

**EMA NETWORK**  
**6TH MEETING OF THE EUROPEAN NETWORK OF ENERGY**

**Clean Energy for All Europeans: Specific Regional Initiatives**

**The Sardinian Energy Plan and specific actions for its implementation**



**REGIONE AUTONOMA DELLA SARDEGNA**  
**ASSESSORATO DELL' INDUSTRIA**

**Alfonso Damiano**



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## Outline of the Presentation

- Brief introduction of the Sardinian Energy System
  - Structure of the Energy System
  - Energy Balance
  - Time evolution of CO<sub>2</sub> Emission Inventory in Sardinia
  - Correlation between the CO<sub>2</sub> and the transformation of the Energy System
  - Time evolution of the Energy Demand
  - Time evolution of Electricity Generation
  - Energy District
- The Sardinian Energy Plan
  - Strategy
  - Main Goals
  - Smart Energy System & Energy Storage
- Specific action for its implementation
  - Natural Gas supply chain
  - Smart Grids and Micro grids
  - Electric Mobility



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The Island of Sardinia is located in the center of the Mediterranean sea. It has an area of 24090 km<sup>2</sup> and a population 1 675 411. The position of Sardinia Region in the European Area is highlighted in the picture.

By energy point of view Sardinia is a semi-closed energy system characterized by a significant electricity demand due to presence of metalworking and chemical industries. its electrical interconnection with the main land has been reinforced by a 500+500 MW HVDC cable just in 2005. Before this data the Sardinian Energy System was semi-closed and for this it is particular interesting for analyzing the evolution of the energy system under specific energy policy and for implementing novel energy paradigm.

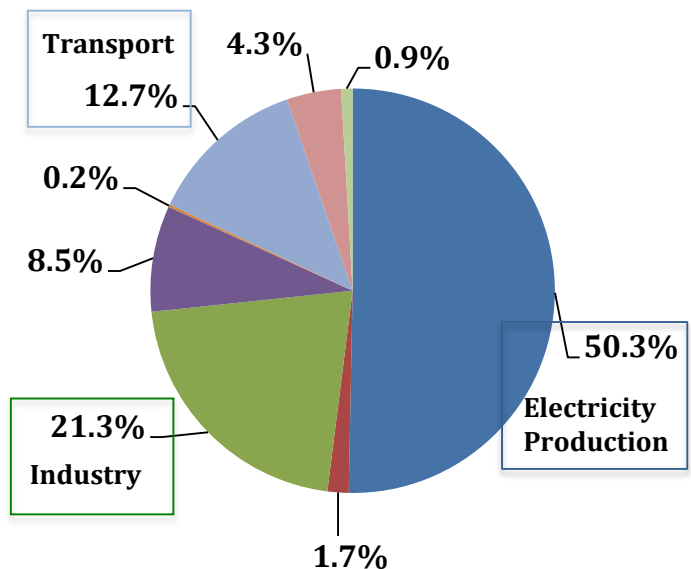




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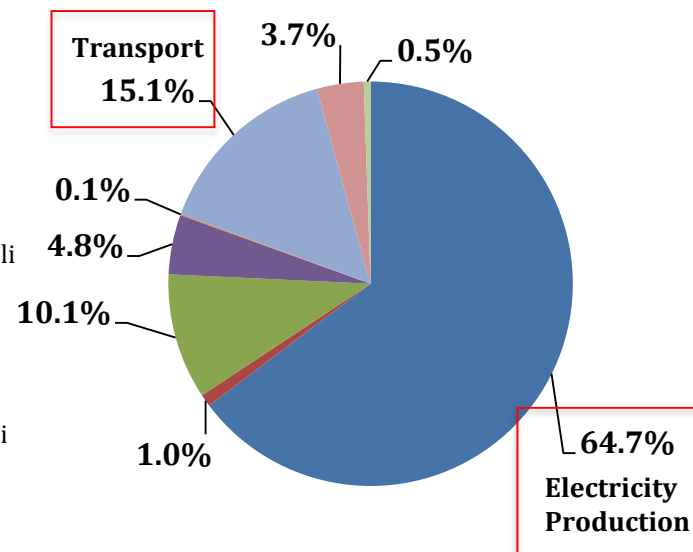
## CO<sub>2</sub> Emission Evolution in SARDINIA

Emission in 1990 – 16 MTON



- Combustione nell'industria e impianti energetici
- Impianti di combustione non industriale
- Processi produttivi (combustione nell'industria manifatturiera)
- Processi produttivi (combustione senza contatto)
- Estrazione e distribuzione di combustibili fossili ed energia geotermica
- Uso di solventi ed altri prodotti
- Trasporti stradali
- Altre sorgenti mobili e macchinari mobili (trasporti fuori strada)
- Trattamento dei rifiuti e discariche

Emission in 2010 – 18,1 MTON





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## CO<sub>2</sub> Emission associated to Energy Demand in Sardinia

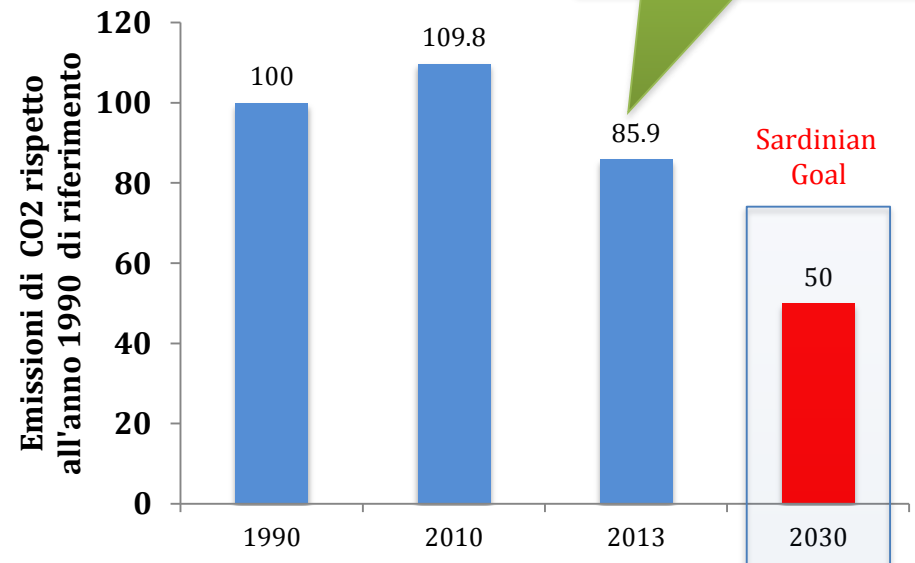
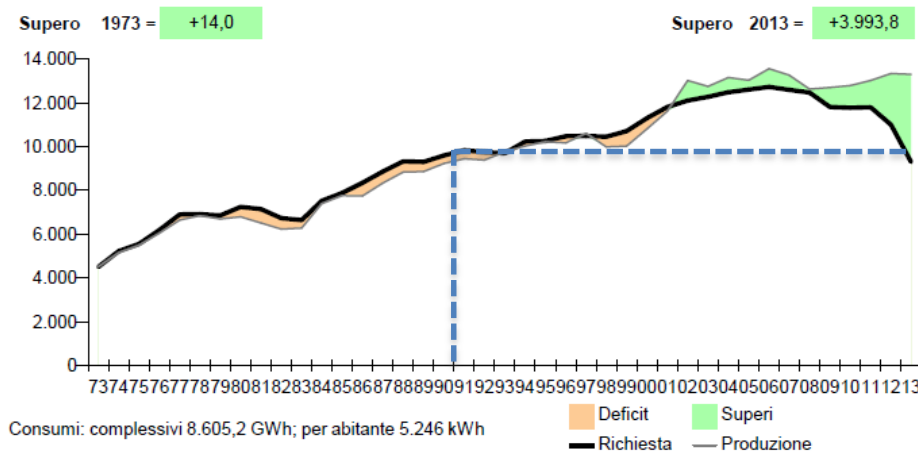
CO<sub>2</sub> in 1990 – 16 MTON (Ref. ISPRA)

