Devices (IED) are fundamental technologies



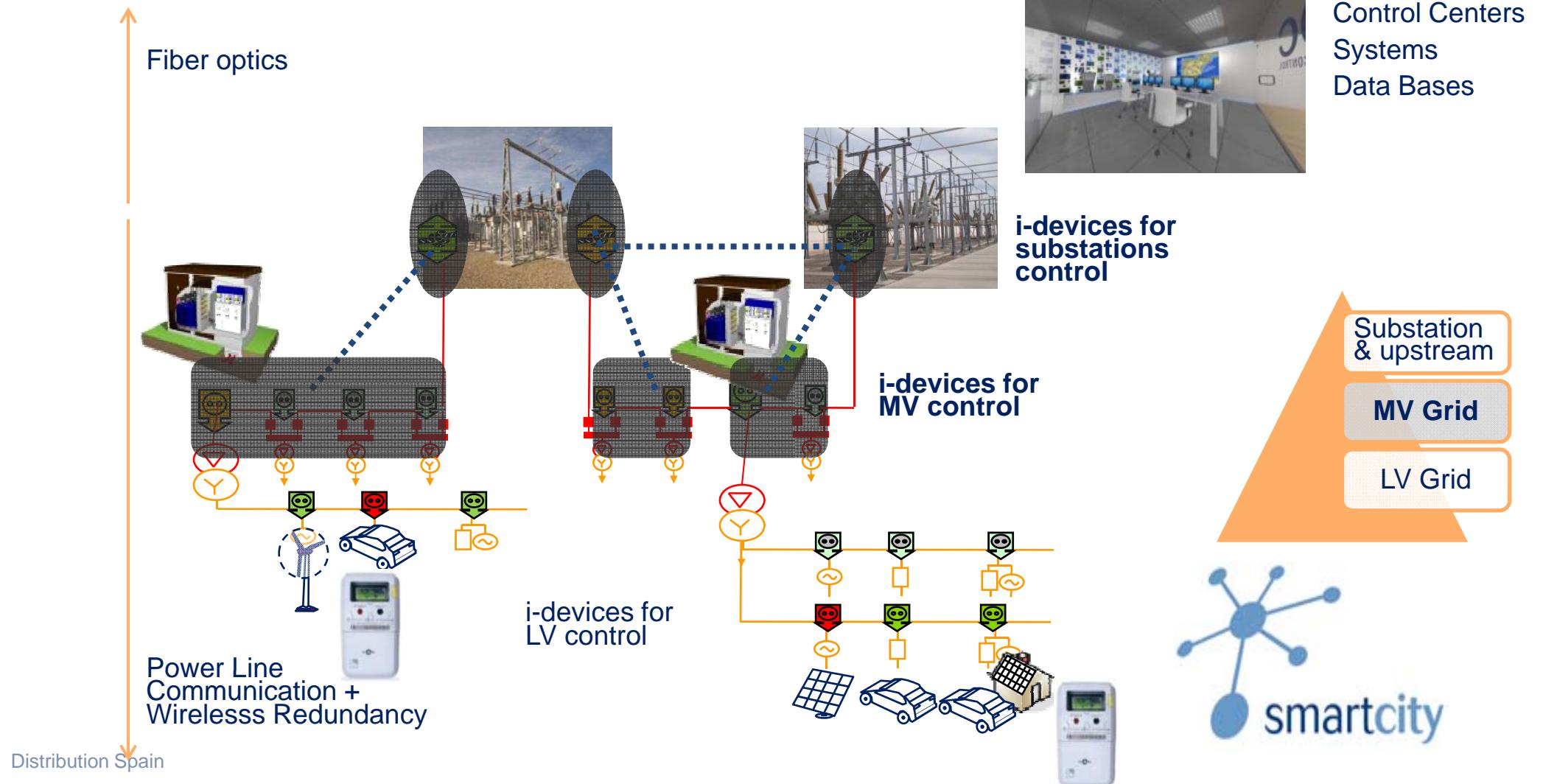
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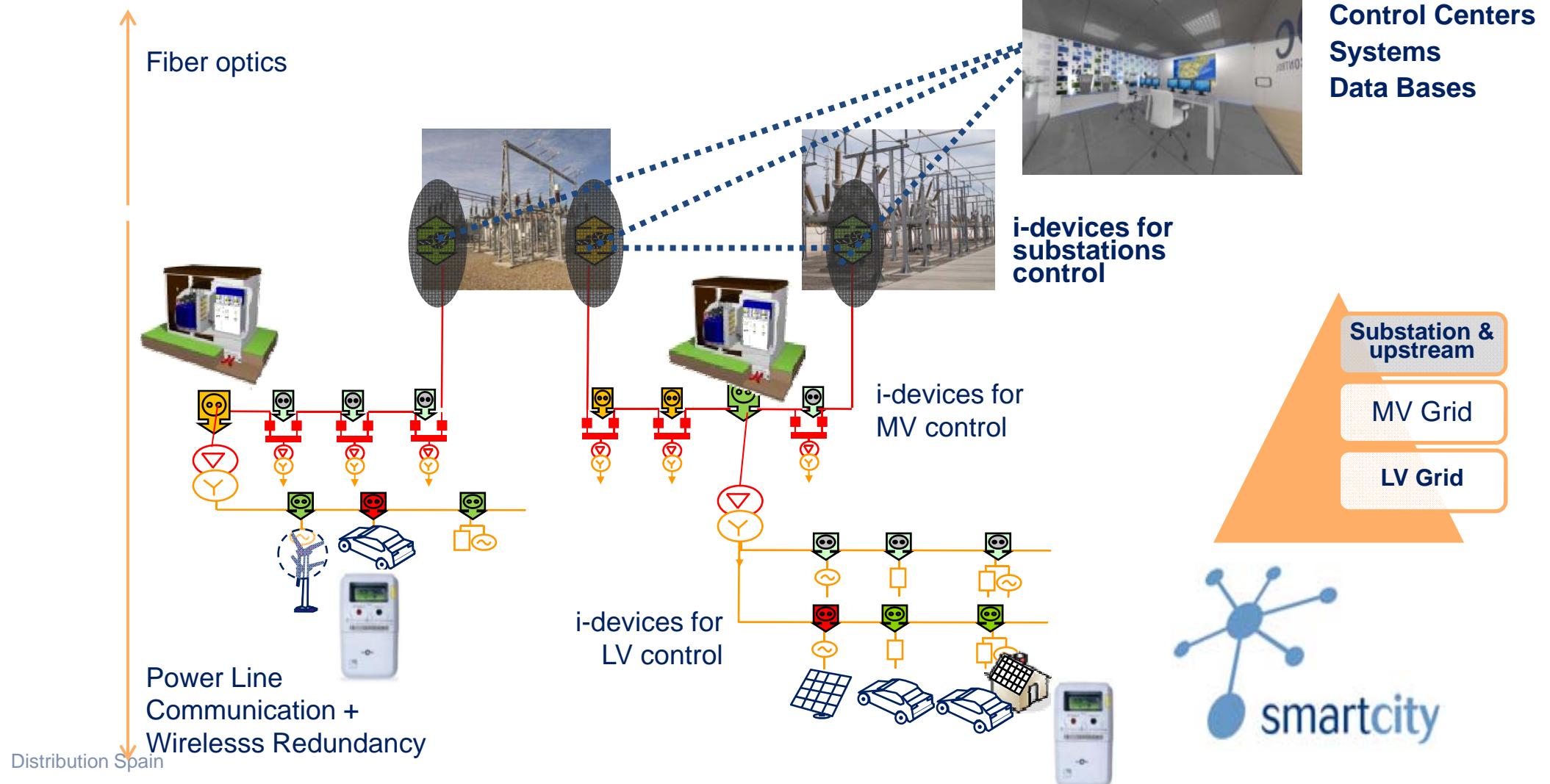
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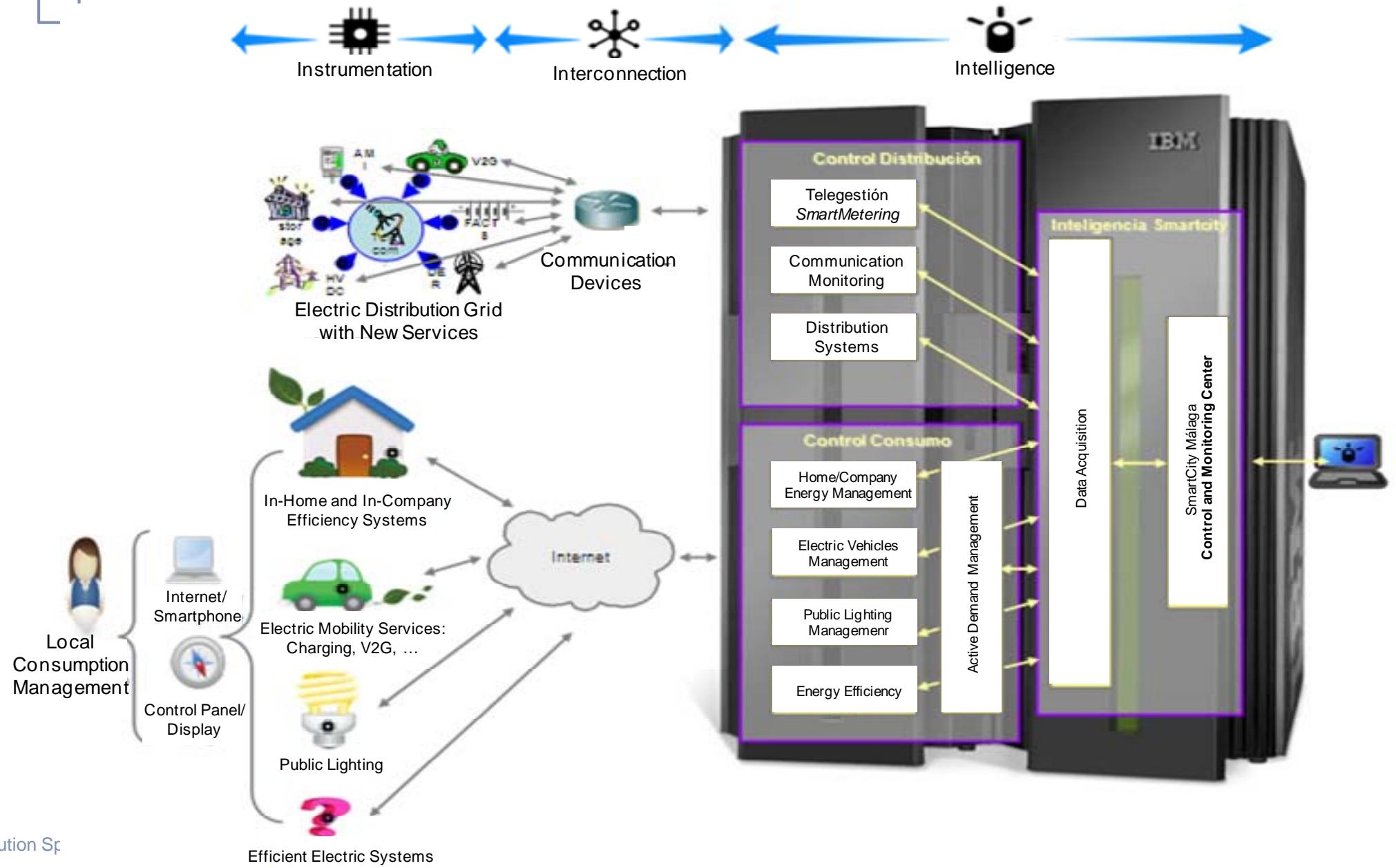


