ZEPT: Zero Emission Porto Tolle demonstration project

Short report: Strategy,Targets and R&D Activities

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UK Carbon Capture & Storage Community Network Biannual Meeting

LEEDS - September, 15th , 2010

Agenda

- **Enel's CCS projects in Italy**
- **ZEPT – Zero Emission Porto Tolle**
- **ZEPT- R&D Supporting Activities**

ENEL's CCS projects in Italy

ENEL Group , since 2006, decided to take the lead in the development of CCS technologies in coal fired plants by:

- Promoting one demo project:
  - **ZEPT**- **Z**ero **E**mission **P**orto **T**olle, a post-combustion capture and storage demo project
- Developing knowledge in the area of oxy-firing and pre-combustion technologies:
  - Oxy-coal combustion project
  - Power from Hydrogen

A CCS demo plant in Italy

Why

Torrevaldaliga Nord Power Plant (3 units, 2000 MWe)

- In Italy Enel plans to built up to 5000 MWe clean coal capacity, substituting existing oil fired or NG fired steam cycles.
  Clean coal plant characteristics:
  - ✓ Closed coal management system
  - ✓ η = 45%
  - ✓ extremely low pollutant (NOx, SOx; particulate) emission levels

Next project of this kind is Porto Tolle

- These assets need to be preserved in the carbon constrained scenario

CCS retrofit technologies required

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The Porto Tolle Power Plant conversion project

	Old Plant	New Plant
• Gross power output (MW)	2640	1980
• Net efficiency (LHV)	39%	45%
• Fuel	Oil (0,25% S)	Coal
• Emissions SO2/NOx/Dust (mg/Nm3)	400/200/50	100/100/15 (hourly basis)

✓ **New main components:**

- USC boilers
- SCR denitrification system
- FGD plants
- Fabric filters
- 2 domes for coal storage

✓ **Biomass co-firing capability**

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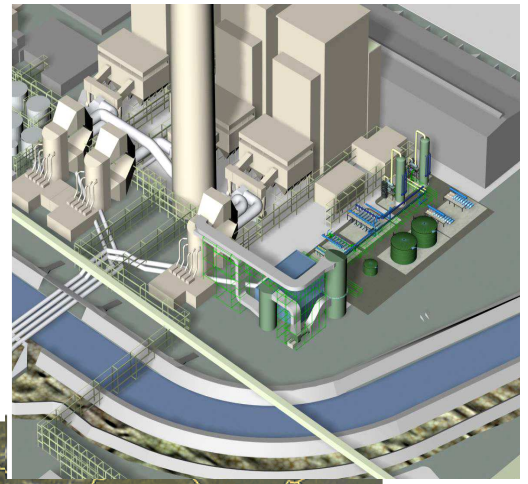
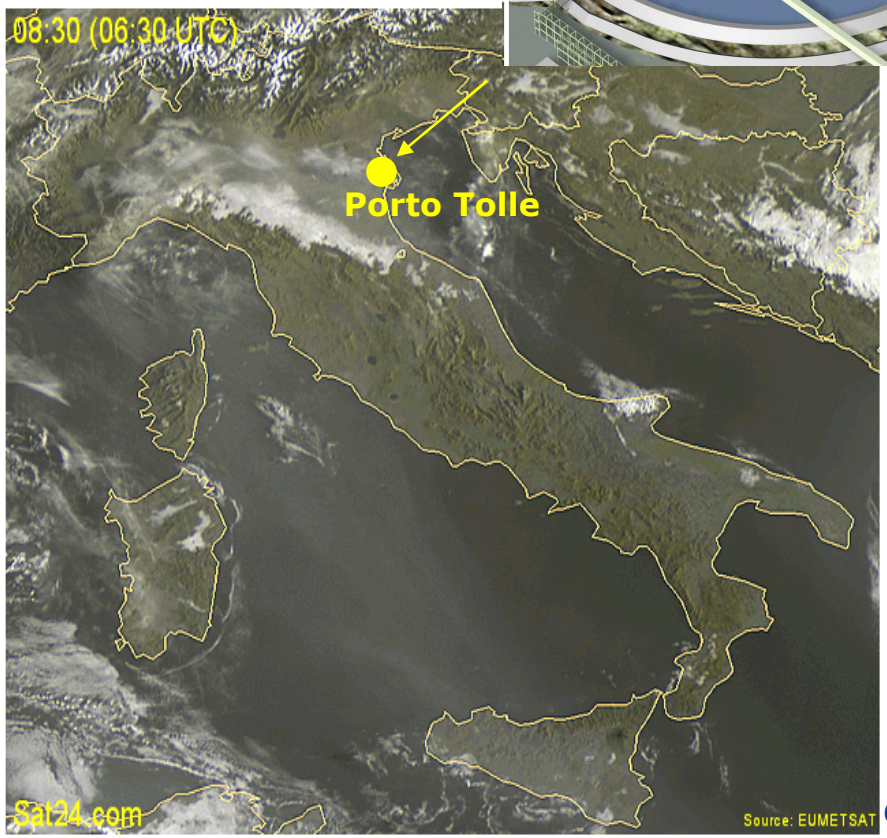
ZEPT- Zero Emission Porto Tolle