CO<sub>2</sub> in 1990 associated to energy demand **16** Mton

CO<sub>2</sub> in 2010 – 18,1 MTON (fonte ISPRA)

CO<sub>2</sub> in 2010 associated to energy demand **17,43** Mton

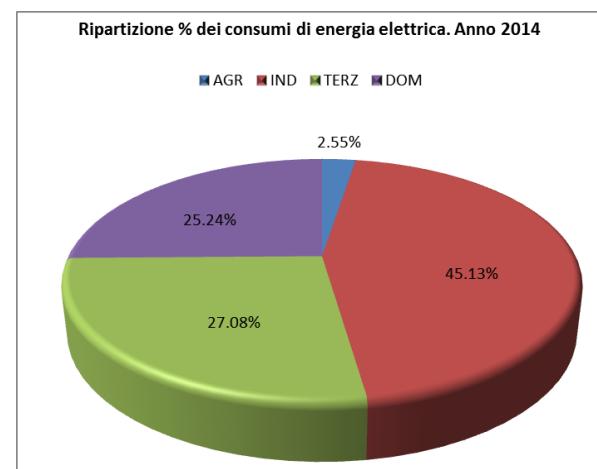
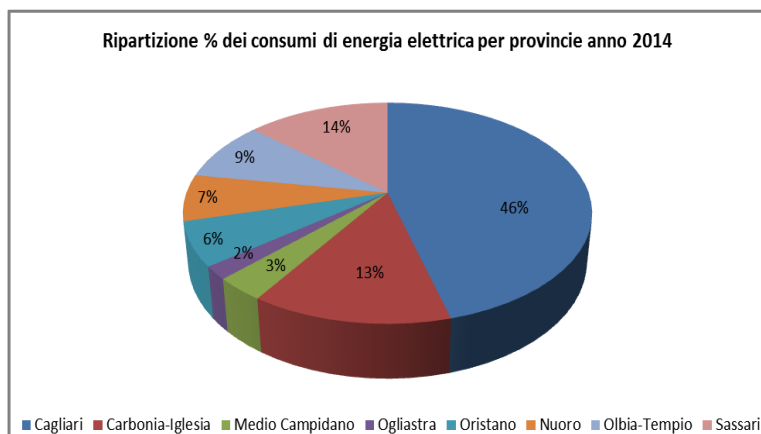
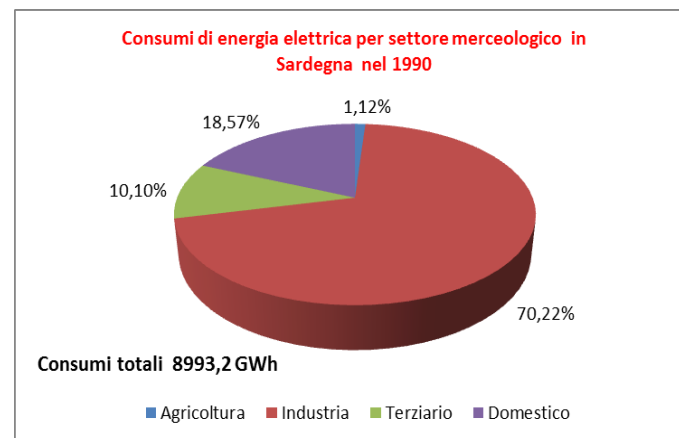
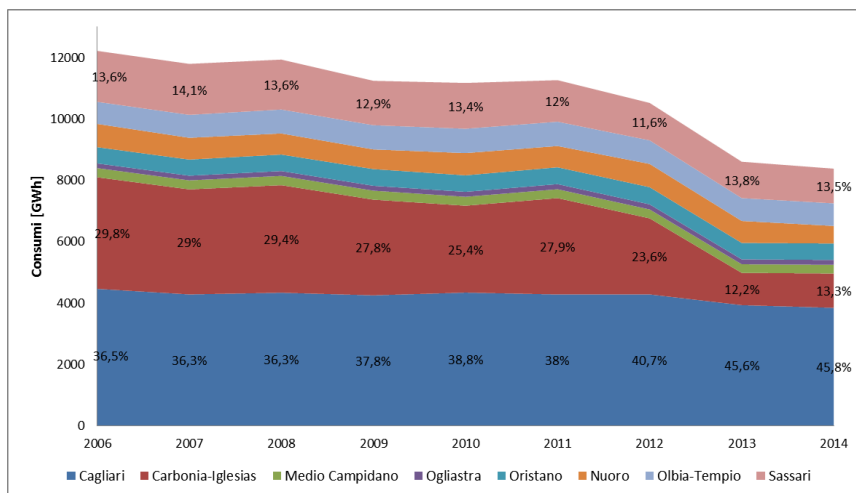
Estimation of CO<sub>2</sub>  
Emission  
associated to  
demand





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## Time Evolution of the Electricity Demand in Sardinia

