

# Italy's Smart Grid Programmes and Projects

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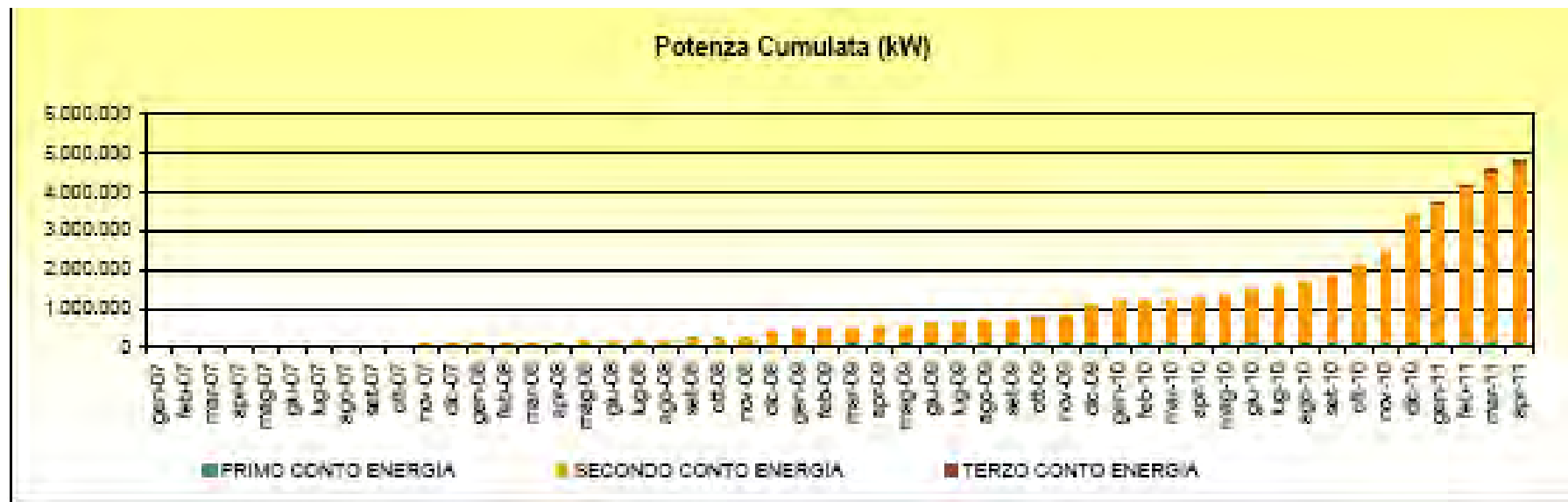
# Italy present situation on smart grids

- 33 million smart meters in operation
  - 331 million regular monthly/bimonthly readings
  - 5 million spot readings
  - 12 million load profiles
  - 2 million remote contract activation and termination operations
  - 11 million remote contractual change operations
- 100.000 MV substations remotely controlled (automatic fault clearing procedures)
- Optimization of asset management policies based on a GIS census of network assets
- Database of network events (power outage notification, fault detection, etc.)
- Optimization of network investments based on a risk analysis.



# Italy present situation on smart grids

- National incentives (feed-in tariffs) for RES is motivating new investments in generation both bulk and DG:
  - Requests for 50 GW of renewables connections on Distribution Networks + 100 GW on transmission networks (note Italian peak load for 2010: 54 GW !!)
  - 15% of HV/MV substations observe reverse power flow

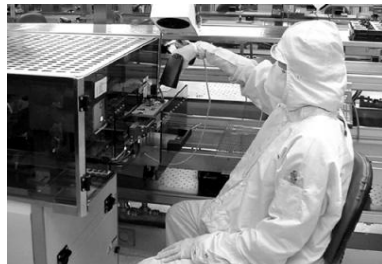
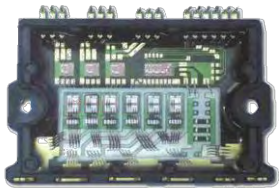


Total cumulated power of PV plants in operation at end April 2011 – (source GSE)

# Italy present situation on smart grids

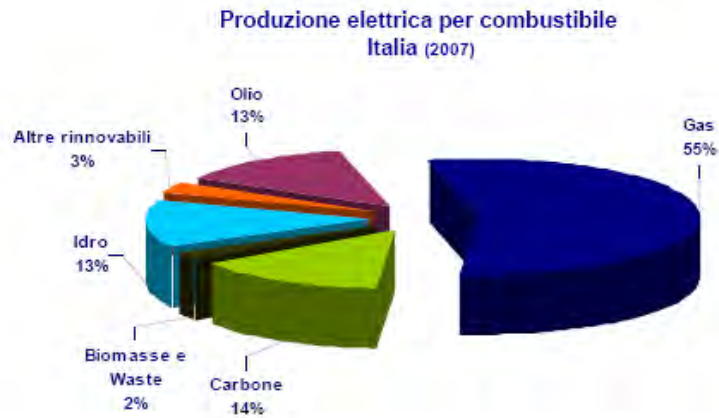


- Medium and small size industry developing and proposing advanced or breakthrough technologies: power electronics, DMS, small storage, DG control, ICT solutions
- Regulator allowing for incentives to smart grids innovation pilots
- Public funds for R&D on the electrical system
- Public research centers and universities active in house and internationally