The Enel's CCS demo project

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





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One of the six EEPR projects

Total funding: 1 b€

IGCC
Off-shore
gas field

Post-combustion
Off-shore gas field

Oxy-fuel CFB
On shore saline aq.

Post-combustion
Off-shore saline aq.

Oxy-fuel and
post-combustion
On shore storage

Post-combustion
On shore saline aq.

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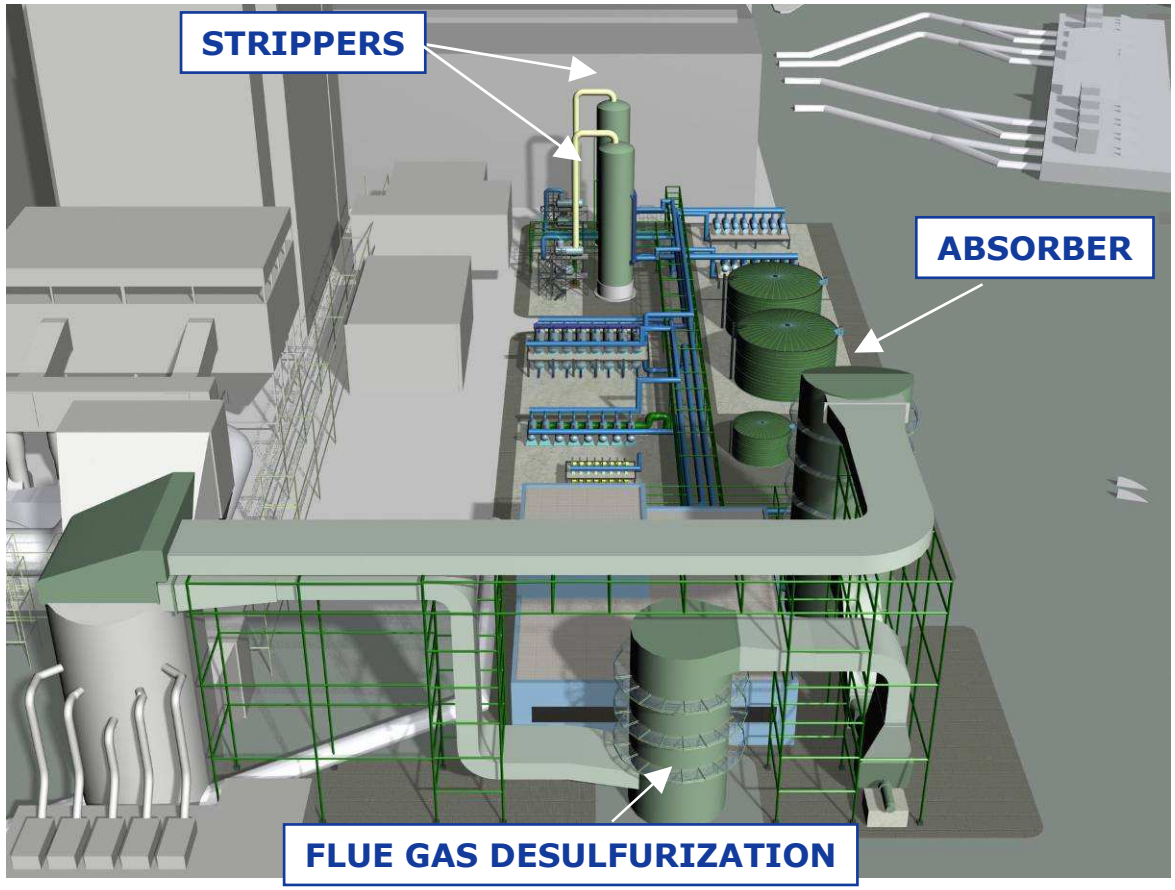
Demo main features