Smart Grid Architecture

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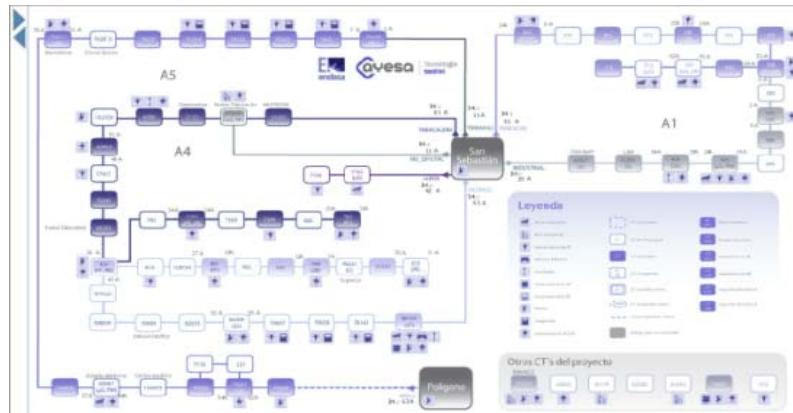
WP05 Systems. Information Technologies



WP05 Systems. Information Technologies



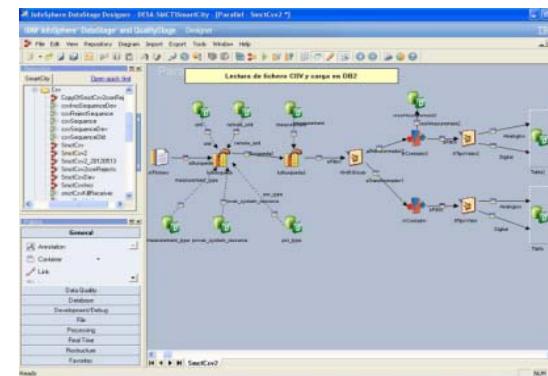
Active demand management system



Monitoring System: sinóptico de red



Monitoring System: KPI



Data acquisition system



Remote management system

WP07 and WP10 Mini and Micro Generation and Storage

Mini Storage:

Trade Fairs of Málaga:
storage of 106kWh

Micro Storage:

Microgrid with street
lighting consumption

24kWh

Generation:

33 kW LV

12,94 MW MV



WP08 Energy Efficiency. Public Lighting

– New luminaries installation:

- Sodium Technology
 - Placed in Pacífico Street
 - Installation of Flow Regulators and Stabilisers
- **LED and Halogen Technology Lamps**
 - Placed in Antonio Banderas Seawalk
 - Point-to-point control

– Installation of new controller cabinets and sensors

– Intensive use of renewable generation and energy storage systems



60 test LED and Halogenuro public lights with remote control

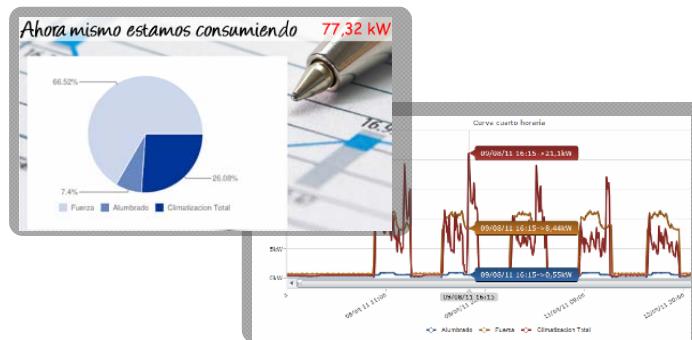
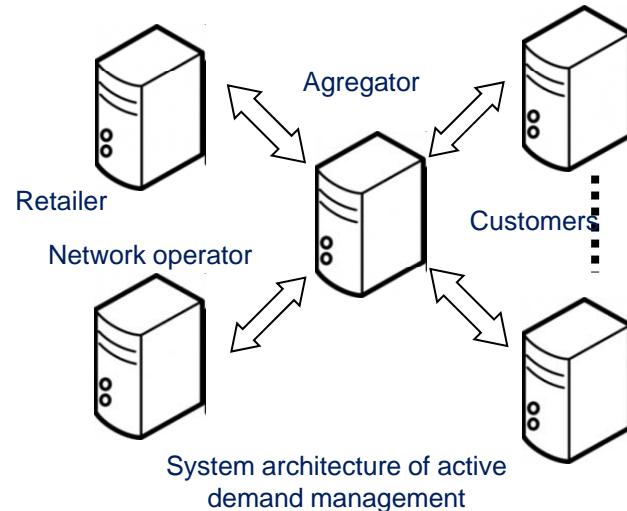
9 lights with wind generation (600W)

10 lights with photovoltaic generation (85Wp)

139 lights points with remote control

12.100 W total controlled power

WP08 Energy Efficiency. Public Lighting



WP11 AMI

Architecture adapted to european regulation



Functionalities:

- **AMMS System** – central management and coordination of the whole metering system
- **Electronic meters** – Real-time operation. Allow the energy control and measurement, the remote connection / disconnection, over 6 tariff periods and 2 different contracts
- **Concentrator** - Detects and manages (real-time, fully automated) the new meters connected to the grid
- **PLC-Power Line Communications**– Automatic management of any network change
- **Communication protocol, based in METERS & MORE**, with all the reliability of Enel technology and experience.

Cenelec A Band

PLC of 28.8 kbps operated at 4.8 kbps

BPSK modulation

Security (AES-128 bits hardware encryption)

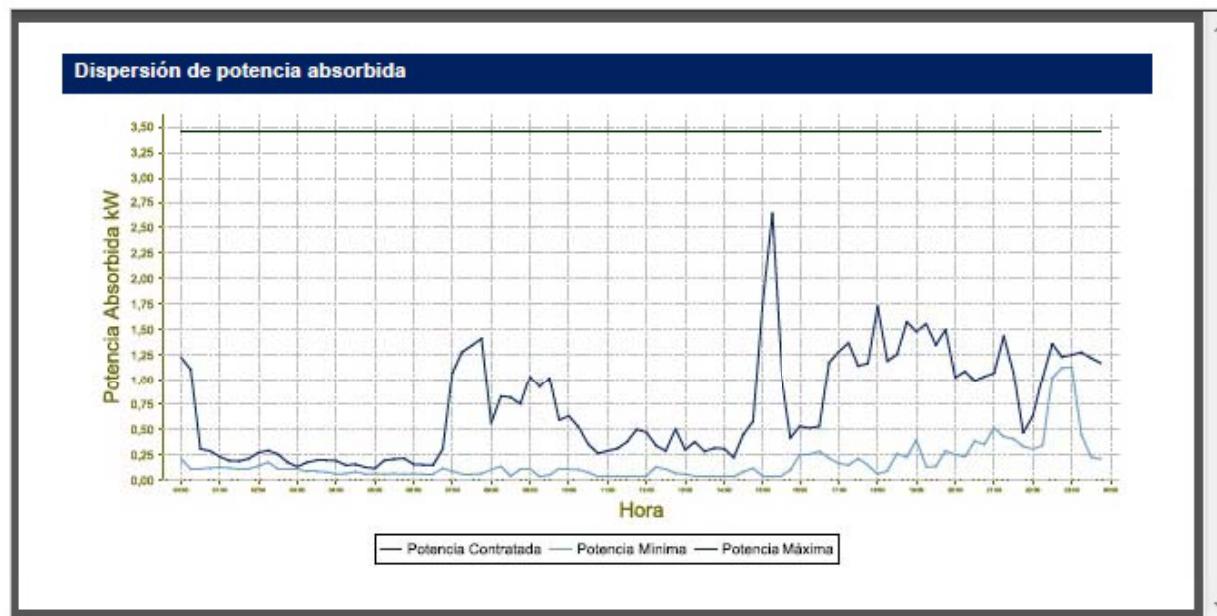
Field-proven METERS & MORE PROTOCOL

**meters
AND
more**
OPEN TECHNOLOGIES

WP11 AMI

Available real-time data from the smartmeter:

- Mean energy consumption
- Active-reactive energy comparison
- Mean hourly power consumption
- Comparison between other clients with similar power factor



Exportar:  PDF  Word

Successful case: Telemanagement

Smart meters are the first step in the establishment of policies for energy saving and efficiency

Technology

Smart meter and the concentrator



Energy efficiency

Informed and active customers



Level of implementation



33 M



> 4 M (today)
13 M (2018)



WP12 Electric Vehicles

Green eMotion Project is working for the future electric mobility standars in Europe



Endesa is very active in the most advanced projects in electric mobility in Spain