# Italy's challenges

- The energy mix is still unbalanced toward fossil fuels (gas, coal and oil), mostly imported;
- In order to fulfill the European engagement of reduction the carbon footprint pathways are necessary:
  - Energy portfolio (e.g. RES integration)
  - Energy efficiency
  - Electric mobility
  - System modernization resolving bottlenecks and zonal prices unbalances
  - Interconnections with neighboring countries



# The smartgrids priorities



**LARGE SCALE INTEGRATION OF RES:**  
Demonstration project involving at least 1000 prosumers:

- Network design rules
- Optimised network operation
- Impact of power electronics and standardised ICT solutions

**ACTIVE DEMAND:**  
Demonstration project involving at least 50.000 users:

- Provide clients with information about their electric consumption
- Enable energy efficiency
- Development for future home area network



# The smartgrids priorities



## ICT INFRASTRUCTURES:

Demonstration project involving at least 3 cities – 200.000 users:

- Distributed Broadband IP
- SCADA management



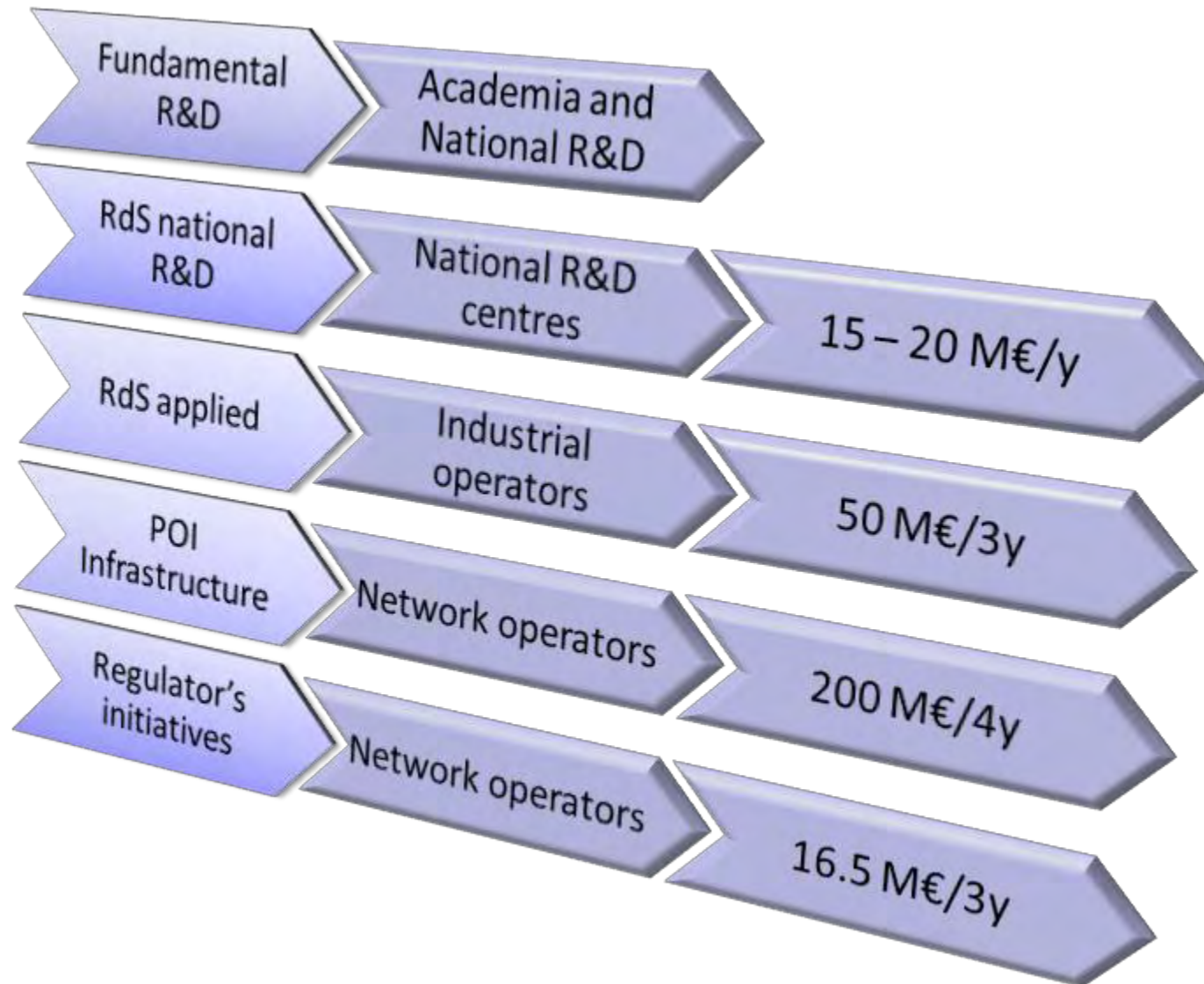
## E-MOBILITY:

Demonstration project involving at least 3 cities:

- Demonstrate the technology and the sustainability of the e-mobility
- Validate the approach related to the vehicle re-charging
- Check the impact of the e-mobility on the electrical system
- Demonstrate the business case and the public acceptance

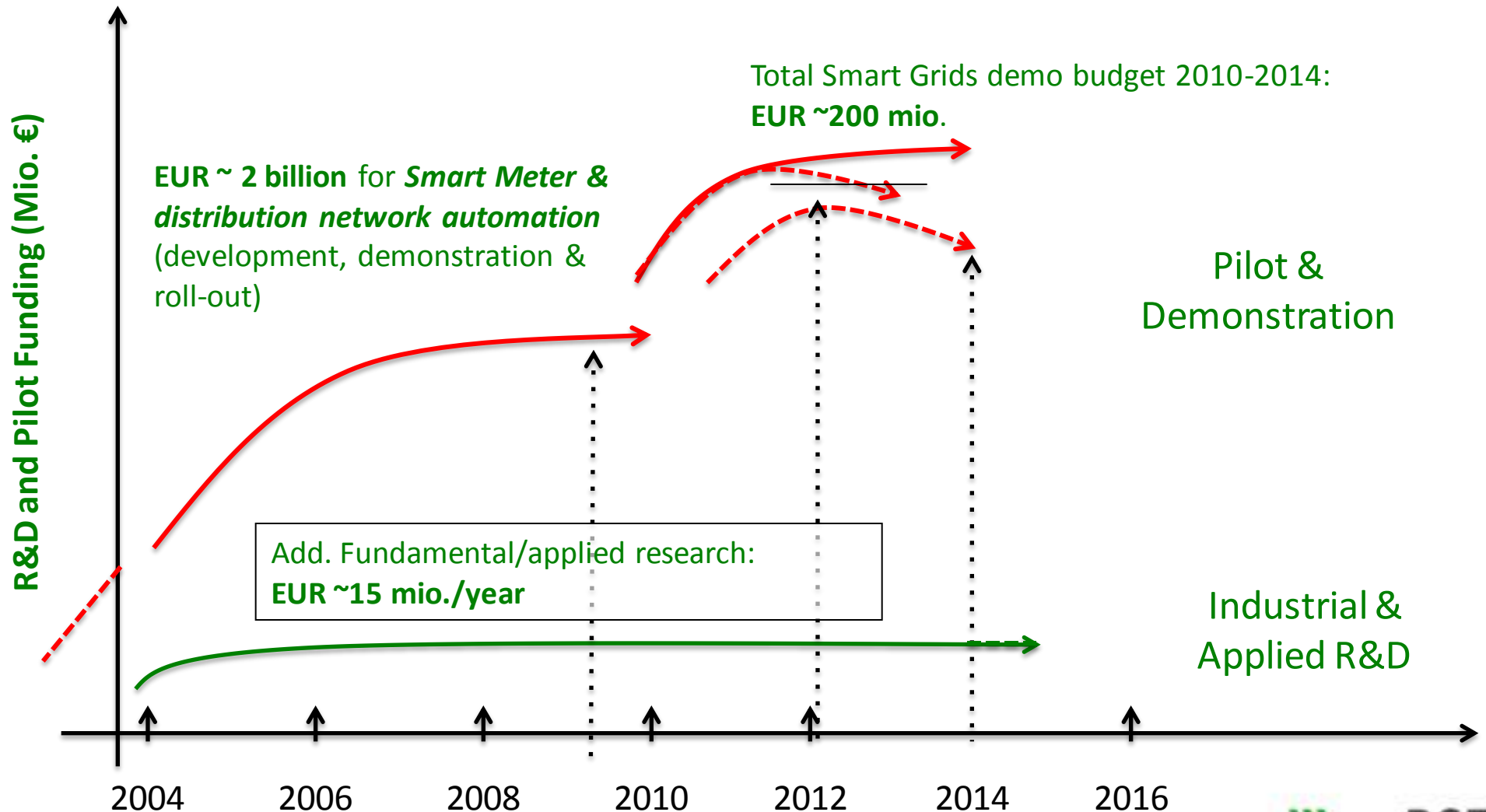


# The smartgrids RD&D funding mechanisms





# The timeline of RD&D



# Italy's smart grids programs: RdS

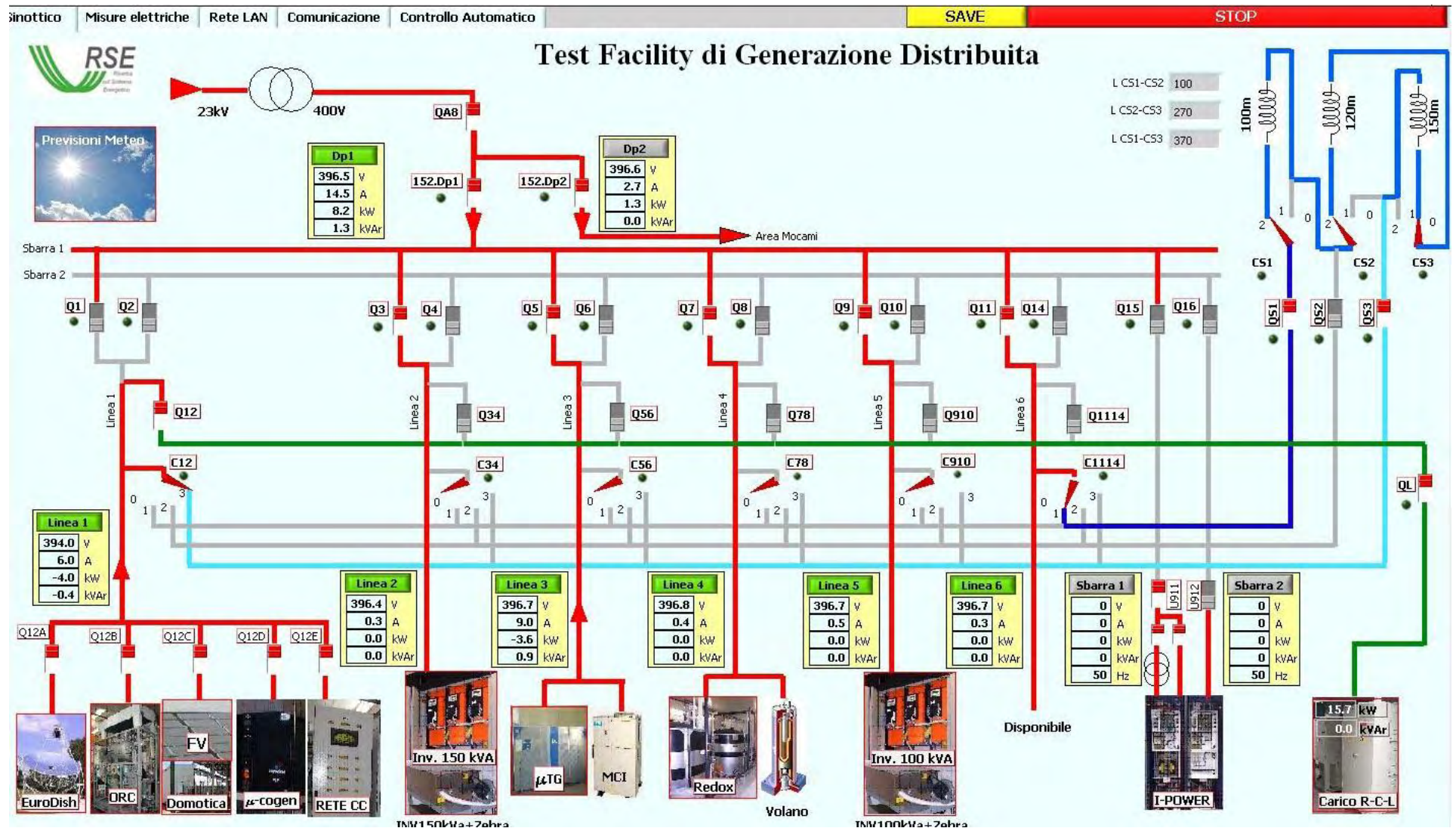


- 15-20 M€ dedicated to smart grids R&D
- Scenarios for the development of the Italian network;
- Active networks: costs and benefits;
- Control systems and tools of active networks;
- Interconnections with neighbouring countries;
- Security of the infrastructures;
- Power quality issues;
- Technologies and components: power electronics, ICT and protocols, HTS applications, metering;
- E-mobility;



Funding scheme based on a fee on the electricity bill of each customer, dedicated to national strategic research activities in the field of the electricity system. Activities regulated according to the Decree of the Ministry of Industry, trade and handicraft dated 8 March 2006