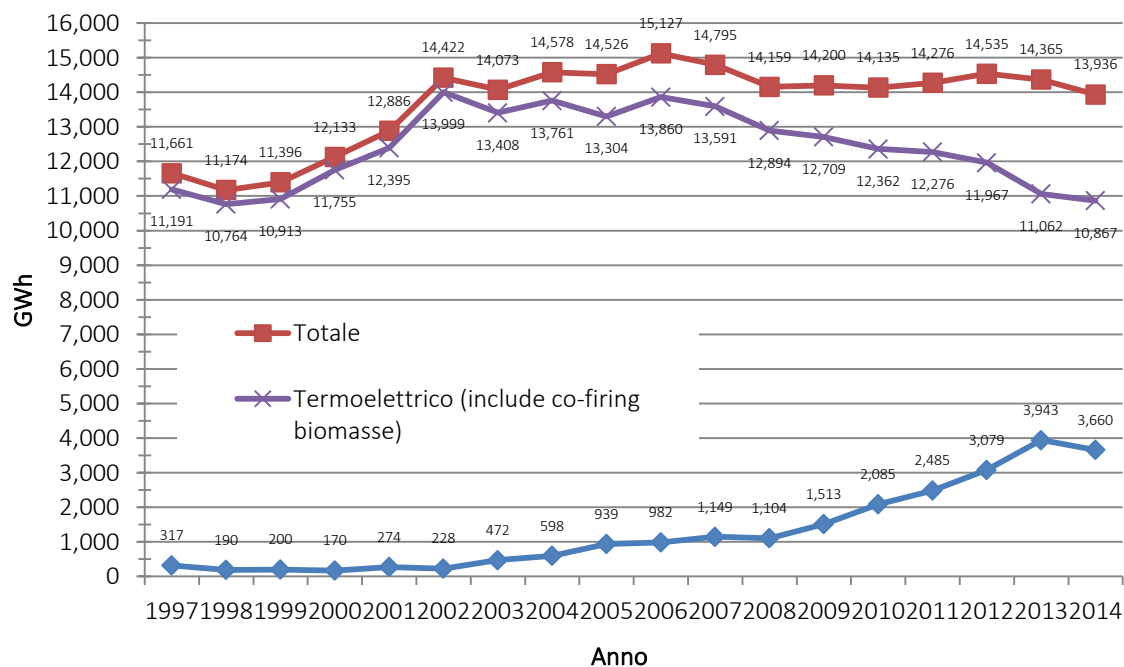




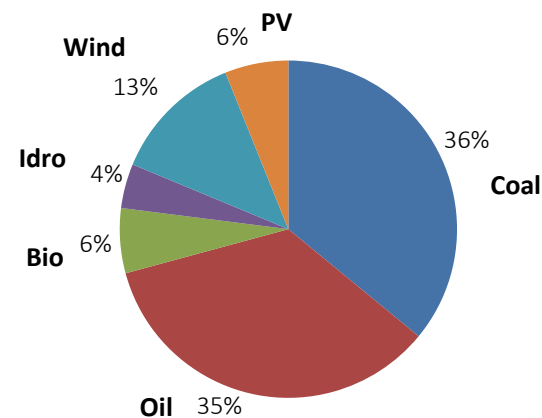
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## Electricity Generation

Gross Electricity production in Sardinia (1997-2014)



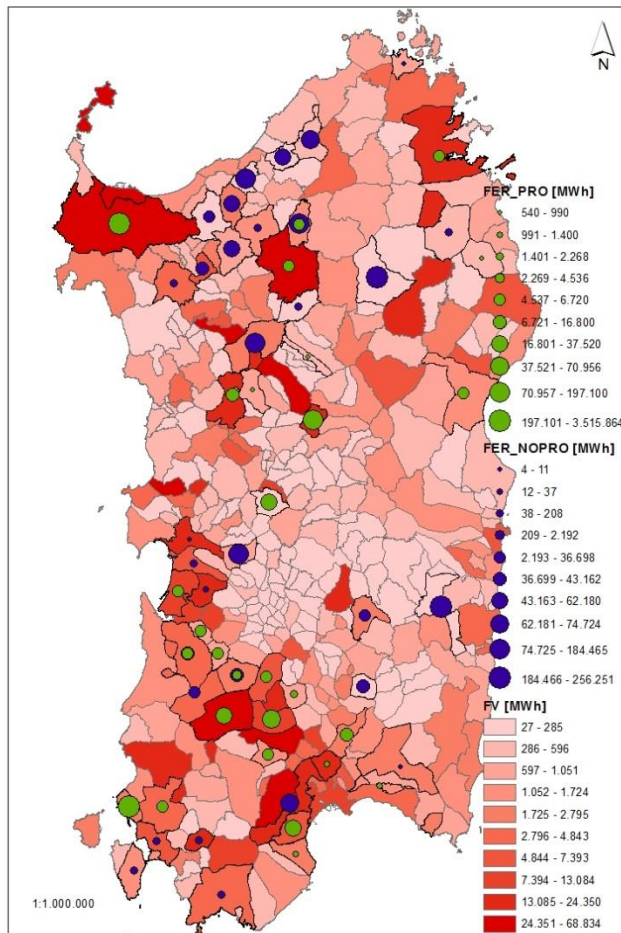
Percentage of electricity generation in 2013  
For different Primary Energy Sources





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## Distributed Generation and Thermal Power plant in Sardinia



### CONSUMI DI E. ELETTRICA PER UNITA' DI SUPERFICIE PER COMUNE

Fiume Santo Sezioni 3 e 4  
active from 1992 e 1993  
2x320 MW

Grazia Deledda  
Sulcis 2  
active from 2005  
350 MW

Ottana  
2 x 70 MW

Sarlux  
active from 2000  
550 MW

CONSUMO PER UNITA' DI SUPERFICIO [MWh/kmq]

Average Net efficiency of thermal power plants in Sardinia 31 %  
Average Net efficiency of thermal power plants in Italy 44,8 % (ISPRA)