Zem2all – Real test

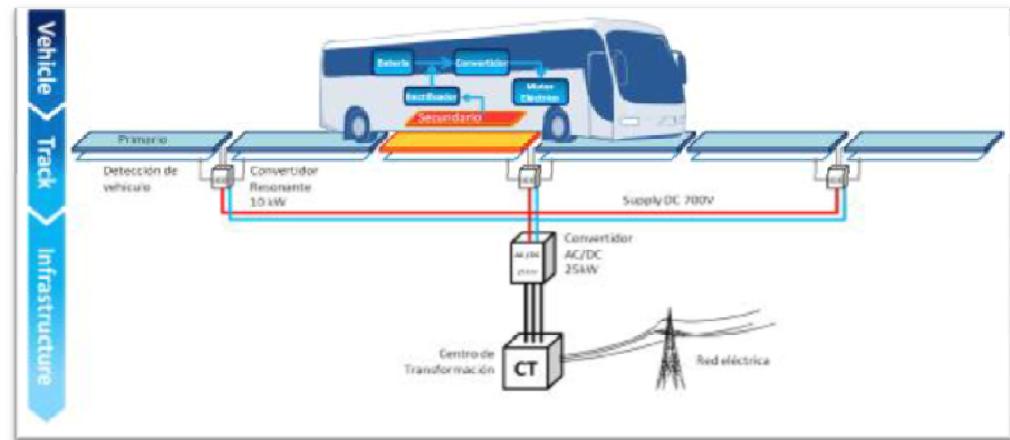
- + Monitoring of 200 EV in real use conditions
- + Home charging (LV) and more than 20 quick chargers
- + Control center to obtain data



The **V2G** concept, Vehicle to Grid, considers the bidirectionality of EV. Connected to network, they can function as:

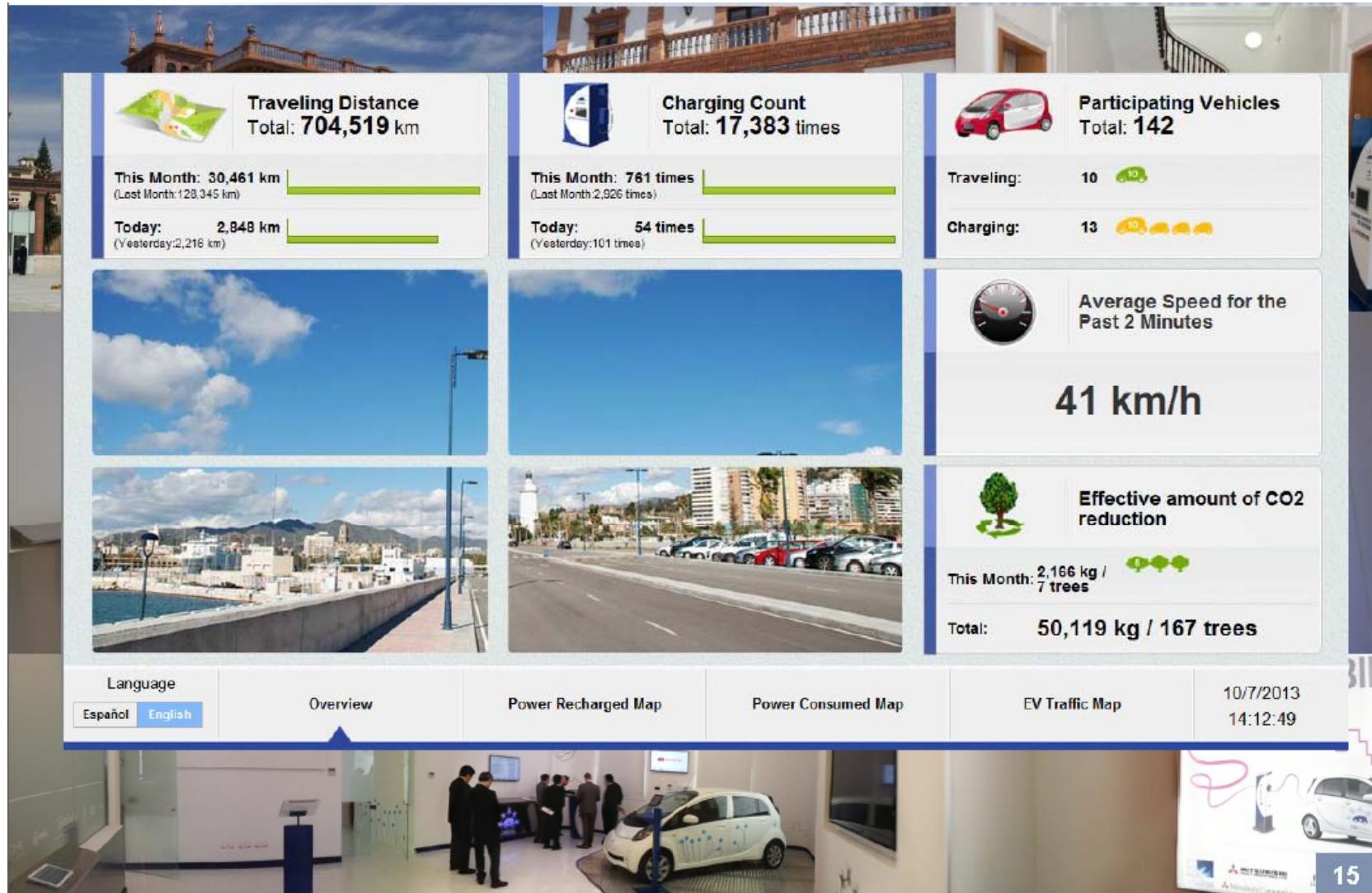
- Energy sources, when they inject the stored energy in their batteries
- Accumulators, when they charge the batteries with the network energy

Victoria project – Induction charging



- + Development of a wireless charging system for urban buses
- + Two modes: static and dynamic
- + Implemented into Smart City Malaga area

