ITALIAN NATIONAL AGENCY FOR NEW TECHNOLOGIES, ENERGY AND SUSTAINABLE ECONOMIC DEVELOPMENT

LOW CARBON SOCIETY RESEARCH NETWORK 4th MEETING

17-18 September 2012, Oxford

Carbon Capture and Storage in Italy

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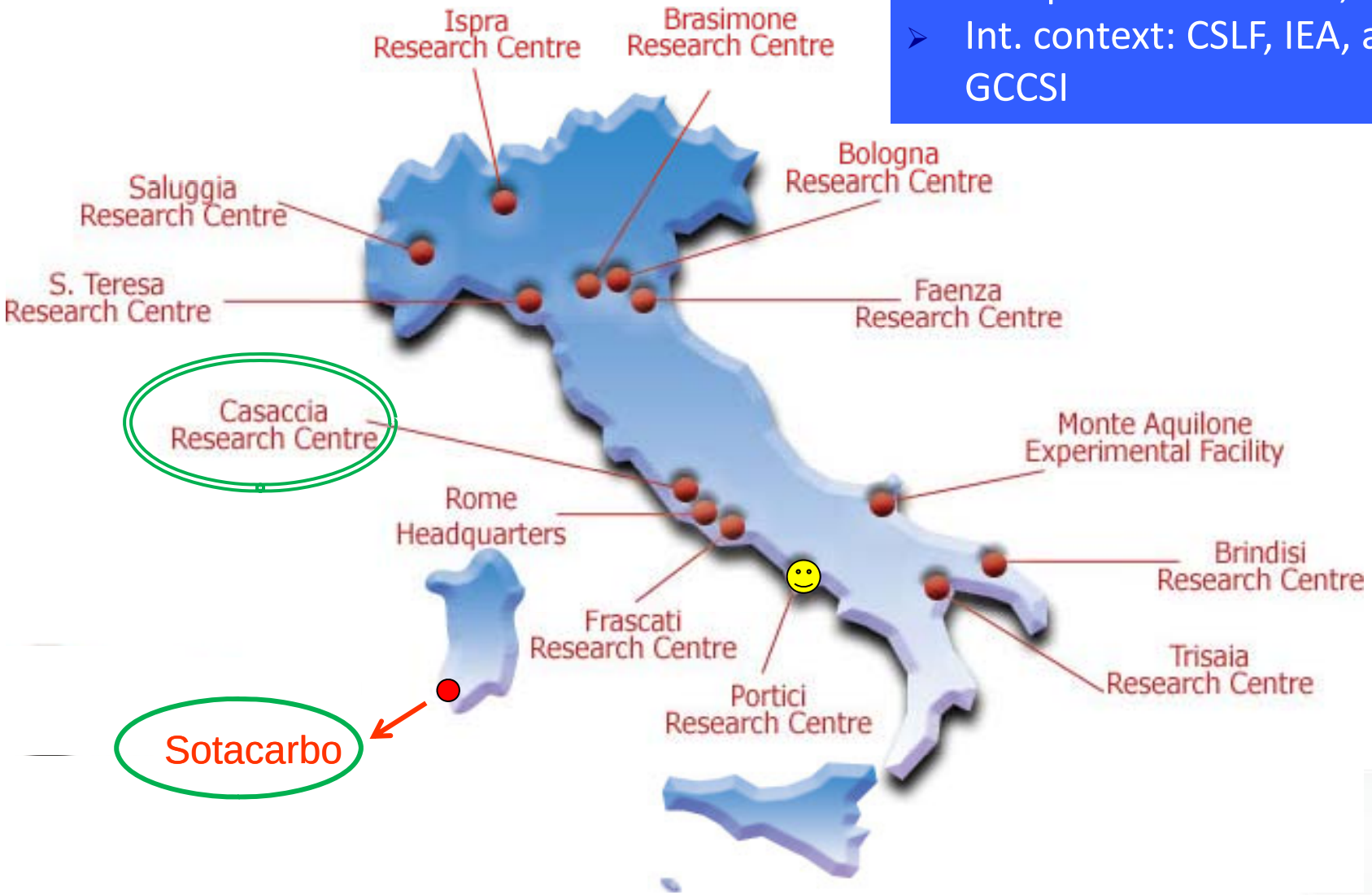
ENEA research centres and Sotacarbo

ENEA activities

- R/D/D
- Support/advice for MSE and Government
- European context: EII, EERA, ZEP, FP7
- Int. context: CSLF, IEA, agreements, GCCSI