# RSE: DG test facility – a pilot plant for smart grids



# RSE: DG test facility – a pilot plant for smart grids

PV



Gas engine



Biomass



Microturbine



Storage



Fuel cells



Stirling motor

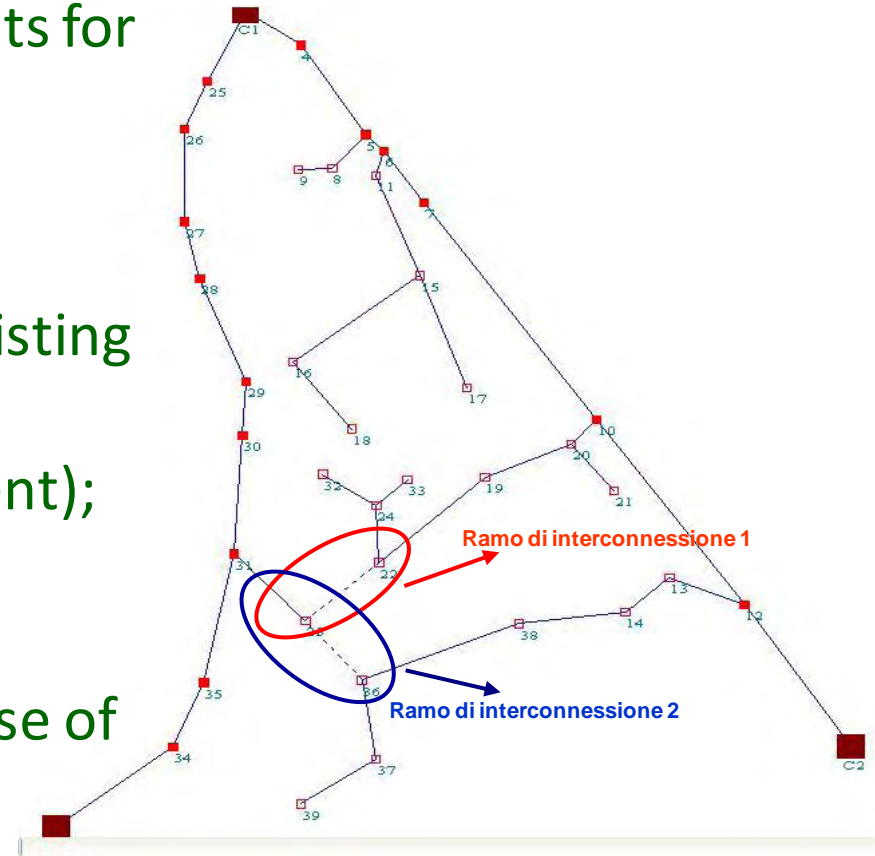


Solar thermal



# RES integration: system planning with DG

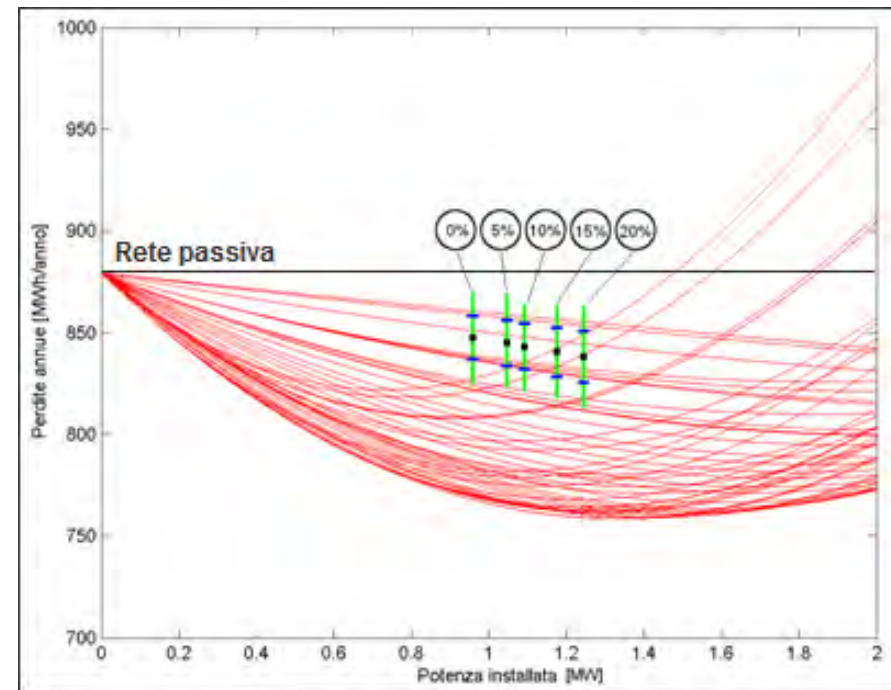
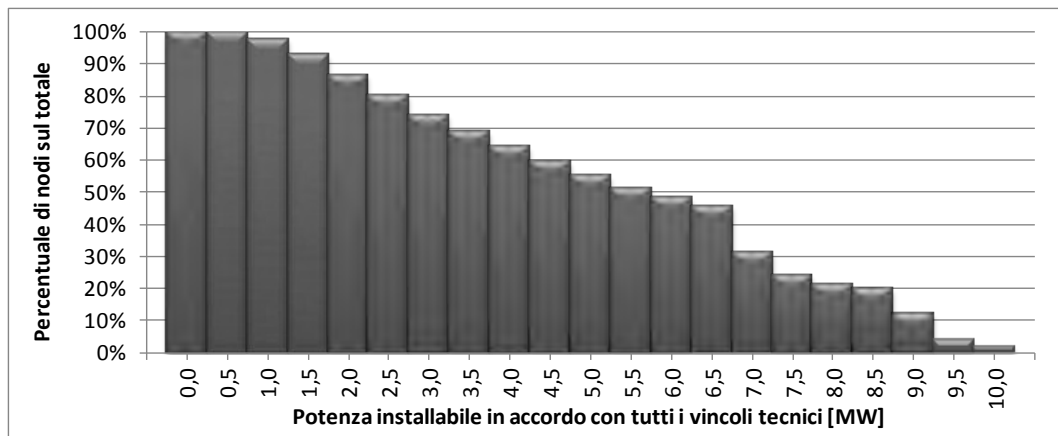
- SPREAD calculates the best network configuration minimising the overall costs for the distributor (CAPEX + OPEX);
- Costs categories considered:
  - Network investments (upgrade of existing lines, transformers, switchgears and installation of new network equipment);
  - Minimise network losses in lines and transformers;
  - Minimise non-delivered energy in case of unplanned unavailability;
  - Optimise active management (remunerating ancillary services)