ZEM2ALL



Control and Monitoring Center



Visitor attention

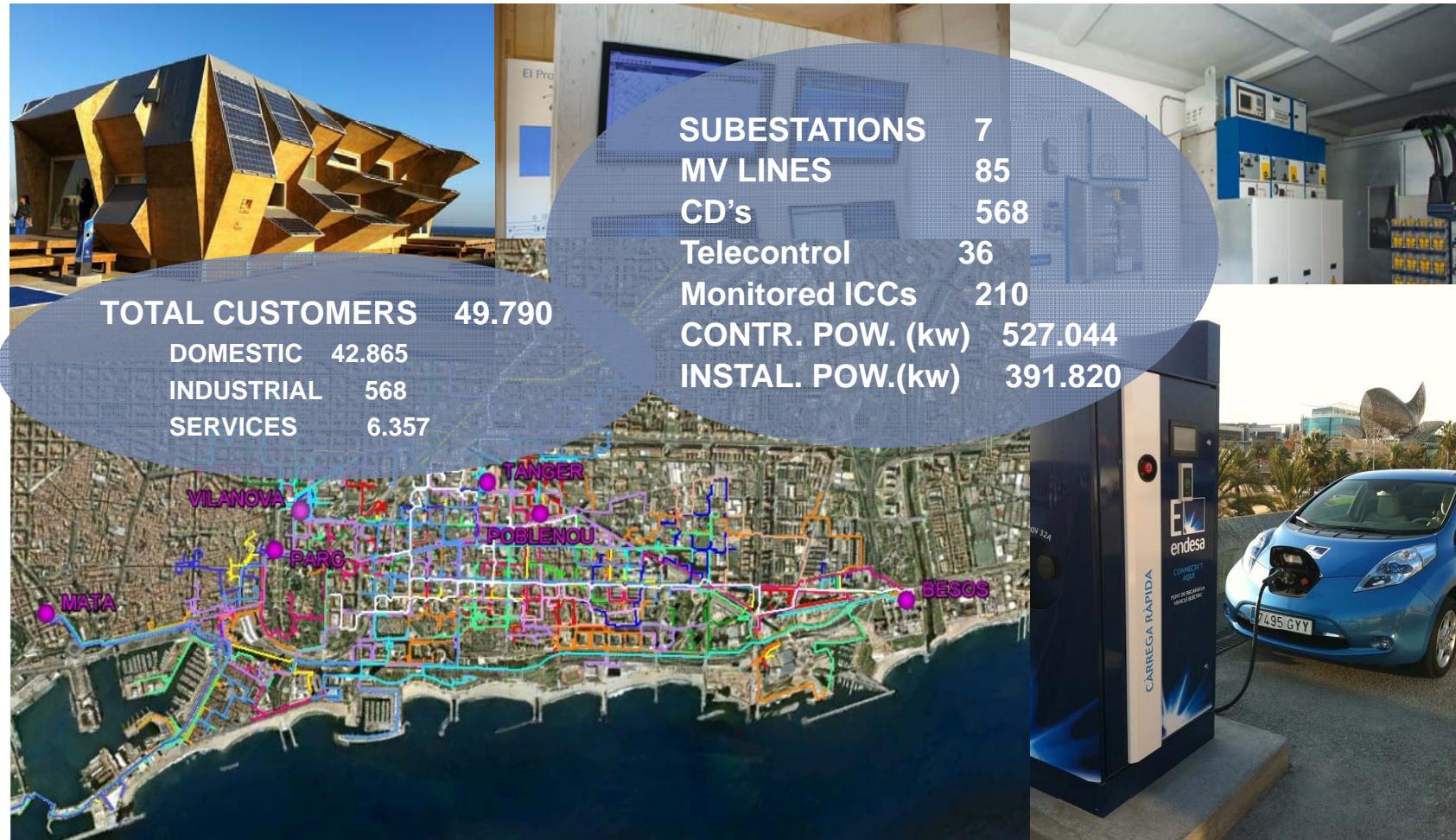


Showing diagram and
videowall for expositions



Smartcity Barcelona Project

Smartgrids Service Center





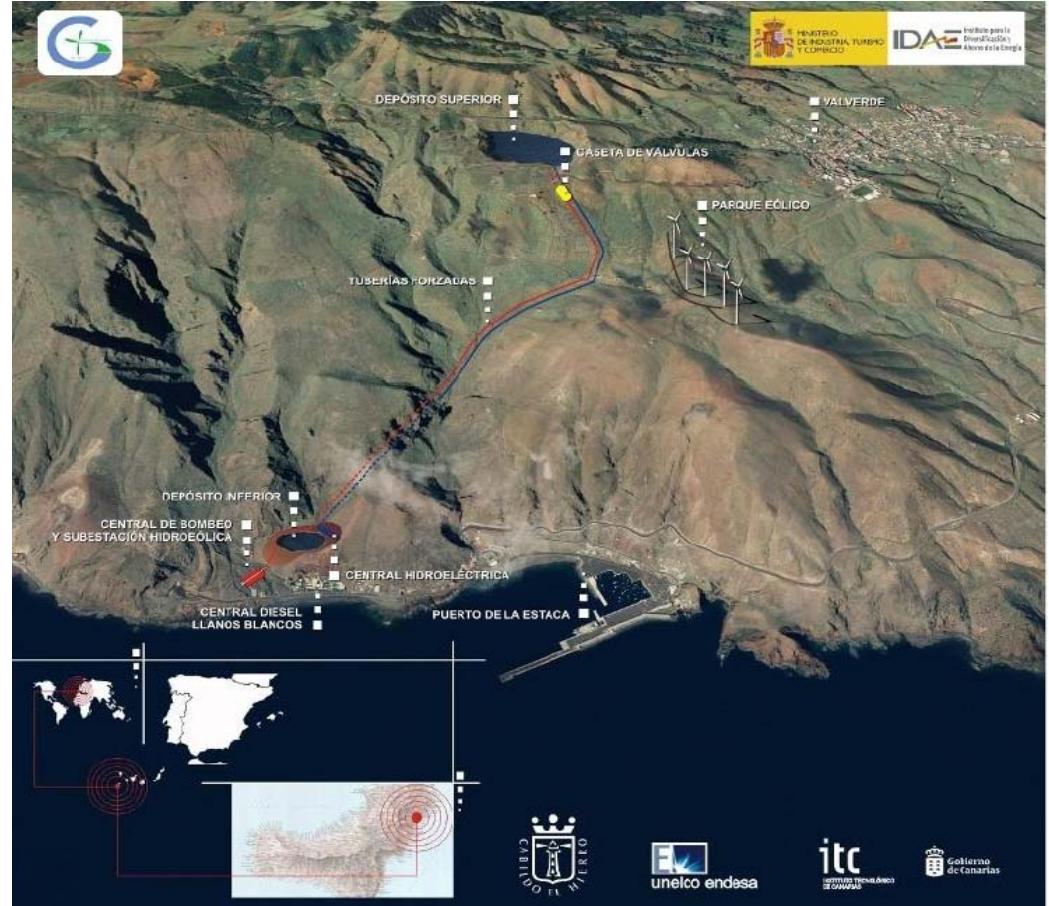
Gorona del Viento Project

Renewables + storage for a top level self supply

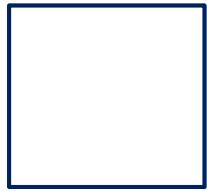


Scope

Upper reservoir:	500.000 m ³ , 714 m high
Lower reservoir:	150.000 m ³ , 60 m high
Wind generation:	5x2,3 MW, total 11,5 MW
Hydro generation:	4x2,8 MW, total 11,2 MW
Pumping station:	6x0,5 MW + 2x1,5 MW
Conection:	20 kV grid from insular system
Insular peak demand:	7,5 MW
Demand coverage:	100% power, 70% energy
CO₂ avoided emissions:	21.000 tons/year
Budget:	65 M€



Endesa created and boosted the project 20 years ago. The spanish and canarian governements support, with IDAE finaniciation made it possible. The project will be operating in 2012.