Electricity generation in Italy

ENERGY REQUESTED: 326,000 GWh

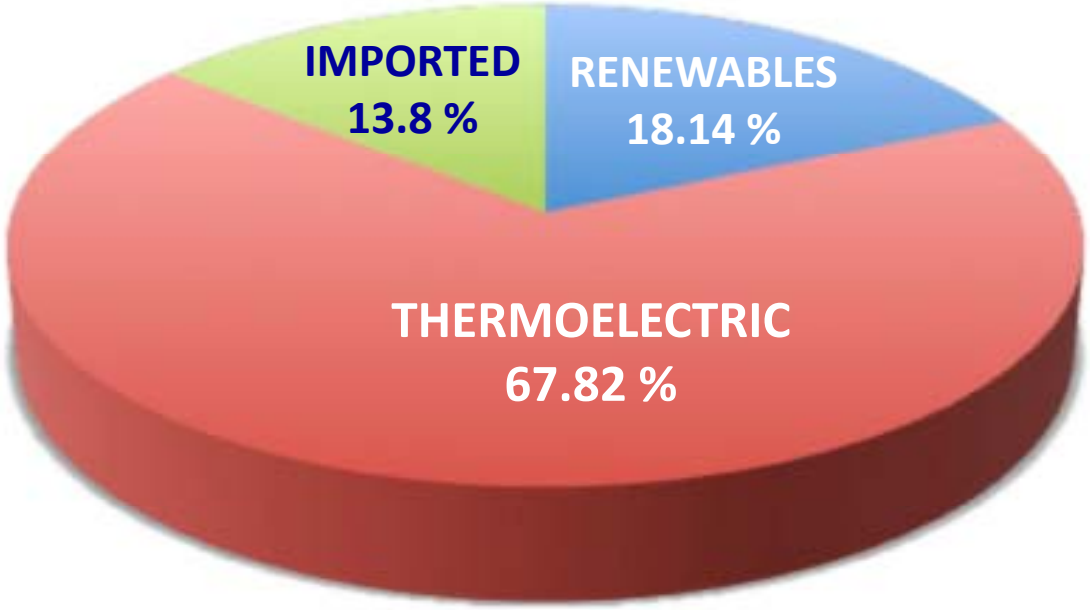
THERMOELECTRIC: 221,100 GWh

RENEWABLES: 59,150 GWh

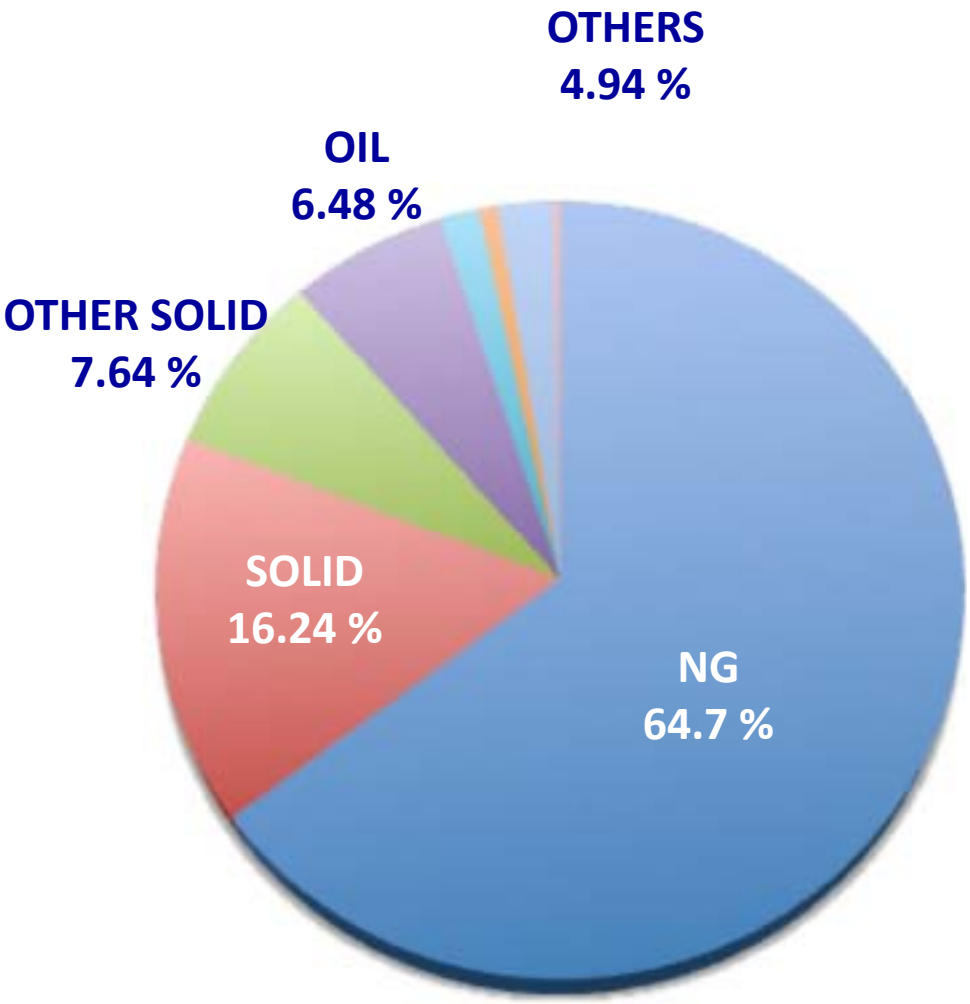
IMPORTED: 45,000 GWh

HYDRO: 52,000 GWh (15.95 %)

WIND + PV: 7,150 GWh (2.19 %)