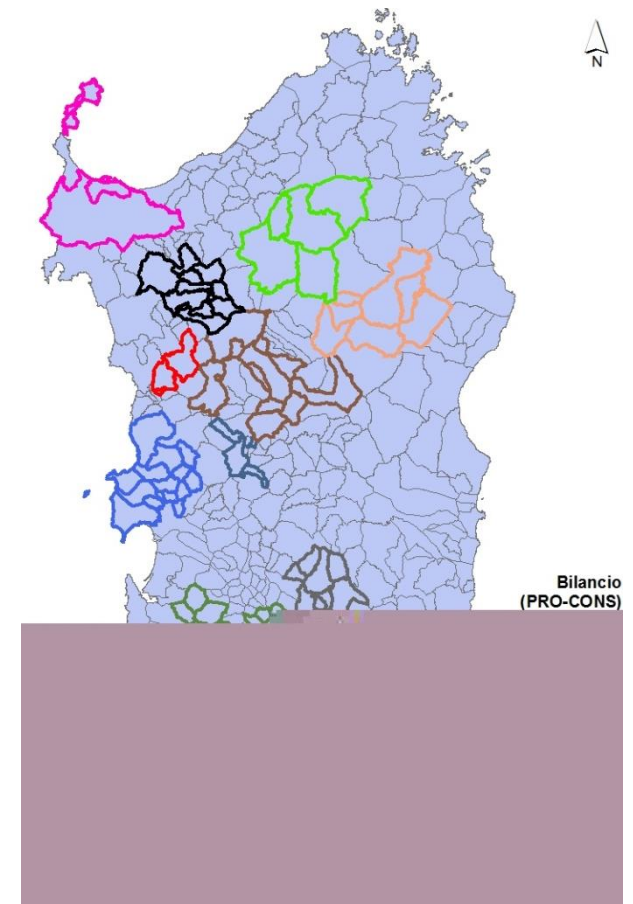
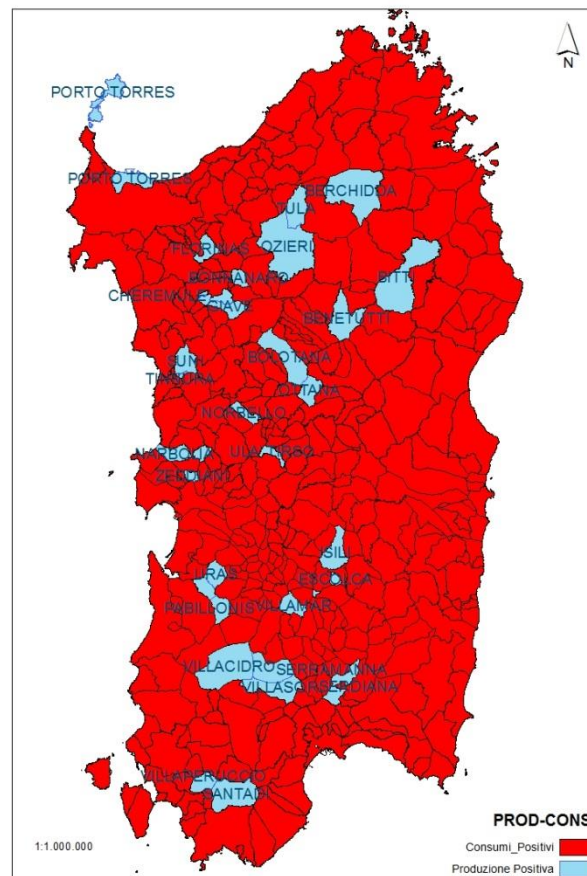




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## Energy Districts

**11 Energy district  
in which there is a  
good matching  
between local  
production and  
demand**





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# **Energy Plan of Sardinian Region**



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## Energy Strategy

- Achievement by 2030 **a reduction in CO<sub>2</sub> emissions**, associated to the demand of residents in Sardinia, equal to **at least 50%** of the values recorded in 1990.
- Development of an **energy system based on the shared and distributed energy concepts**
- Development of an energy model based on **smart grid**
- Development **of a supply chain for Natural Gas in the island**
- Use the **transformation** of the energy system **as an economic and social flywheel**



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## Goals

- **Reduction of CO2 emissions associated to Sardinia energy demand of 50% compared with 1990 values**
- **Transforming the Sardinian energy system into an integrated and intelligent configuration;**
- **Energy security;**
- **Increased efficiency and energy savings;**
- **Promotion of active research and participation in the field of energy.**



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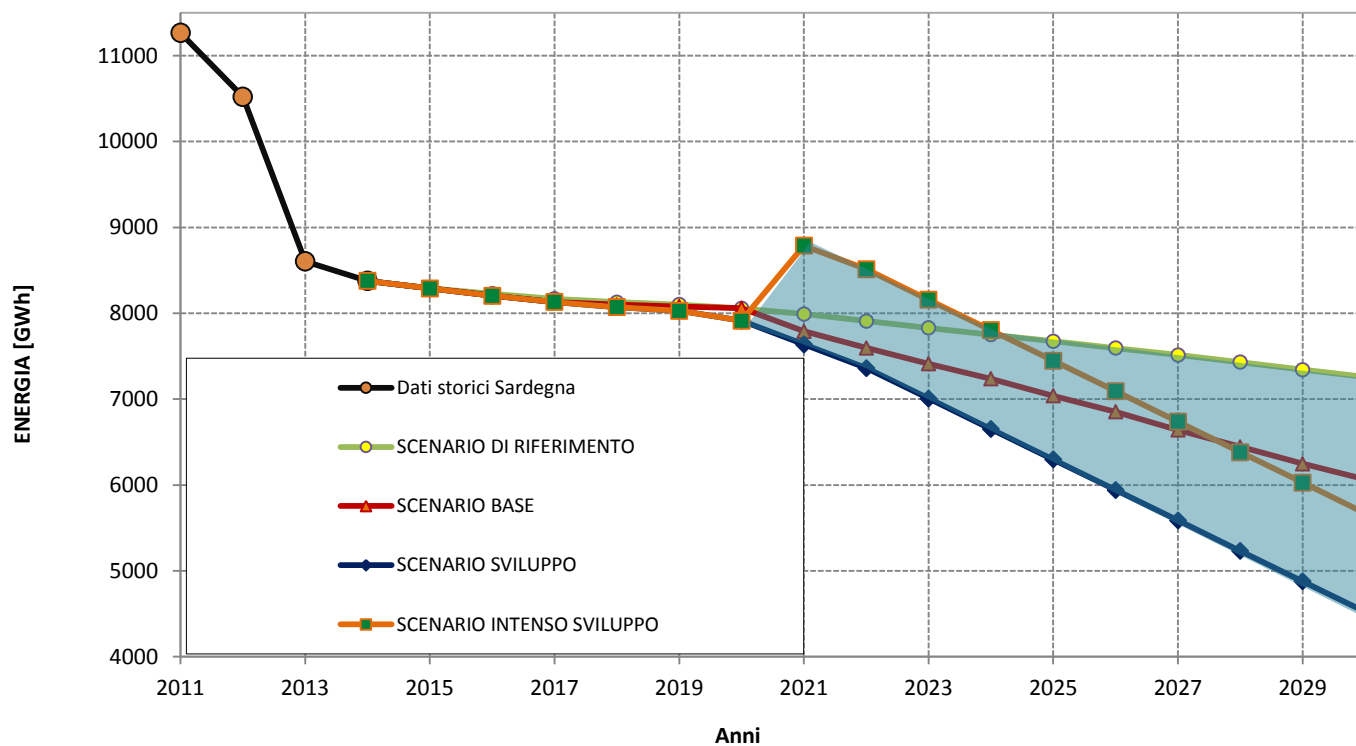
**Assumption and Scenarios for the development of Sardinian Energy Plan 2030**