LATAM

Smart Grid projects in Latin America

~~CODENSA~~

Bogotà



chilectra

- ✓ Public Lighting pilot in calle nº 93 and in the southern part of the city
- ✓ Electric taxi pilot
- ✓ Network Automation startup

Santiago



- ✓ Smart metering pilot
100 smart meters certified by SEC in operation

- ✓ Public Lighting pilot in Calle Seminario and in Smart City Santiago

- ✓ Electric mobility
 - successfully installation of the Enel's EMMS system
 - Electric bus pilot

- ✓ Network Automation project for Smart City Santiago

- ✓ Net metering pilot for distributed generation integration in the grid



coelce

Fortaleza



- ✓ Smart metering pilot
100 smart meters in operation



ampla

Búzios



- ✓ First 217 smart meters in operation (collaboration Enel and Landis+Gyr)



- ✓ Public Lighting
90 LED Archilede in operation around the Lagoa



- ✓ Electric mobility
8 charging stations, 4 electric cars



- ✓ Network Automation project for Cidade inteligente Búzios



ampla

Niteroi



- ✓ Smart metering pilot
100 smart meters in operation

The electrical and communication solutions should grow coordinately

XX century Network

N-1 Network design
Electromechanical
Unidirectional communication
Centralized generation
Radial topology
Few sensors
Blind network
Manual refund
Static
Manual diagnostic
Decisions by committees of emergency
Load Flow Control Limited
Limited information rates
Few possibilities for customers

XXI century Network

N-2 Network design
Digital
Bidirectional
Distributed
Mesh topology
Lot of sensor
Real time monitoring
Semi-automatic refund
Adaptative
Expert diagnostic systems
Assisted decisions and simulations
Load flow control system in all the Network
Full pricing info
Lot of possibilities for customers

To develop the smart grid, several barriers must be overcome



There is also good practices that can be build

Barriers

- + Regulation of the electricity system
- + Implementation of the necessary investment
- + Standardization and interoperability

Successfull case

- + Implementation of the Remote Management



Benefits and Results

Value Proposal for these cities

- Involves one of the most significant challenges that society will face this century.
- Turns the initiative into an international showplace to display technology relevant to the project.
- Enables experience gaining and the addition of new capabilities which will encourage future research and development.
- Puts in a competitive position both the industry and the national R+D, particularly in Andalucía.
- Others initiatives



Malaga, Barcelona and Buzios have become a window and an international point of reference

It yields knowledge and added value capabilities which will strengthen the development of the industry and the national R+D at the right moment

Grid of today + ICT = Grid of the future

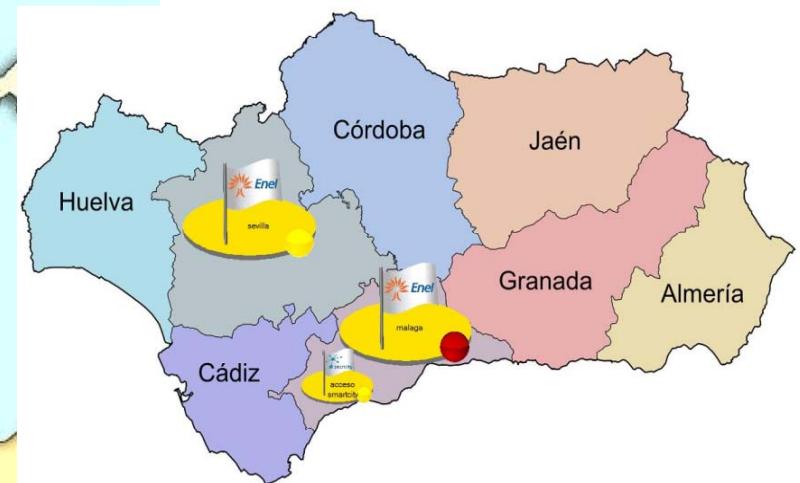




ANNEX. SCMA COMMUNICATIONS NETWORK

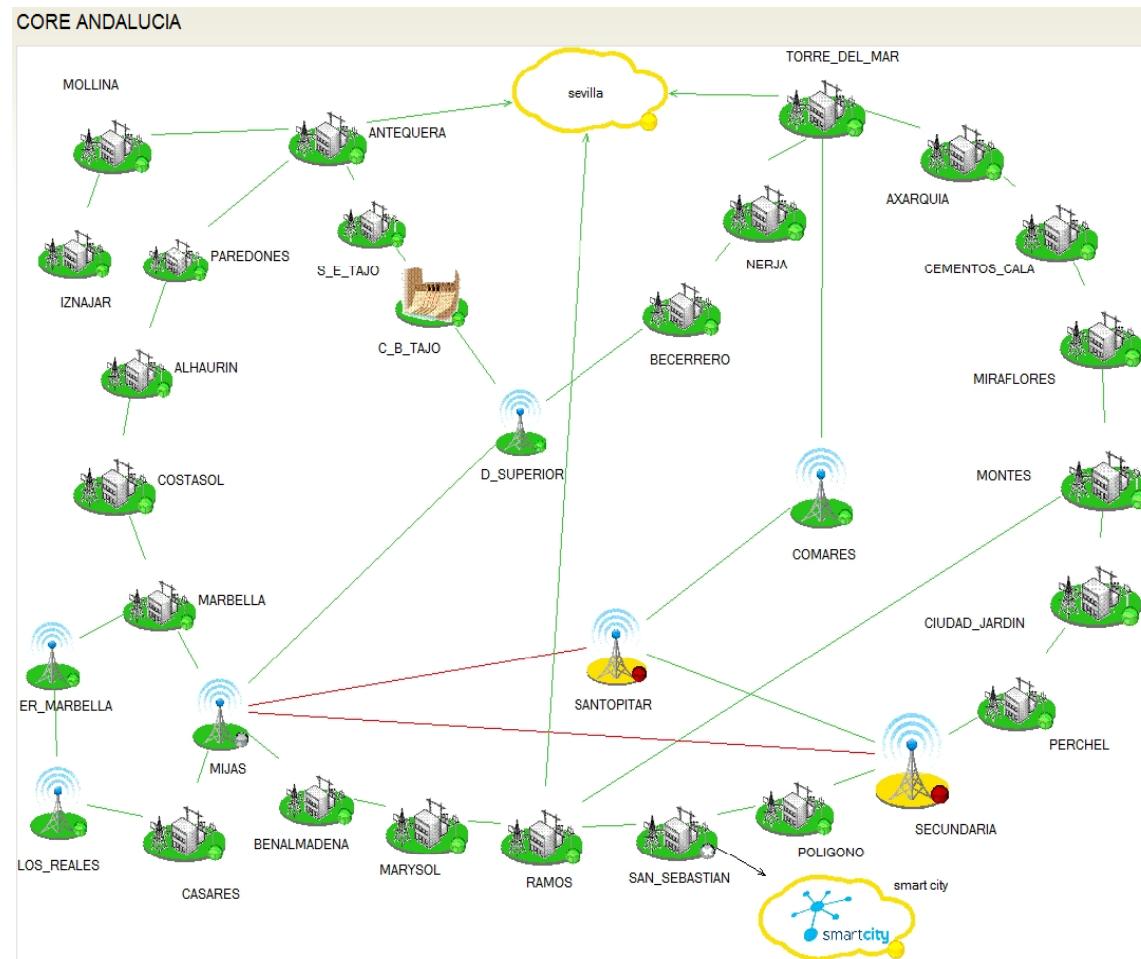
Smart Grid ICT

Flexible, adaptative, reliable Information and Communication Technologies are the basis for Smart Grids