# RES integration: hosting capacity

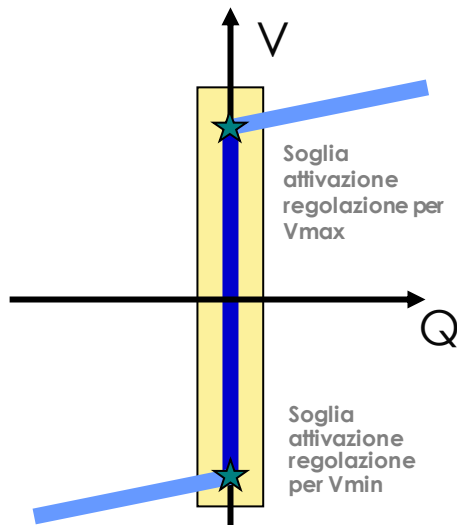
Considering real distribution networks (MV and LV) to assess the maximum ratings of DG which can be connected without violating PQ and equipment limits thresholds (voltage and current)

The models for the DG simulate the real generation profile of the generation technology considered

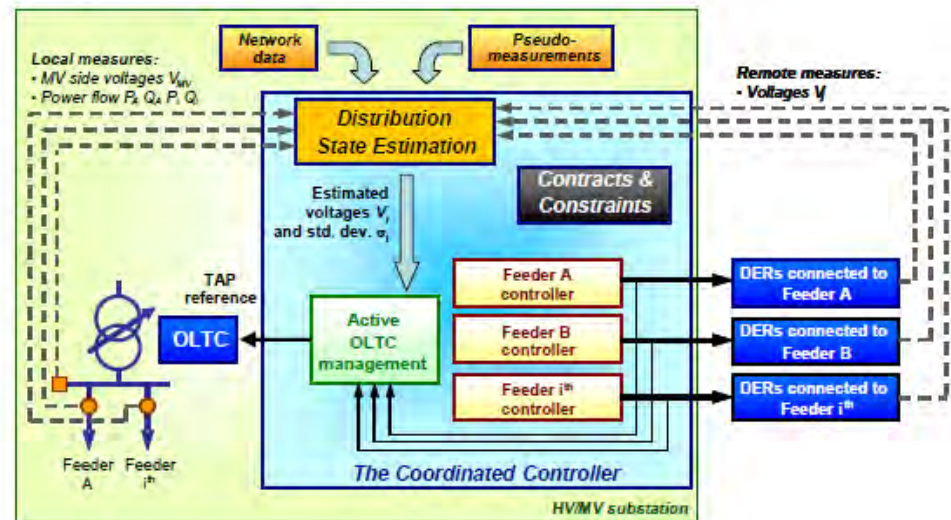


# RES integration: distribution system control

- Distribution system control in presence of DG, acting on generators set points to tune the voltage profile in the network



- Local control installed on the generator



- Central supervision and control, installed in a primary substation and managing also the DG connected to the feeders

# RES integration: power quality issues



If not correctly managed DG can give rise to voltage disturbances such as:

- Voltage variations and unbalance
- Voltage dips
- Voltage Swells
- Interruptions
- Rapid Voltage Variations
- Flicker
- Voltage Harmonics, THDv

The monitoring system consists of 600 measurement units (MU):

- 400 in primary substations statistically representative of the network characteristics
- 200 at the Customers delivery points along the MV lines (owned by MV Customers and DSOs)

Italiano

- DATA SINCE JANUARY 2009
- DATA OF YEARS 2006÷2008
- AGGREGATED VOLTAGE DIPS 2006÷2008

**QUEEN**  
Qualità dell'Energia Elettrica

CONTACT

## The Italian system for power quality monitoring of MV distribution networks

**QUEEN** is the web site of the "Ricerca di Sistema" to get access and examine the results database of the ongoing monitoring campaign of power quality on MV distribution networks in Italy.