SCENARIO	CONSUMO DI EE [TWh/ann]	Var. 2014-2030	QUOTA DI AUTOCONSUMO SU PRODUZIONE DA FER	CONSUMO DI EE RESIDUO [TWh/anno]	PRODUZIONE EE DA FER (escluse biomasse e al netto dei pompaggi) [TWh/anno]	POTENZA CTE NECESSARIA PER SODDISFARE LA RICHIESTA REGIONALE DI POTENZA[MW]
BASE	7,2	-14%	1) 50% su produzione FV 2013 -DOMESTICO; 2) 50% su produzione FV 2013 – TERZIARIO; 3) 30% su produzione FV 2013 – INDUSTRIA; 4) 30% su produzione EOLICO 2013 – INDUSTRIA; 5) utilizzo della produzione IDROELETTRICA 2013 a acqua fluente e a bacino per la copertura in autoconsumo del sistema idrico integrato.	6,1	4,93	960
SVILUPPO	7,2	-14%	1) Stesse ipotesi su FER 2013 dello SCENARIO BASE 2) 50% su nuova produzione	4,6	5,93	660-960
INTENSO SVILUPPO INDUSTRIALE	8,35	-0,3%	1) Stesse ipotesi su FER 2013 dello SCENARIO BASE 2) 50% su nuova produzione	5,75	5,93	660-960



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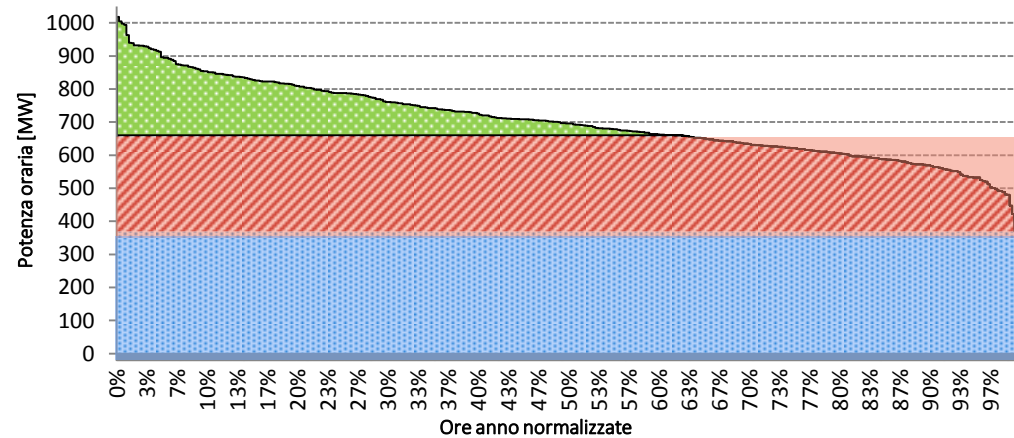
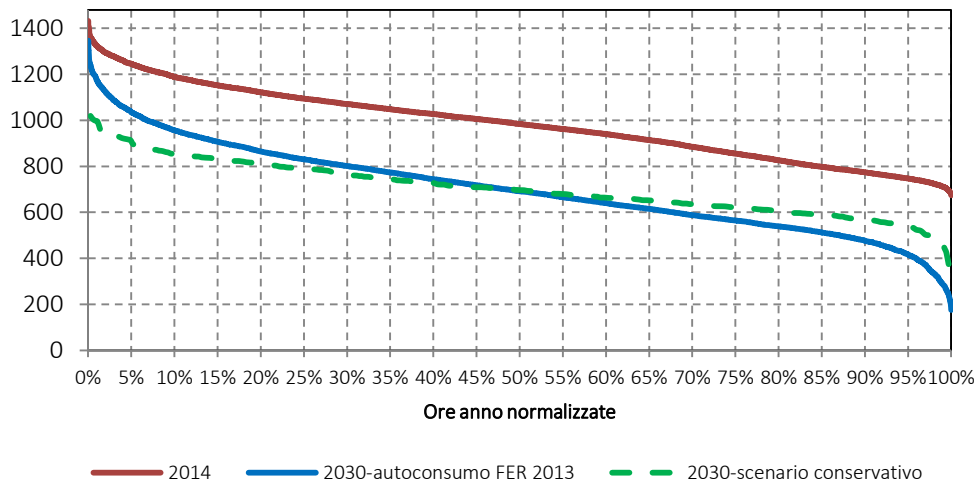
Scenarios of electricity demand evolution observed by main grid





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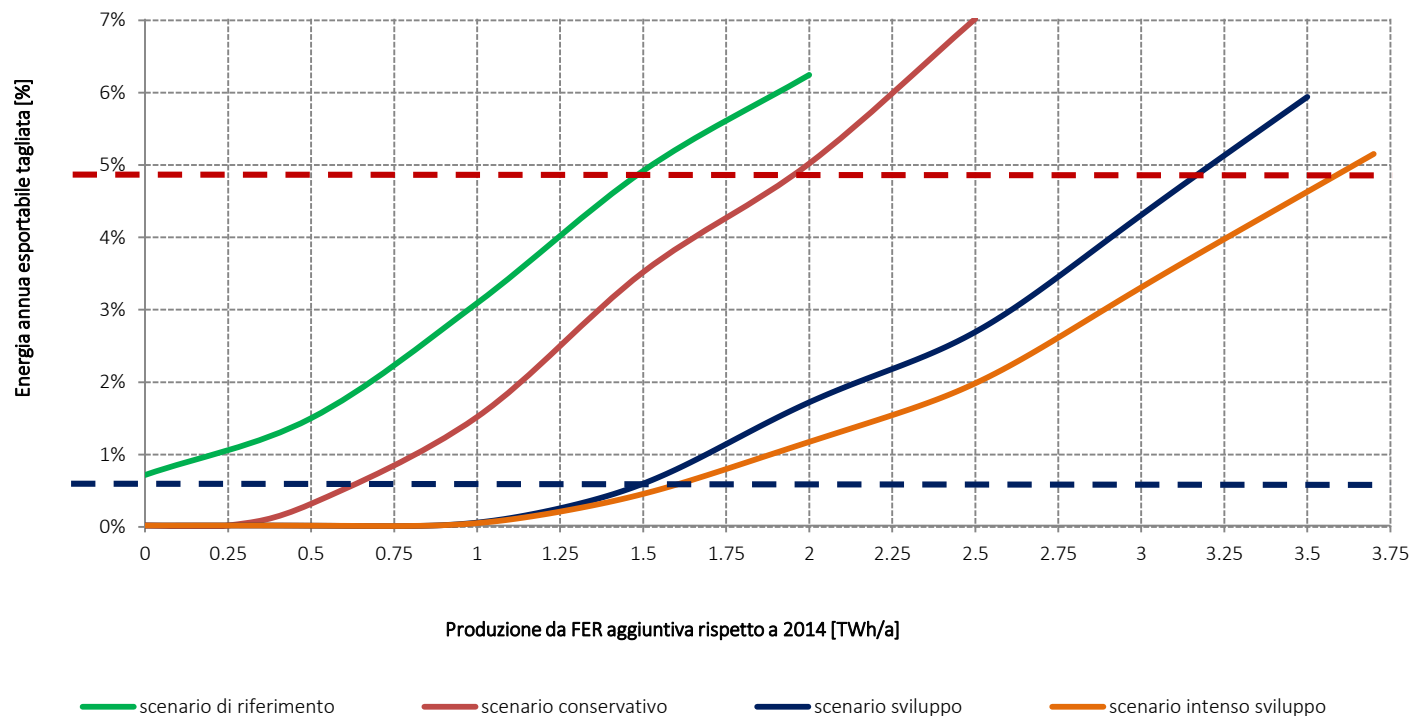
Effect on the Electrical power System of Smart Grid oriented to optimize the self-consumption