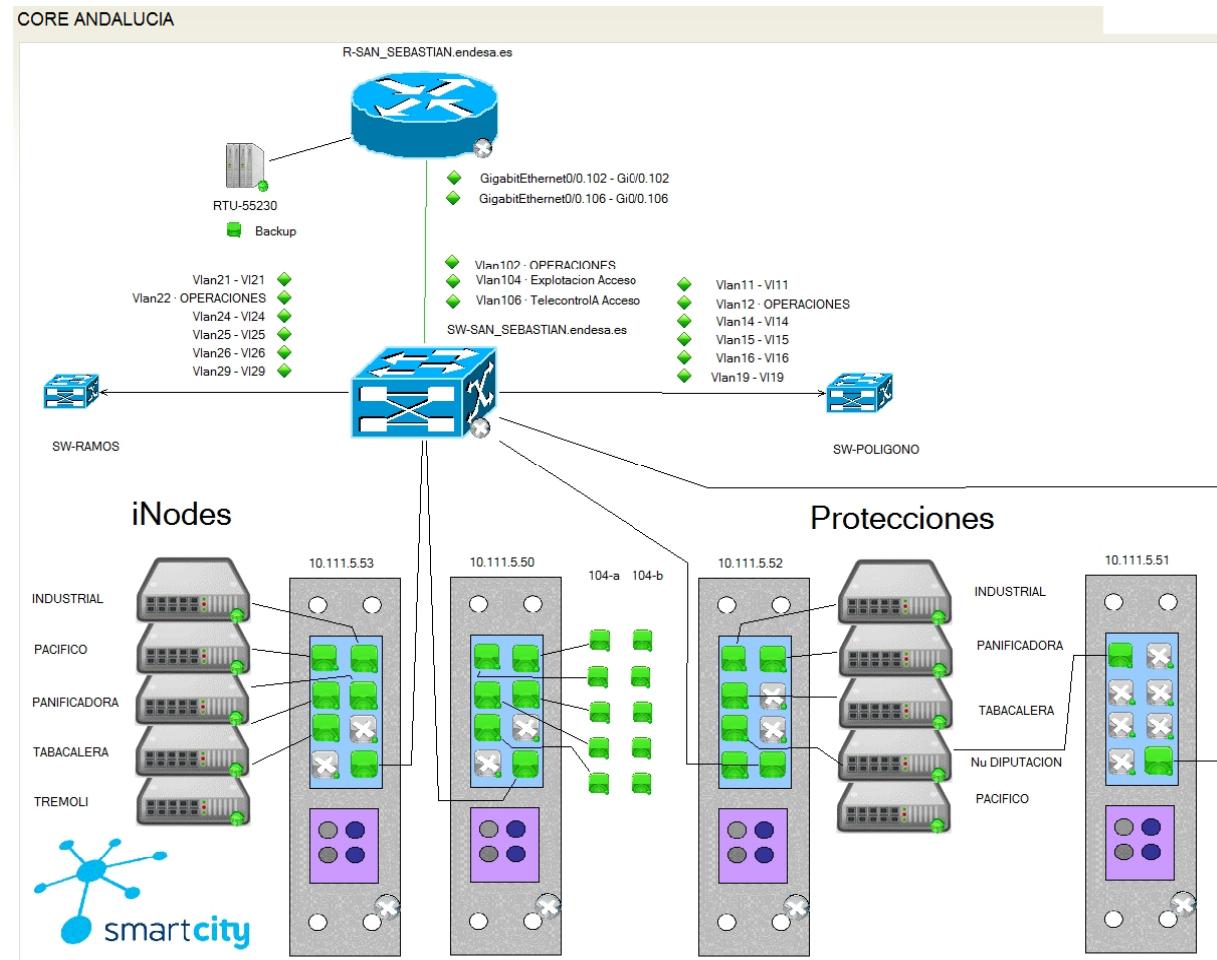
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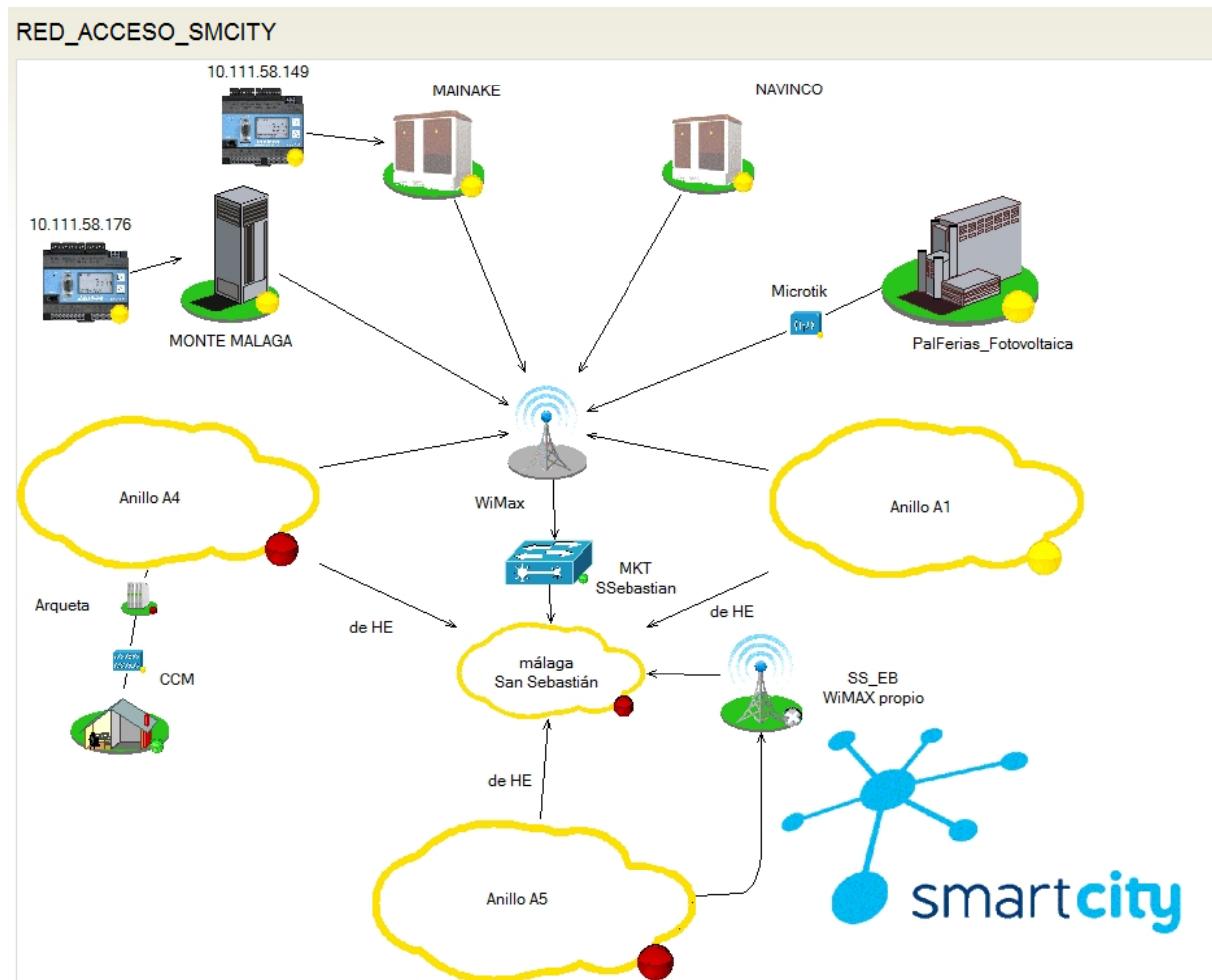
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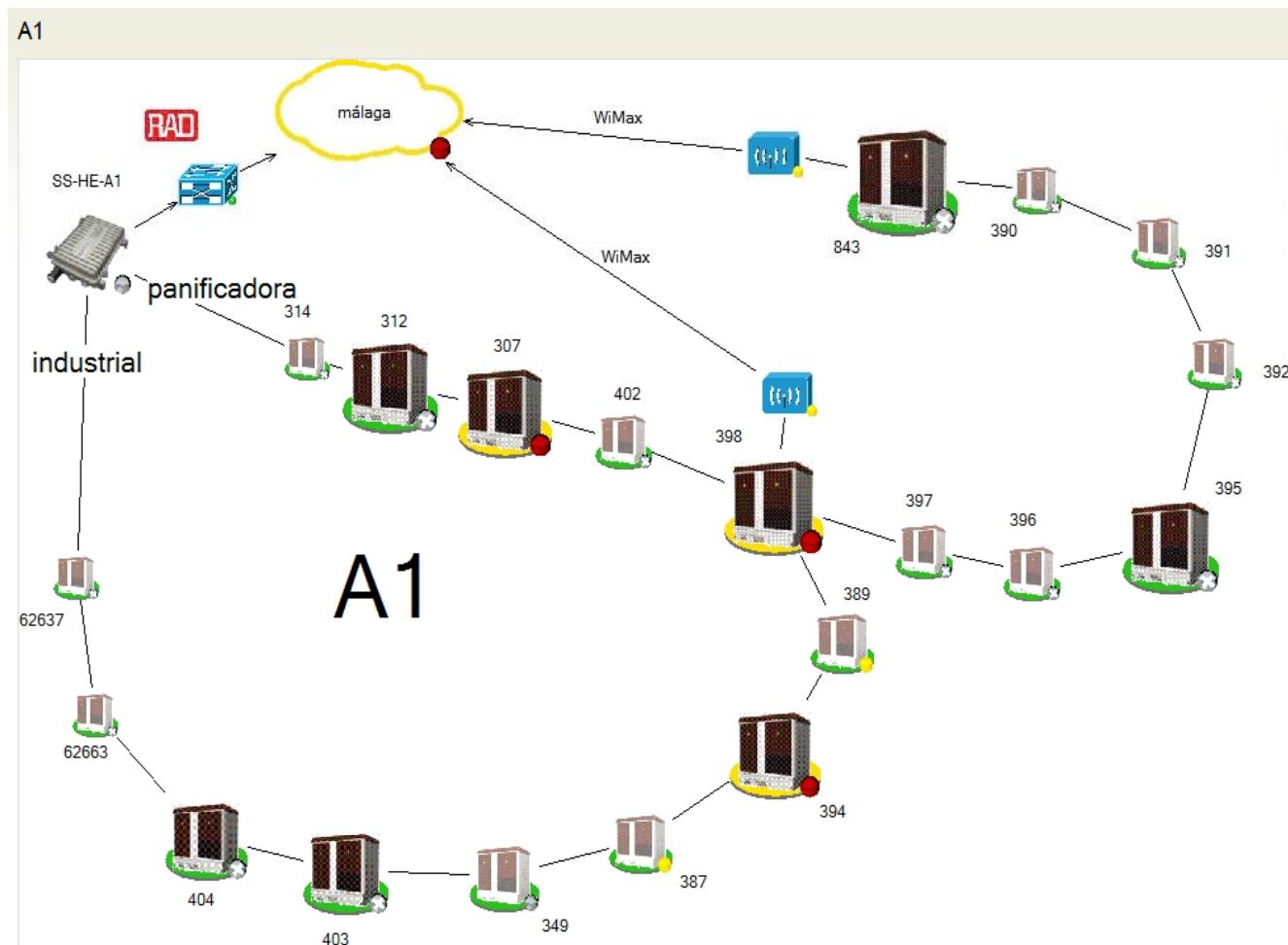
Smart Grid ICT