The monitoring system has been performing PQ measurements since 2006 but from today onwards a new web site QUEEN is daily working. Among its main innovations we have to mention:

- the system updating in accordance with the most recent developments in standards dealing with voltage characteristics in distribution networks
- the monitoring extension to new kinds of voltage events (overvoltages or swells)
- the availability of an English version of the portal

At the moment the new QUEEN allows a free access to power quality data starting from January 2009, by selecting the following option:

- DATA SINCE JANUARY 2009

The old web site QUEEN is still working in the meanwhile to get access to PQ historical data occurred during the three years period 2006÷2008, by selecting the option:

- DATA OF YEARS 2006÷2008



# RES integration: storage

- Characterising Lithium batteries (High energy and high power Li-ion, Li-po)
- Assessment of the Battery Monitoring System performances
- Behaviour under extreme conditions and ageing



# Demand participation: smart meters

- Second generation energy meters:
  - Bi- directional communication
  - Open communication protocols
  - Multimetering capabilities
  - Opening to multiple actors to enhance the market efficiency



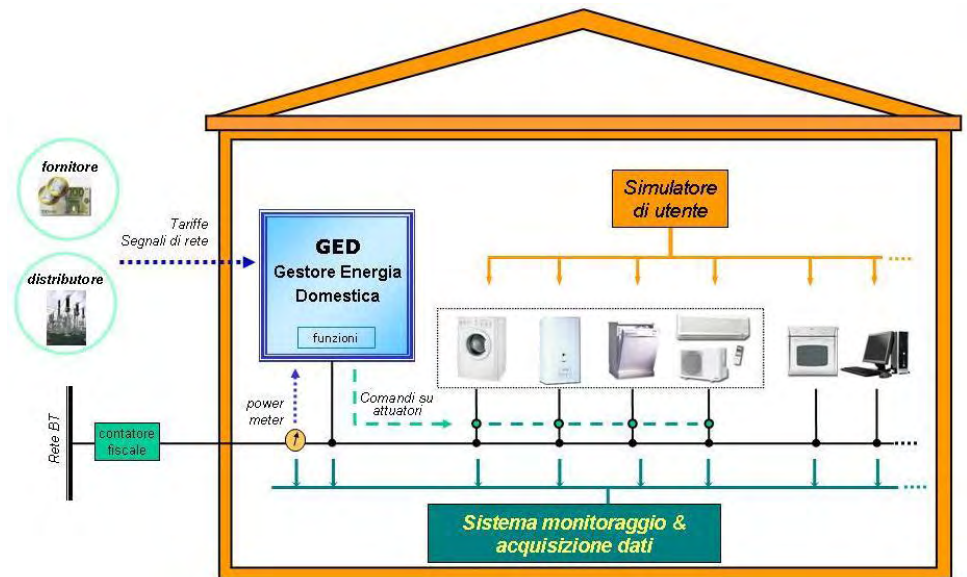
# Demand participation: home energy management

## Local Energy & Power Manager

- Combines signals received from DSOs (network signals), retailers (tariffs) and user preferences to manage power flowing “to” and “from” the network within limits that may even change every hour.

## Display for Energy Savings

- Consumption and cost curves
- Simplest but effective possibility to improve use of energy (increase of awareness)
- Easy installation even in existing buildings



# E-mobility



Mobility scenario

Electrical system development

Air quality and emissions

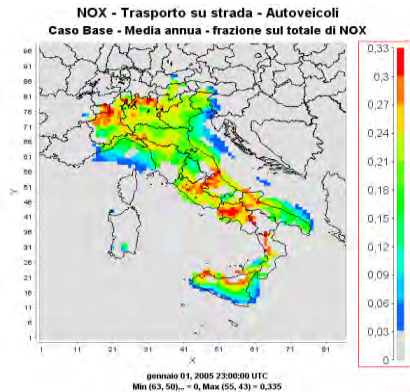
Environmental impact

Regulation and standards

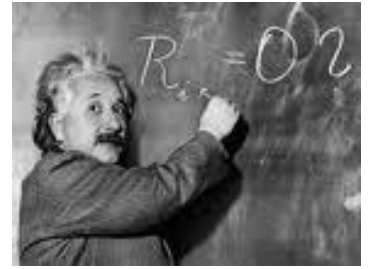
Impact on networks

Technology

Consumer engagement



# Breakthrough technologies



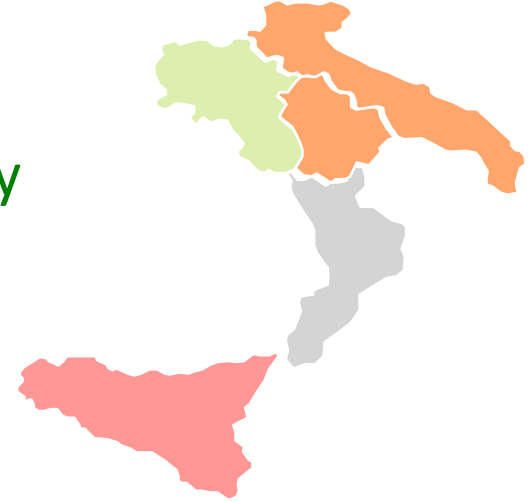
## Italian breakthrough technological initiatives:

- Smart meters and related communication technologies
- Universal DC-AC interfaces for active distribution systems (inverter controls)
- Electrical storage management systems
- DMS – Distribution Management Systems with protection and control
- Virtual Power Plant control
- Power electronics



# The programmes: the POI schemes - framework

- The Inter Regional Operative Program – POI was approved by the EC in December 2007 [C(2007) 6820] with the aim to: “Increase the ratio of load supplied by renewables and the energy efficiency, promoting the local development opportunities in four Italian Southern regions: Campania, Puglia, Calabria, Sicilia.”
- ENEL Distribuzione signed an agreement with the Ministry of Economic Development (25/1/2010) for the development of intelligent MV networks
- Two projects are active today:
  - POI 1 – 77 M€
  - POI 2 – 123 M€



# The programmes: the POI schemes - objectives

- Enable the integration of distributed generation in the distribution network, demonstrating on several test sites the evolution of the network towards a passive/active management mix.
- The program practically aims at transforming the MV network structure to host PV plants 100 kW – 1 MW;
- The present MV network has already a certain level of DG hosting capacity; the program aims at increasing this factor (in terms of number and rating) assuring the compliance to all power quality and system availability requirements



# The programmes: the POI schemes - structure

The Programme is structured over 4 regional projects (one per region considered), each consisting of 5 Tasks:

- **P0 - Site preparation**
- **P1 – Reducing the effects of MV faults on DG generators:** development of ICT solutions to point out network portions subject to failures to reduce DG outage
- **P2 – DG Dispatching:** automatic and remote disconnection of DG in case of network perturbations – anti-islanding protections
- **P3 – Advanced voltage regulation:** allowing the voltage regulation on all MV nodes in presence of DG
- **P4 – MV networks managed in meshed configurations**

	Importi in M€	PROGETTI				TOTALE PROGRAMMA
		Progetto CAMPANIA	Progetto CALABRIA	Progetto SICILIA	Progetto PUGLIA	
Sotto Progetto	Site Preparation	7,9	7,7	14,2	2,0	31,8
	P1	6,0	3,9	5,0	2,0	16,9
	P2	0,4	0,3	1,5	4,5	6,7
	P3	0,7	0,7	1,4	1,2	4,0
	P4	6,4	3,4	4,8	3,0	17,6
	TOT PROGETTI	21,4	16,0	26,9	12,7	77,0





# The instruments set up by the Italian Regulator - aims

ARG/ELT 39/10 25/3/2010: Incentives for smart grids investments of Distribution companies.

- Pilot projects on MV active distribution networks with RES/storage including HV/MV substations featuring innovative solutions for monitoring, control and automation of MV network;
- Key Performance Indicators:
  - Number of real points of DG
  - Quantity/quality of electricity distributed + quality i
  - Increase of DG
  - Degree of active involvement of customers and storage systems in the project



# The programmes: the pilots financed by the Regulator



- 8 projects awarded
- Several regions concerned
- Projects started January 2011 – 3 years demonstration
- Total 16.5 M€ (higher ROI rate)
- Transformation of portions of HV/MV substations and medium voltage network already experiencing reverse energy flux;
- Management of DG (dispatching, protection, supervision, automation, voltage regulation, communication);
- Pre-requisite: high replicability

# Conclusions

As in many other fields, Italy reacts to structural difficulties with creativity and intelligence.



In the case of energy, the enlargement of the national mix to include renewables is a must, together with the energy efficiency measures and the load flexibility.

The geographical topology of the country and the limited margins of the network require intelligent solutions of network modernisation.



Stakeholders are joining forces to facilitate this transformation and to leverage on national competences.

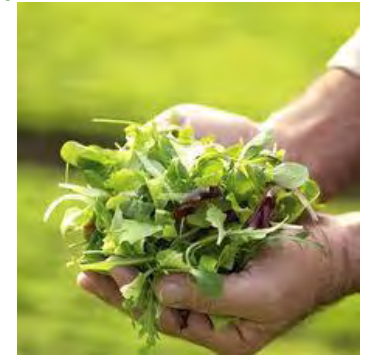
# Conclusions

Synergies and collaboration are made possible between research and operators to facilitate the smartgrids developments and deployment.



Smart grids technologies are demonstrated in the field thanks to national research programs, operators investments and regulatory intelligence.

The results of the pilots and demonstration activities are shared among stakeholders and leverage on national competences .



Italy wants to remain at the forefront of the smart grids developments and applications and will participate actively in all European and worldwide smart grids collaborative efforts.



grazie

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