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## Effects of Smart Grids for the exploitation of RES in the Sardinian Energy System 2030







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**Specific action for its implementation**



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## Implementation of Smart Grid

The Ottana CSP-CPV pilot plant

The Ottana pilot solar plant enterprise started on 2011 in the framework of the European Regional Development Fund 2007-2013 Sardinia, Axis III Energy

The Ottana pilot solar plant has an overall power of about 1000 kWe and is composed by two distinct sections:

- CSP section of 630 kWe with a two tanks TES system of about 15.2 MWh
- CPV section of about 400 kWe with a molten-salt battery system of about 430 kWh

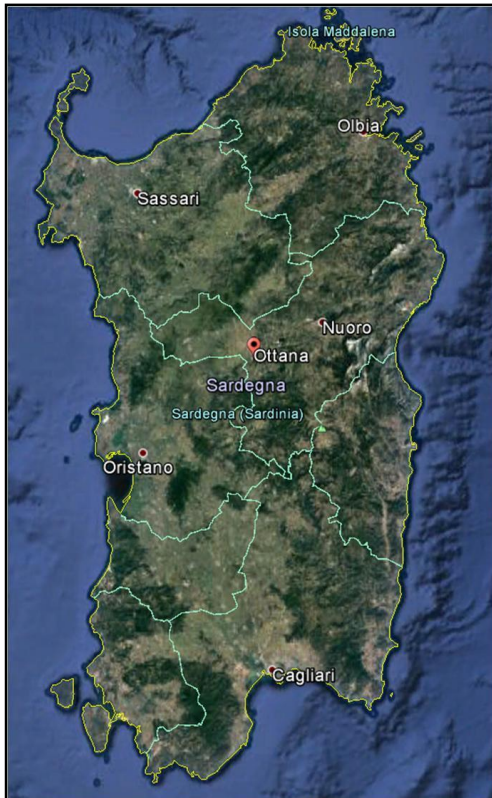
The experimental pilot solar plant is a part of a wider solar park, owned by ENAS, which includes a conventional 4 MW PV plant, in operation, and two new conventional PV plants of 5 MW and 6 MW respectively under construction



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## Implementation of Smart Grid

Geographic location of the Ottana pilot solar plant



Geographic coordinates:  
 $40^{\circ} 14.25 \text{ N} - 8^{\circ} 59.63 \text{ E}$





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## Implementation of Smart Grid

### Aerial view of the Ottana pilot solar plant



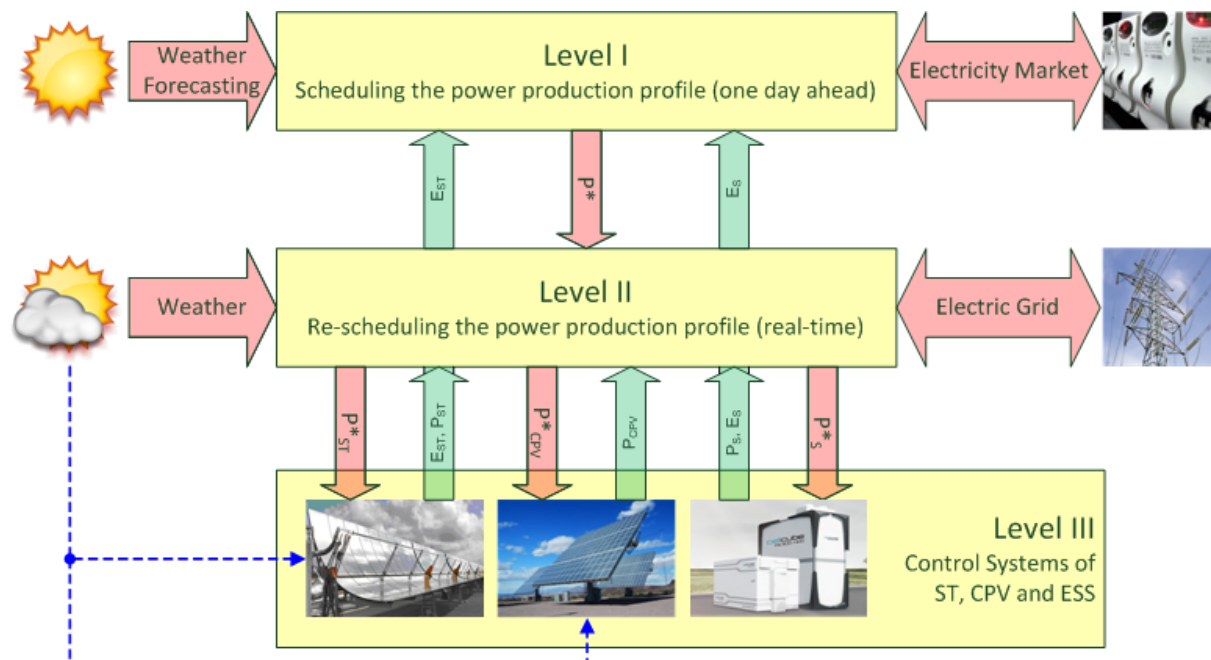




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## Implementation of Smart Grid