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**



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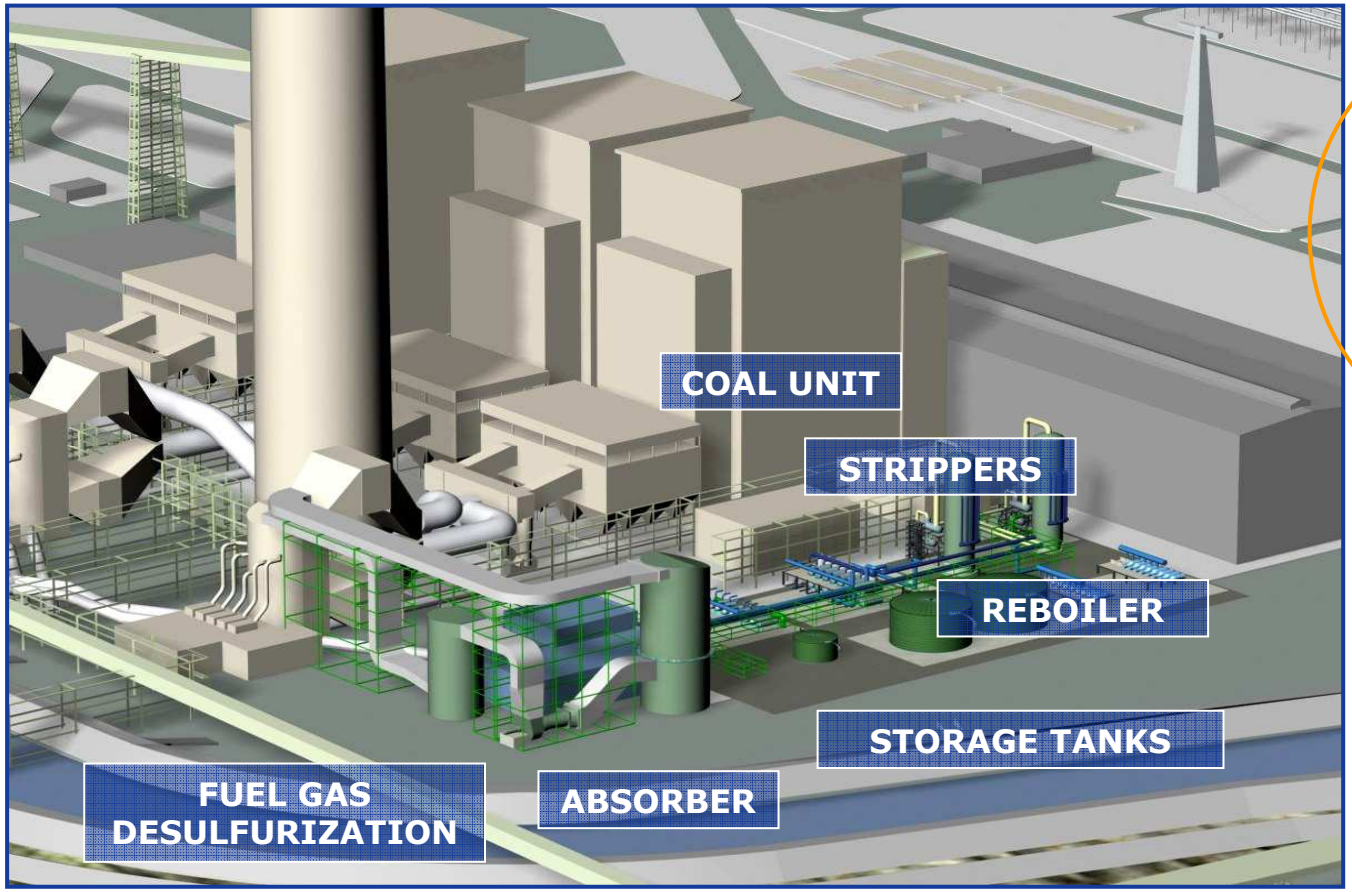
CCS demo plant lay-out