THERMOELECTRIC ENERGY GENERATION: 221,100 GWh



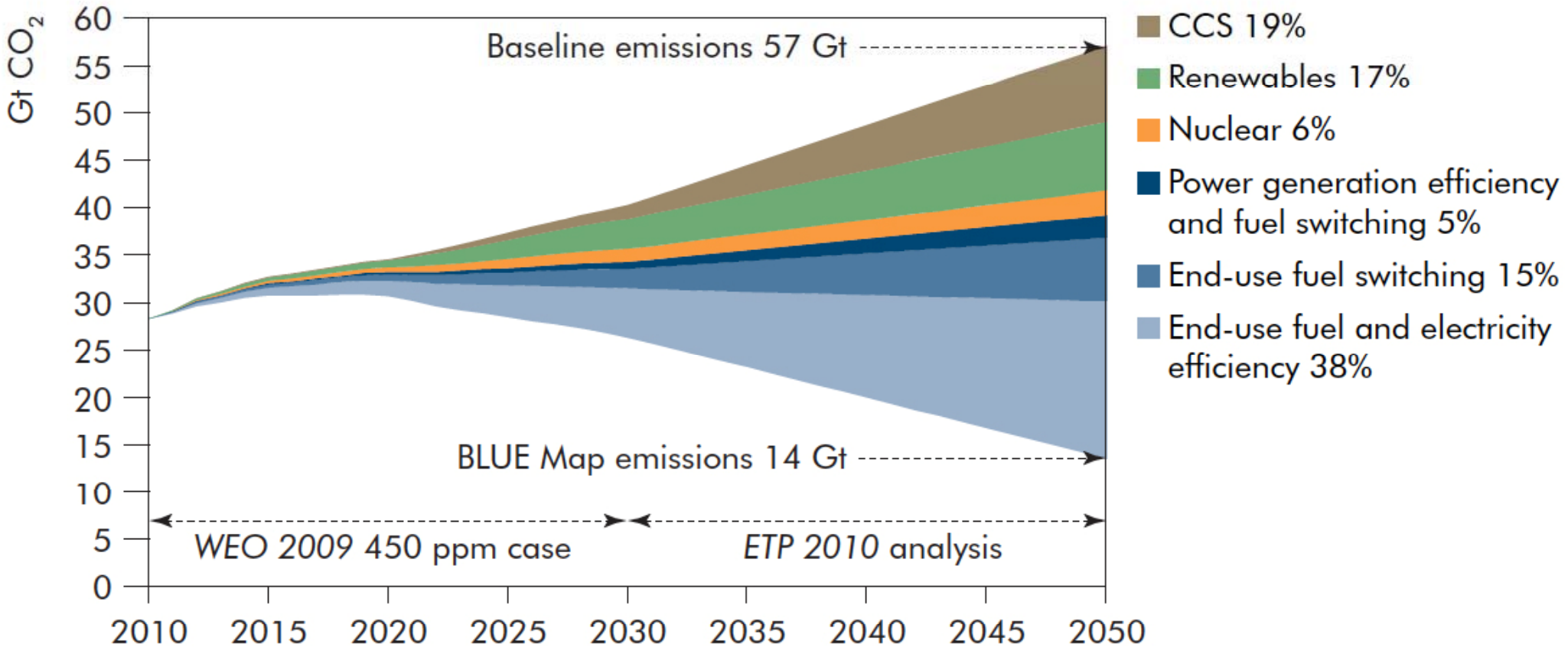
CCS: a key solution for the EU

Greater energy efficiency + Growth in renewables + Other + CCS

CCS needs to deliver

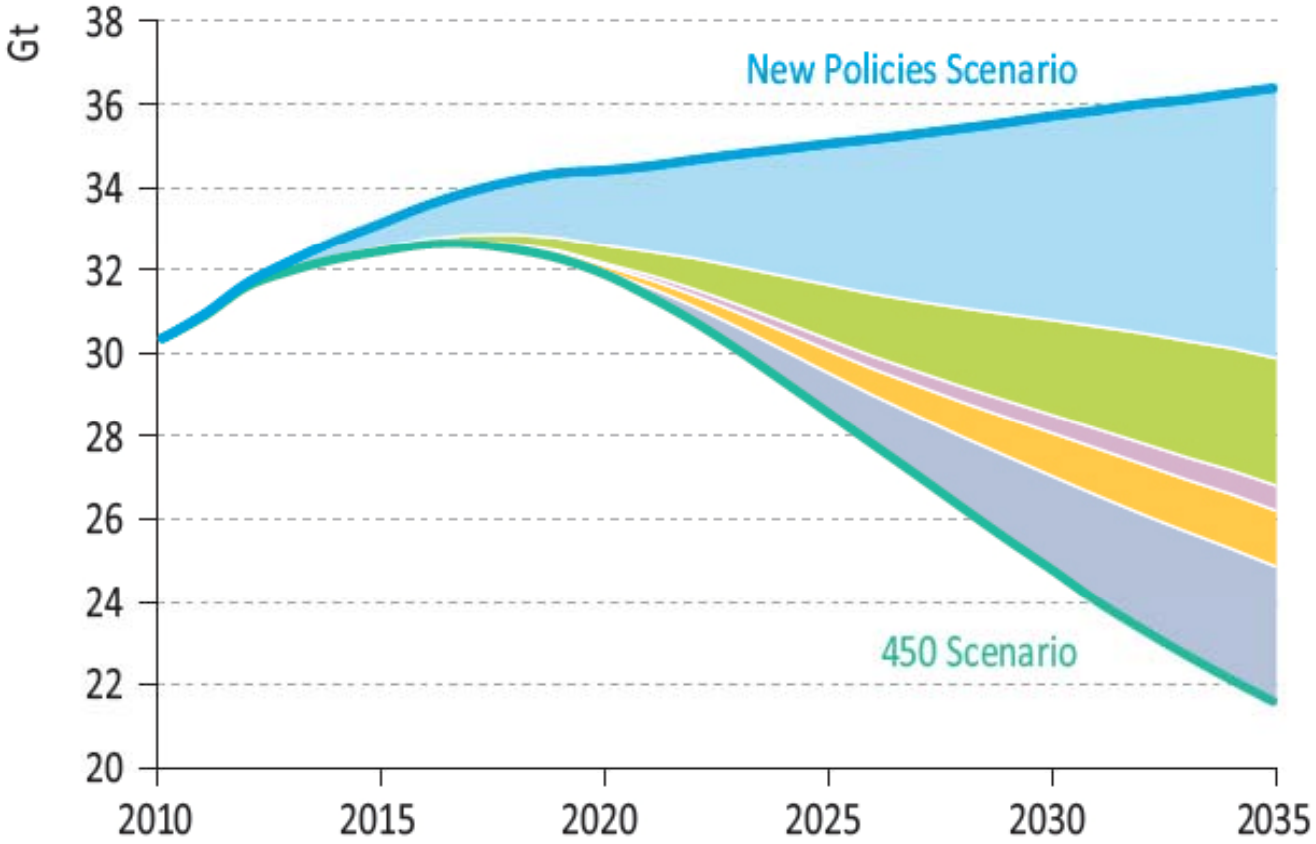
of the required global GHG cuts by 2050!