### Control Scheme of the proposed ancillary storage system

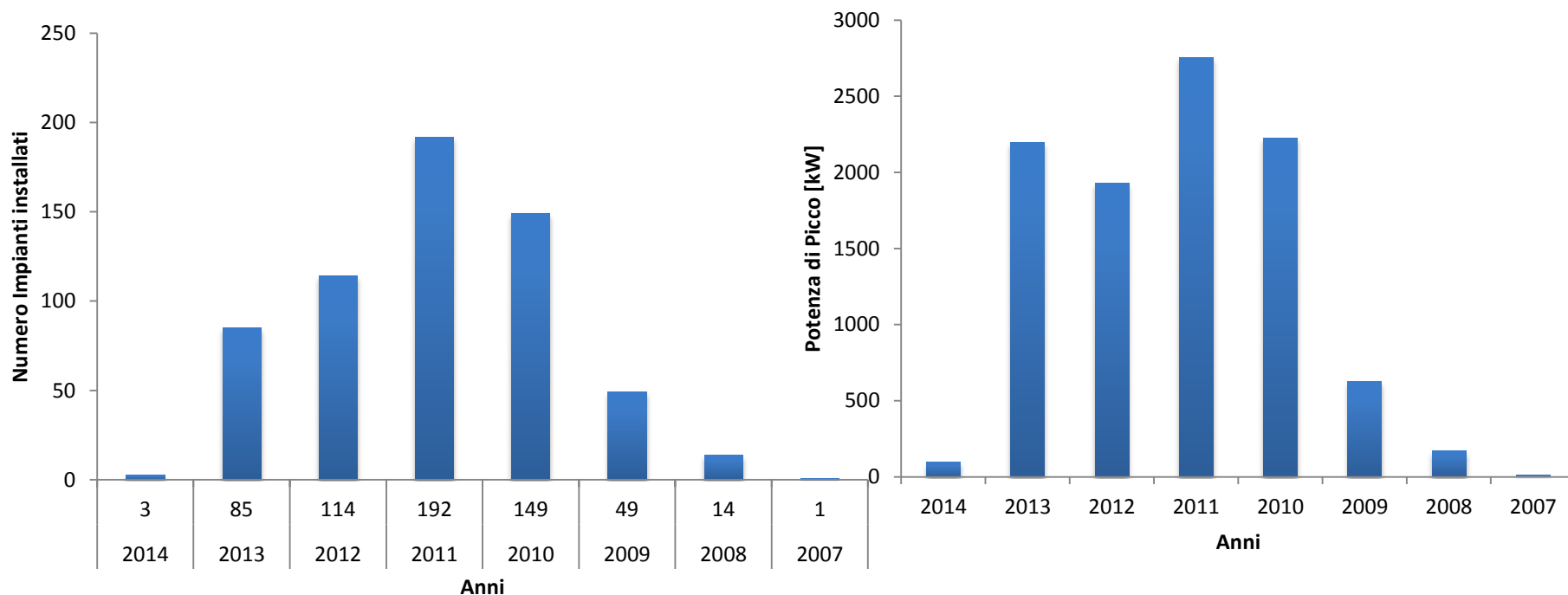




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## Implementation of Micro Grid

Upgrading of PV power plant installed in public building. In Sardinia there are about 600 PV plants with a cumulative power of 10 MW





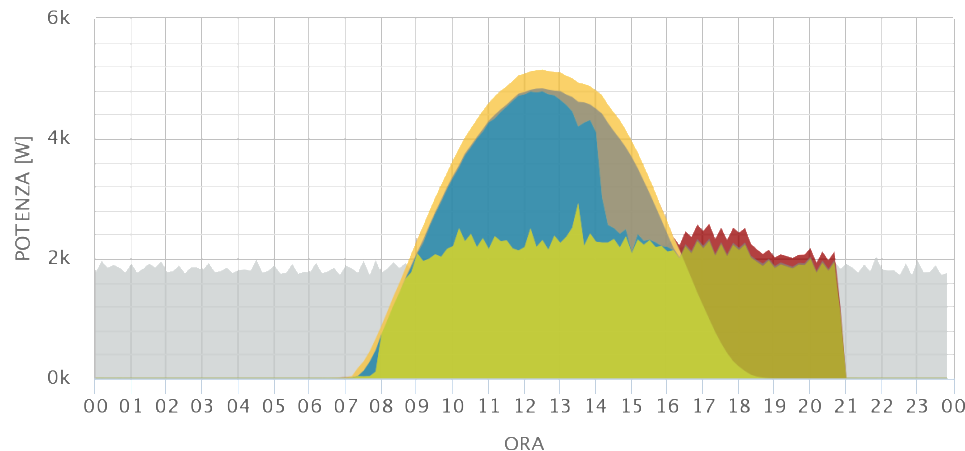
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## Implementation of Micro Grid

Proposal: valorisation of energy use of PV production by means the upgrading of the old PV inverter with a storage system connected in DC oriented to increase the self-consumption to a minimum value of 50%.

### RESOCONTO POTENZA GIORNALIERA

27/02/2017



#### Shockwave

Potenza FV    Charging battery (Power)    Discharging battery (Power)  
Potenza autoconsumo    Consumo domestico (Potenza)    Grid feed-in  
— Potenza AC



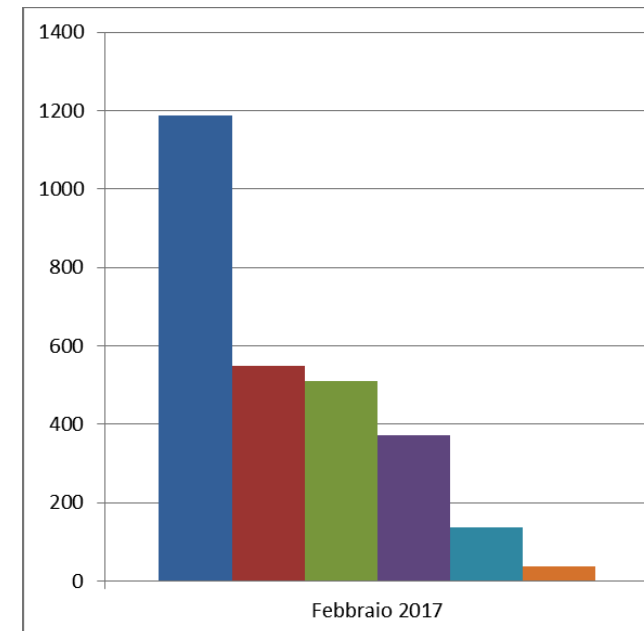
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## Implementation of Micro Grid

### Case of Study

Monitoring results of Feb. 2017

Energy Demand [kWh]	1186,77
PV Energy Production [kWh]	548,61
Self-consumption w/o ESS [kWh]	373,11
Self-consumption provided by ESS [kWh]	137,54
Self-consumption with ESS [kWh]	510,65
Self-consumption respect to production %	93%
Electricity delivered to main grid [kWh]	37,96







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## Implementation of Micro Grid

# Tender for public building which has already installed PV Subsidies 7 M€

Development of the project	09.2016-02.2017	Completed
Presentation of the Tender	03.2017-04.2017	Completed
Public tender of public Administration	05.2017-06.2017	Completed
Analysis of the proposal	07.2017	Completed
Publication of results	07.2017-09.2017	Completed
Transfer of economic resources	08.2017-11.2017	In progress
Project presentation deadlin	10.2017-12.2017	In Progress