Flexible, adaptative, reliable Information and Communication Technologies are the basis for Smart Grids



Smart Grid ICT

Flexible, adaptative, reliable Information and Communication Technologies are the basis for Smart Grids





Smart Grid ICT

Data management is essential: it is not possible to optimize what is not measured

 Centro de Monitorización y Diagnóstico de Distribución

Elemento Eléctrico		Tipo de Señal										
Territorio	Cataluña	Naturaleza										
Ámbito		Origen										
		Magnitud										
		Obtención										
		Agregación										
Filtro Actual	S:MT:"74230"	Área de Trabajo										
Aplicar Filtro												
Elemento	Tipo	Ident. BDE	Naturaleza	Org.	Magnitud	Obt.						
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S_SEBAST/20/TORREMOLINOS/7423	CD	2790067465	M	SMCT	Temperatura ambiente	M						
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POLIGONO/20/PATO-2/74230/17	IS	13023350345	M	SMCT	Potencia activa	M						
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POLIGONO/20/PATO-2/74230/27	IS	13023350335	M	S	Tension	M						
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POLIGONO/20/PATO-2/74230/57	IS	13023350323	M	S	Tension	M						
POLIGONO/20/PATO-2/74230/57	IS	13023350323	M	S	Intensidad	T						
POLIGONO/20/PATO-2/74230/57	IS	13023350323	M	SMCT	Potencia activa	M						
POLIGONO/20/PATO-2/74230/57	IS	13023350323	M	SMCT	Potencia reactiva	M						

Centro de Monitorización y Diagnóstico de Distribución

Señales

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2 2790067469

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MAX MIN

Cerrar



light · gas · people

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