IEA –Energy Technology Perspectives



IEA –Energy Technology Perspectives

Figure 6.4 • World energy-related CO_2 emissions abatement in the 450 Scenario relative to the New Policies Scenario



	Abatement	
	2020	2035
Efficiency	72%	44%
Renewables	17%	21%
Biofuels	2%	4%
Nuclear	5%	9%
CCS	3%	22%
Total (Gt CO_2)	2.5	14.8

International cooperation

- Carbon Sequestration leadership Forum (CSLF)
- Bilateral Agreements Italy-USA, China, UK, … (CCT and CCS)
- IEA: Working Party on fossil fuels, Implementing Agreements
- Global Carbon Capture and Storage Institute (GCCSI)
- In the European context:
  - ➔ European technological Platform ZEP
  - ➔ SET Plan: European Energy Research Alliance EERA
  - ➔ SET Plan: European Industrial Initiatives
  - ➔ Coal&Steel Committee COSCO) – research fund for coal and steel
  - ➔ FP7: ECCSEL Project, for CCS european laboratory

    other projects: capture, storage

Power Generation and CCS in Italy

- The old vision for power generation in the decade:
  - 25% nuclear **CANCELLED**
  - 25% coal
  - 25% renevables
  - other: fossil fuels

- NEW: increase NG, re-gasyfiers, stable coal; Renewables and Efficiency

NEW COAL POWER PLANTS:

- Torre Valdaliga Nord (near Rome): started
- Porto Tolle: authorizations ongoing; post combustion DEMO
- Other coal power plants planned
- 1 coal plant to be realized in Sardinia, with CCS

CCS: the italian policy

Law n.99 on "Regulations for the development and internationalization of enterprises and on the subject of energy:

- allowing the implementation of demonstrative projects on CO2 capture, and permanent storage of CO2 into suitable deep geological formations;
- realizing a coal fired with CCS demo plant in Sardinia region
- R/D Plan for industrial innovation

Other national initiatives

- Funds to Sotacarbo and Carbosulcis for common project with ENEA
- R&D national programs – on CCS - for the next four years
- Strong demonstration initiatives
  - ENEL/ENI
  - Sulcis integrated project - feasibility by ENEA/Sotacarbo
  - Sotacarbo/ENEA, firstly pilot

Transposition of Directive 2009/31

- **Transposition has been done** (decree n. 162, Sptember 2011) after a wide consultation with stakeholders, mainly regional governments and local administrations: now Italy is one of the two members States in Europa that have approved a national transposition law.

- **A national committee** will manage CO2 storage activities.

- Ministry of Economic Development will store and manage all the data concerning exploitation and storage activities of CO2.

Italian programme on CCS

	project/ responsible	NATION. FUND Electr. System	NATION. FUND Energy Strategy	NATION. FUND R&D Progr.	REGIONAL FUND (Sardinia)	EC FUND
DEMO	**Porto Tolle** ENEL-ENI					NER 300 other
	Sulcis 400 MWe Sotacarbo/ENEA				X	NER 300 other
PILOT	**Precomb (and coal-to-liquid)** Sotacarbo/ENEA	X			X	other
	CBM-ECBM in Sulcis basin Carbosulcis-Sotacarbo-ENEA	X			X	other
	Brindisi post comb ENEL					other
	Oxycomb ITEA - ENEA					other
R&D	**pre-comb** ENEA-Sotacarbo-ERSE	X			X	X
	post-comb ERSE-ENEA-ENEL	X			X	X
	oxy-comb ENEA-ITEA-Sotacarbo-CNR				X	X
	ECBM-wells-aquifers ENI-Carbosulcis-OGS-Univ., ENEA,..	X			X	X

EU - EIIs: European Industrial Initiatives

- To strenghten Research and industrial innovation in the energy sector
- To decrease costs and improve performances

Iniziative already started:

- European Wind Initiative
- Solar Europe Initiative (sia fotovoltaico che termodinamico)
- European electricity grid initiative
- Sustainable bio-energy Europe Initiative
- **CO2 capture, transport and storage**
- Sustainable nuclear fission initiative
- Fuel cells and hydrogen
- Energy efficiency
- Smart Cities initiative

EU - EERA CCS Joint Programme

Objectives

- Lower costs and higher efficiency
- public awareness and acceptance

Programme launched at last SET-Plan conference (Nov. 2010)

34 program members

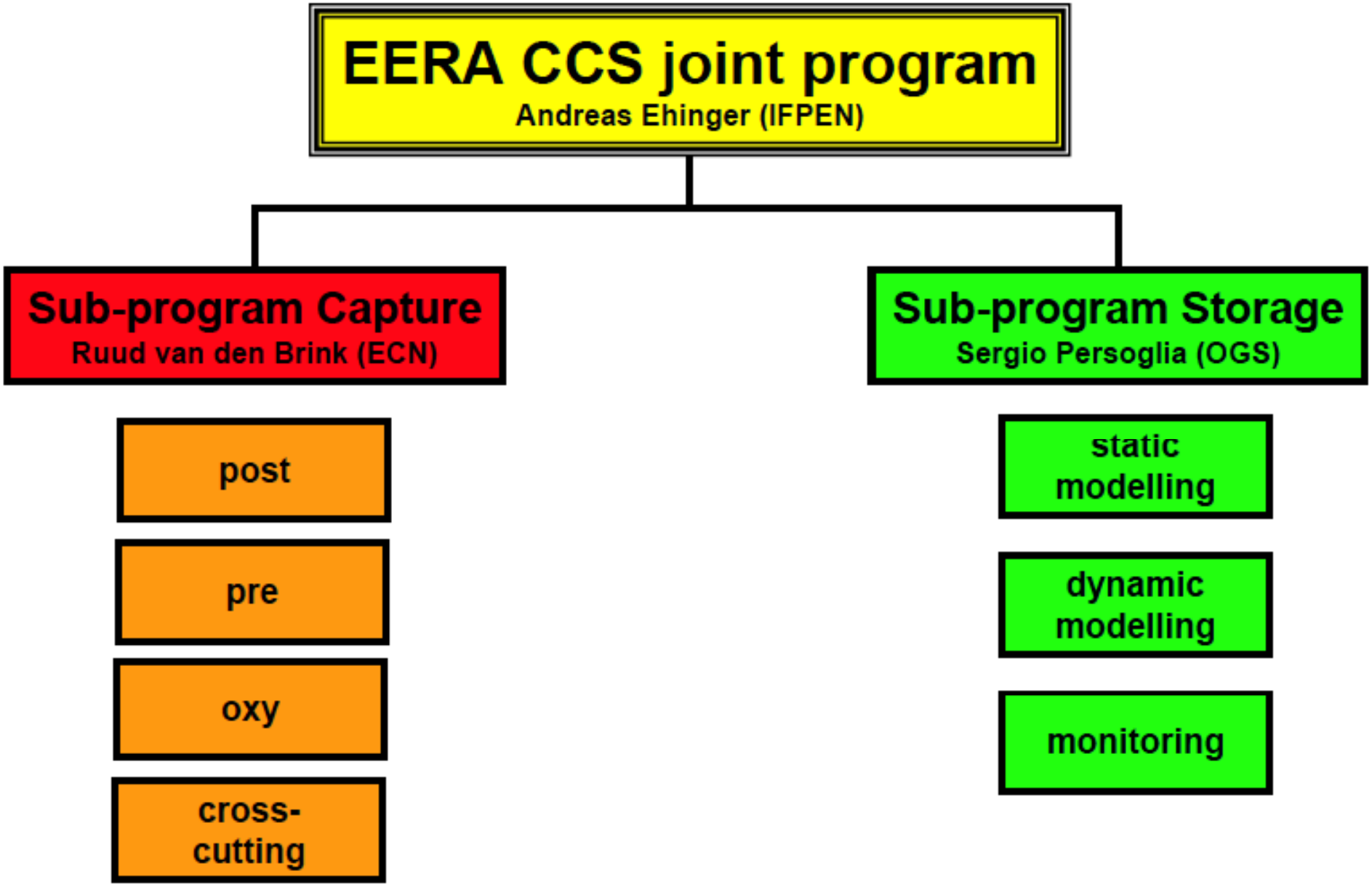
- *24 participants*
- *10 associates*
- *12 countries*