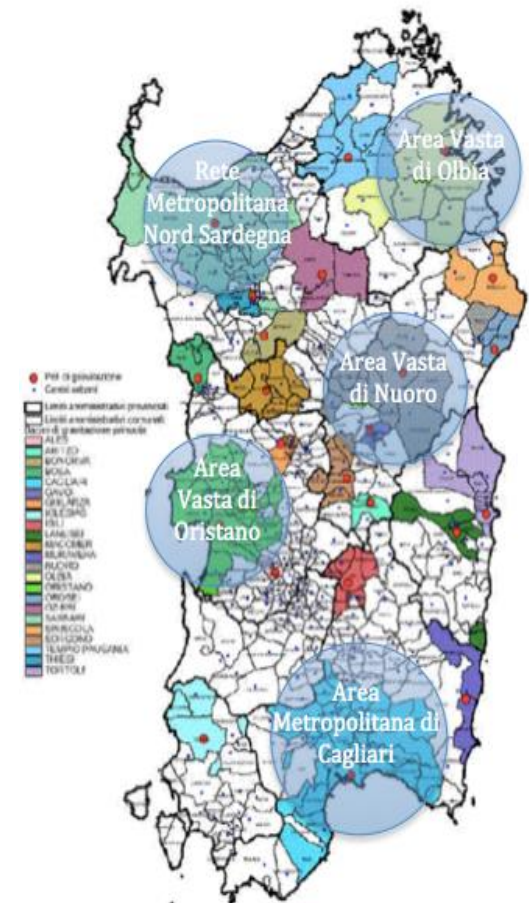


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## Electric Mobility

Development of Charging infrastructure of EV in the main cities of Sardinia Regions

- **52% of the population involved**
- **75% daily mobility need of Sardinia.**
- **22 Municipalities**
- **10 M€ of public fund invested**

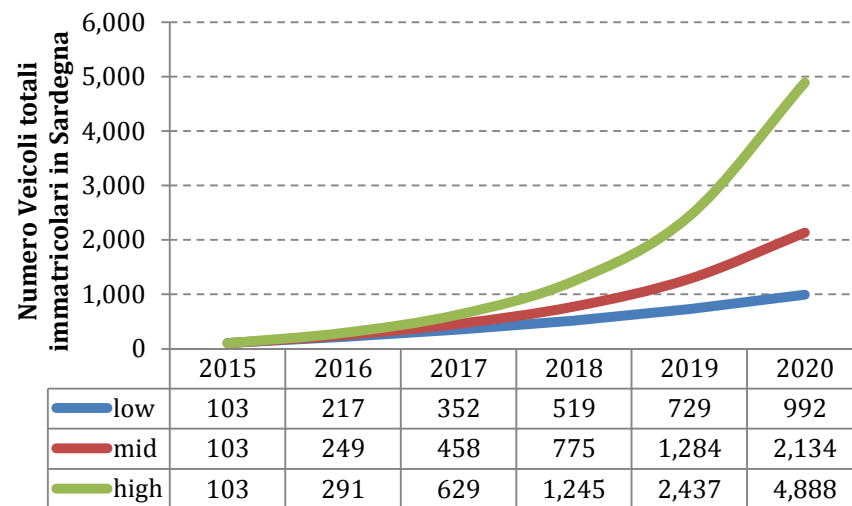




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## Electric Mobility

**Scenario of electric vehicle evolution in  
Sardinia range 1000-4500.**





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## Electric Mobility

### Planned configuration



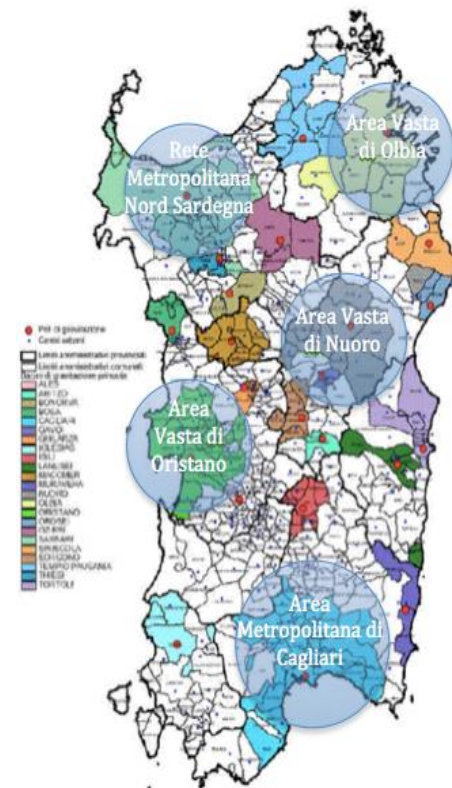
**25**  
**Fast**  
**Charging**  
(Power  
over ai 22  
kW)



**300**  
**Quick**  
**Charging**  
(Power in  
the range  
between  
7 and 22  
kW)



**300**  
**Slow**  
**Charging**  
(Power  
less 7kW)





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## Electric Mobility

**Interconnection between the main city:**

**Fast Charging at a distance of 50 km in the main highways  
25 Fast Charging Station.**



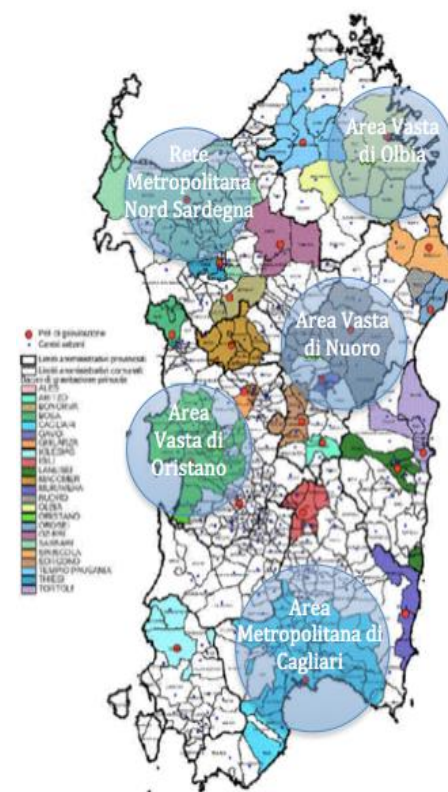


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## Electric Mobility

Preliminary distribution in the main cities:

	Fast	Quick	Slow
Citta Metropolitana di Cagliari	12	147	140
Rete Metropolitana del Nord Sardegna	6	70	70
Comune di Olbia	3	39	30
Area Vasta Nuoro	2	22	30
Area Vasta Oristano	2	22	30
Corridoi Elettrici	25		





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**Electric Mobility**

**Grazie per la cortese attenzione**  
**Thank you for your kind attention**

Regione Autonoma della Sardegna

Assessore dell'industria

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