HR commitment

270 py/y

Several new applications

Program structure



Countries participate in the Preparatory Phase Project

ECCSEL PPP Consortium

1. Norway (NTNU, SINTEF, RCN)
2. France (IFP & BRGM)
3. The Netherlands (TNO)
4. Germany (DLR)
5. United Kingdom (BGS)
6. Switzerland (ETHZ)
7. Spain (CIUDEN)
8. Italy (OGS, ENEA)
9. Greece (CERT/ISFTA)

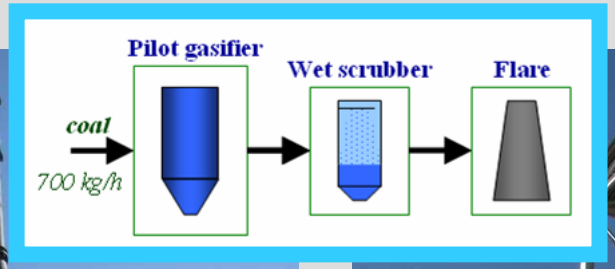
Main activities of national R/D Programme

- "CERSE": technology innovation of the electricity system: CCS.
  - Combined production of hydrogen & power with CCS
  - Capture (pre and post combustion) technologies: sorbents/solvents/membranes
  - Coal to liquid / Plant integration
  - Feasibility analysis for a demonstrative power plant in Sardinia, with CCS
  - Oxy combustion: modelling and advanced tests
  - ECBM Site-Tests in Sardinia Sulcis Area)
  - Italian national road-map on CCS; public acceptance
- "Industry 2015" - Industry-oriented R/D program
  - advanced MILD combustion in coal oxyfired power plants.
- "Law 99/2009"
  - R&D programme for industrial innovation; support to demo projects
- PNR (to be launched)
  - Research projects
  - National research laboratories/infrastructures

ZECOMIX test plant

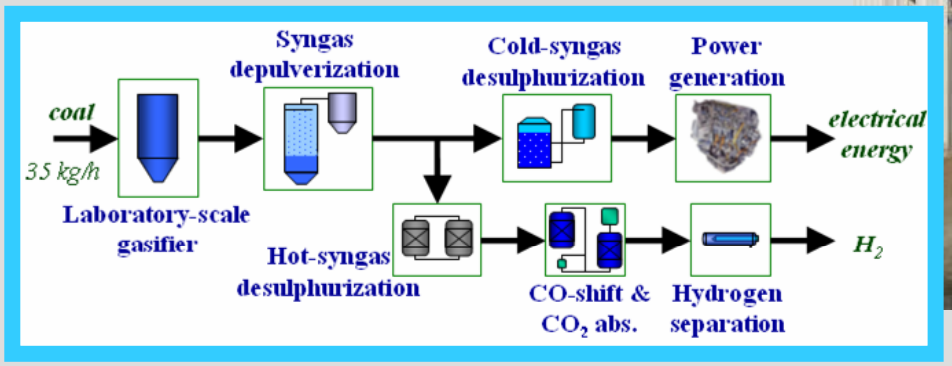
30 kg/h coal

Sotacarbo pilot plant



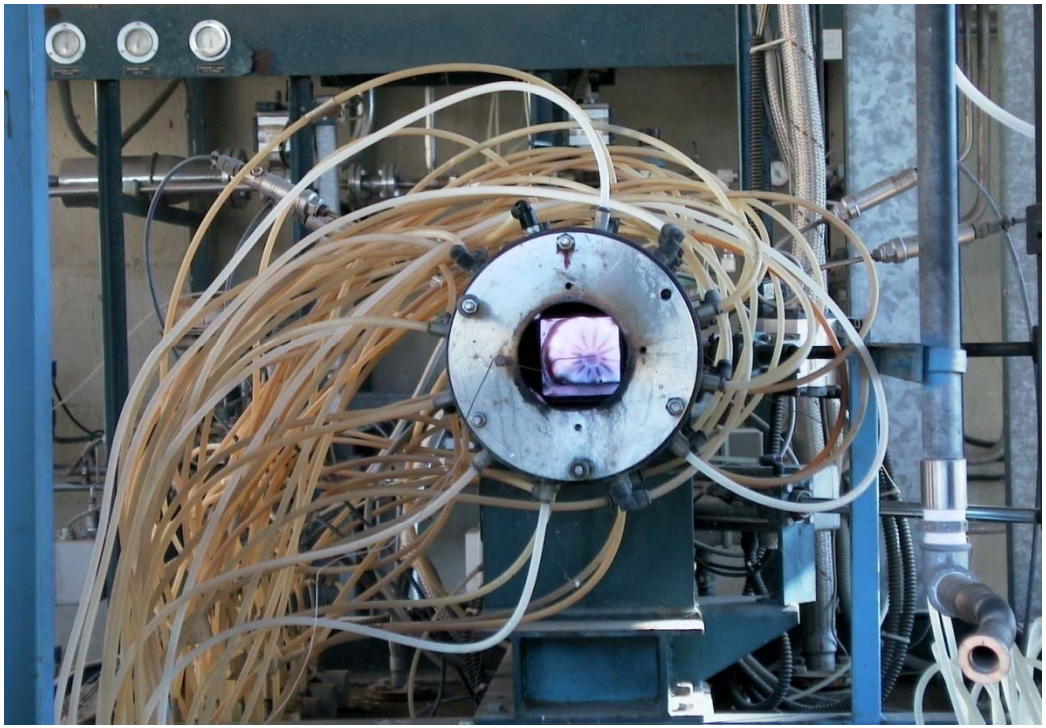
700 kg/h coal

Sotacarbo bench scale plant



30 kg/h coal

H2 combustion at ENEA



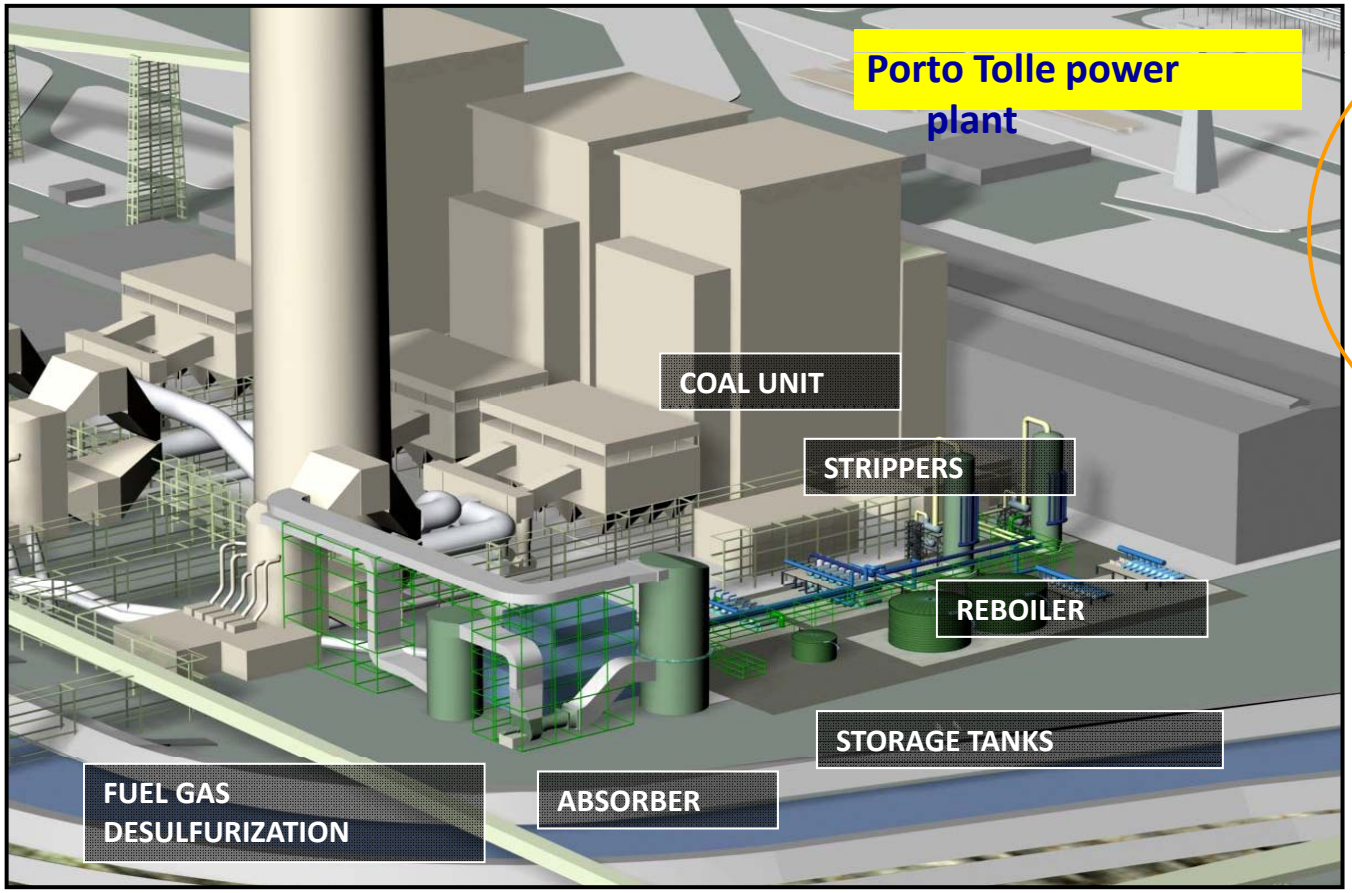
MICOS test plant

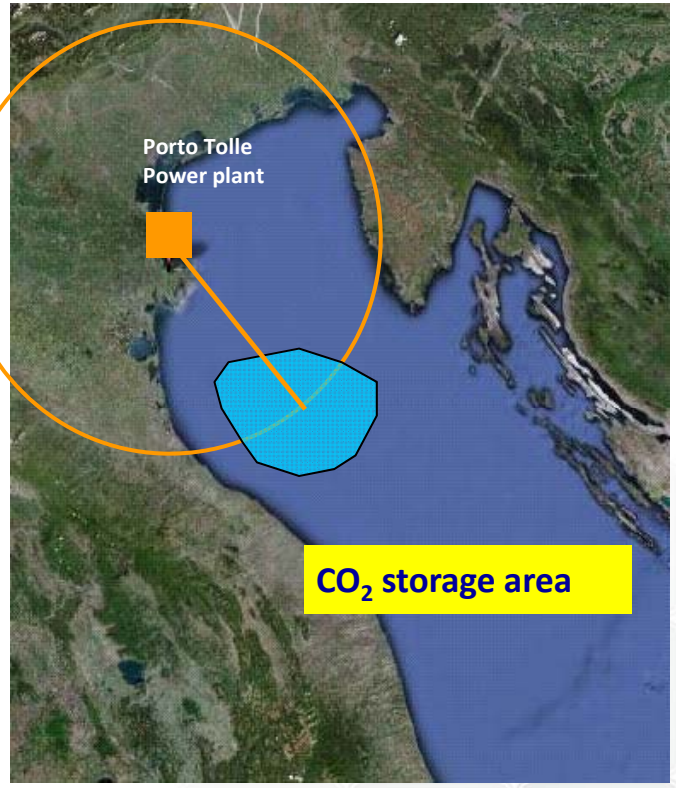
IDEA test plant

ZEPT: Zero Emission Porto Tolle (ENEL)

Project goal

To retrofit one 660 MW_e coal fired unit of Porto Tolle power station with CO_2 post combustion capture equipment and start CO_2 underground storage in an off-shore saline aquifer by 2015

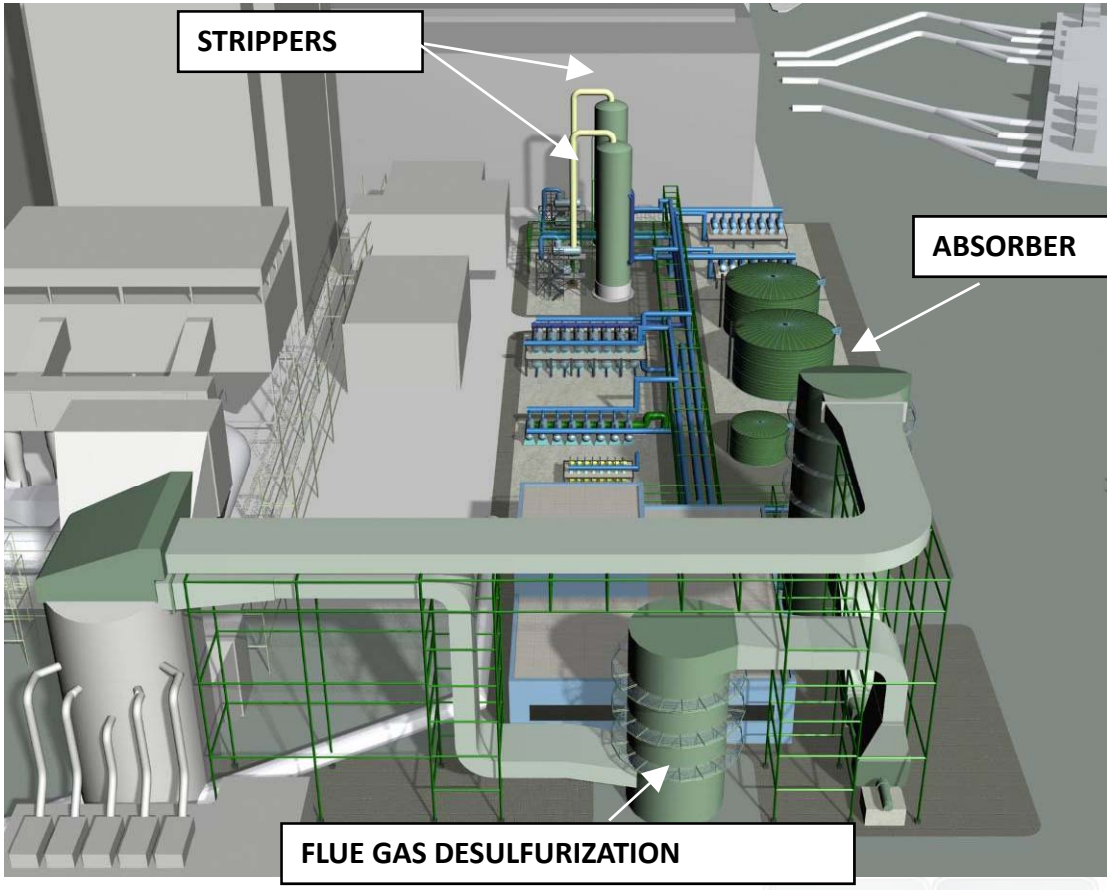




ZEPT: Zero Emission Porto Tolle (ENEL)

Demo main features

Type of Project	**Retrofit**
Power generation	**660 MWe**
Primary fuel	**Bituminous coal**
Secondary fuel	**Biomass**
Power Generation Tech	**USC-PC**
% of flue gas treated	**40%**
CO_2 Capture Tech	**Post Combustion Capture with Amine**
Stored CO_2	**Up to 1 Mt/y**
CO_2 Capture rate	**90%**
CO_2 Storage solution	**Deep saline aquifer**
Storage location	**North Adriatic Sea**
CO_2 value chain	**Pure storage**



ZEPT: permitting and roadmap

- 5 genuary ’11 - Ministry of economic development: authorization for porto tolle power plant, coal fired with biomass co-combustion
- 23 may ‘11 - National State Council: environmental authorization, already obtained (2009) repealed
  - Lack of comparative analysis with gas fired power plant
  - Difference between CO emission limits stated in the environmental authorization not justified
- 5 July ‘11: ENEL: restart of Environmental authorization procedure requested
- 15 July ’11 - parliement: new article (in more general law) approved
- 5 August – regional government of Veneto: modification to regional law on protected ares approved
- 3 Nov ‘11 – ENEL: supplementary documentation sent
- **By first half of 2012: starting of procedure for CO2 injection in the storage site**

400 MWe coal plant with CCS in Sardinia

imported low sulphur coal

coal mine

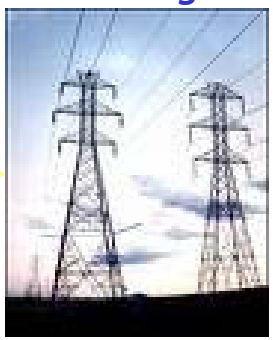
power plant

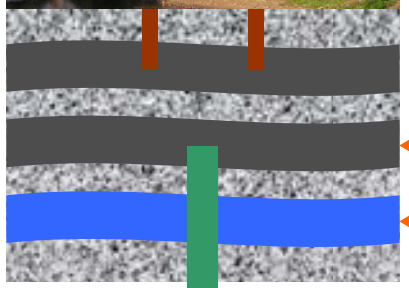
national grid

Sulcis coal

ash

electrical energy



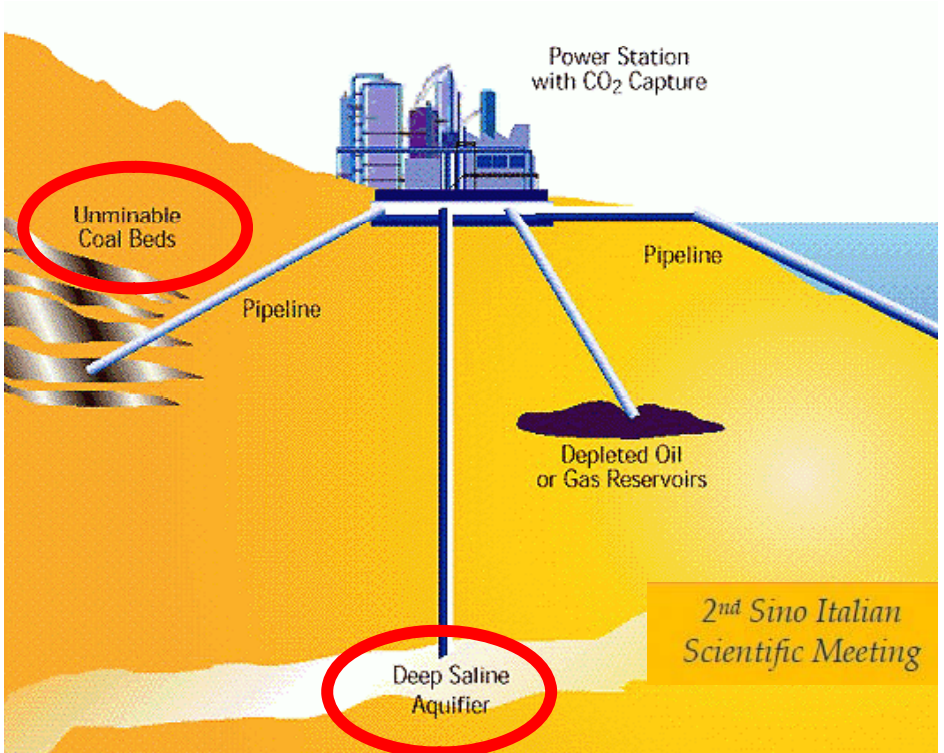


carbon dioxide

methane

plant size: 350-450 MW_e

(italian law n° 9 23/07/2009)

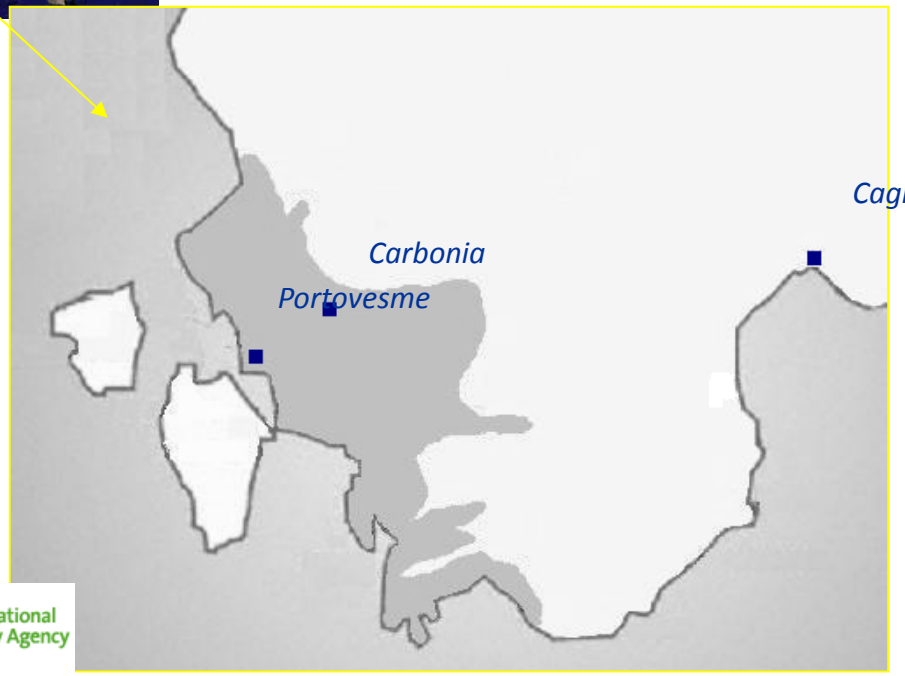


The Sulcis coal basin

onshore extension: ~**700 km²**

offshore extension: ~**700 km²**

about **600 Mt** of sub-bituminous coal



International Energy Agency

Sulcis coal ultimate analysis	
Carbon	53.17
Hydrogen	3.89
Nitrogen	1.29
Sulphur	5.98
Oxygen	6.75
Chlorine	0.10
Moisture	11.51
Ash	17.31
LHV (MJ/kg)	20.83

New CO2 storage project

CO2 storage in Sulcis area
ECBM/aquifers pilot tests

- The project is aimed at **testing, at pilot scale, CO2 storage in deep coal layers and in the underlying aquifers in the Sulcis coal area**, located in South-West of Sardinia Region-Italy, managed by Carbosulcis.

- The presence of two superimposed formations that are both appropriate for CO_2 storage (**ECBM and deep aquifers**) is unique in Italy, a situation which provides additional safety in the form of a secondary, higher-level barrier should storage be conducted in the lower unit

Thank you for your attention

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