Porto Tolle power plant



CO_2 storage area

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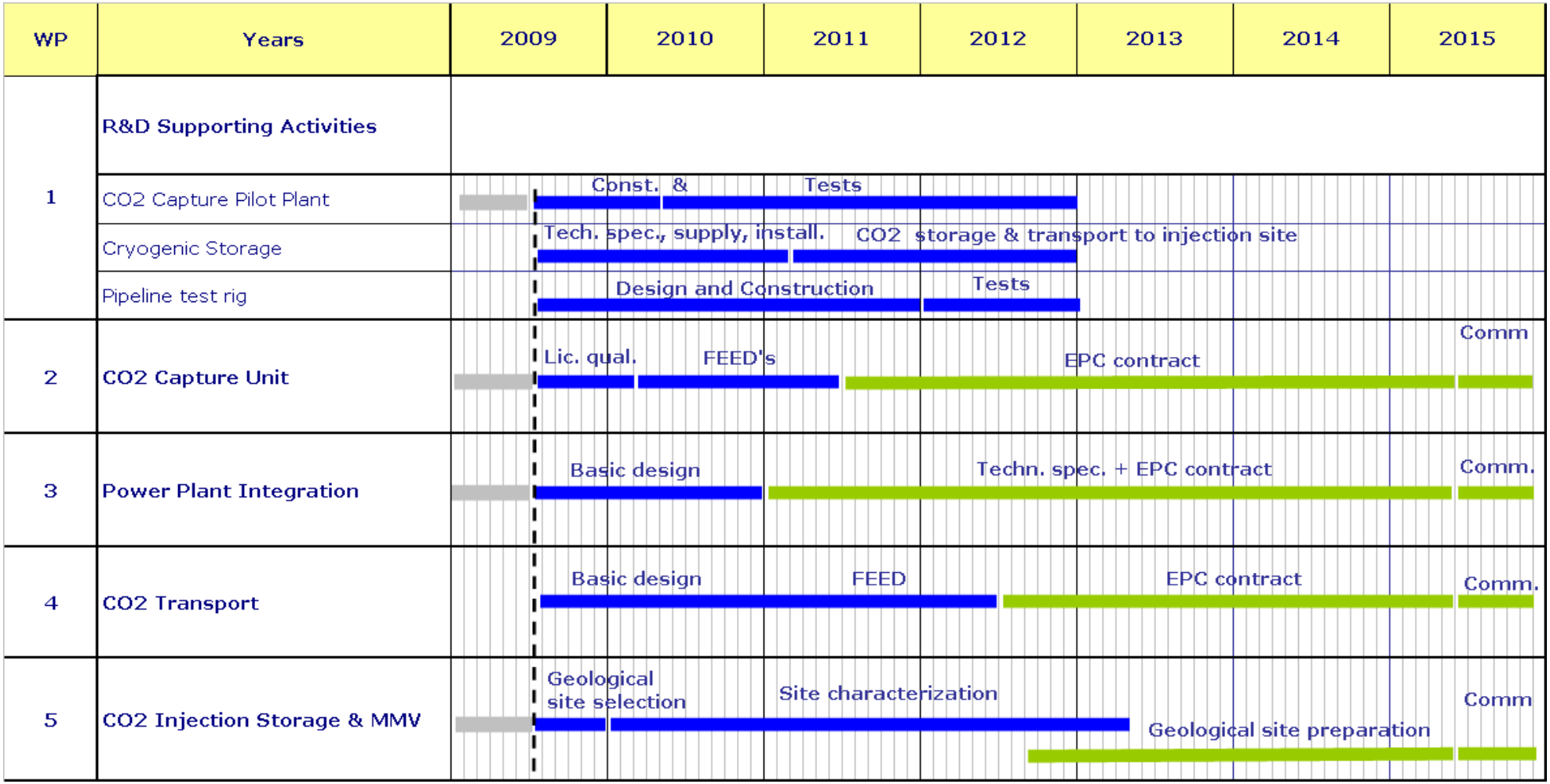
Project time schedule

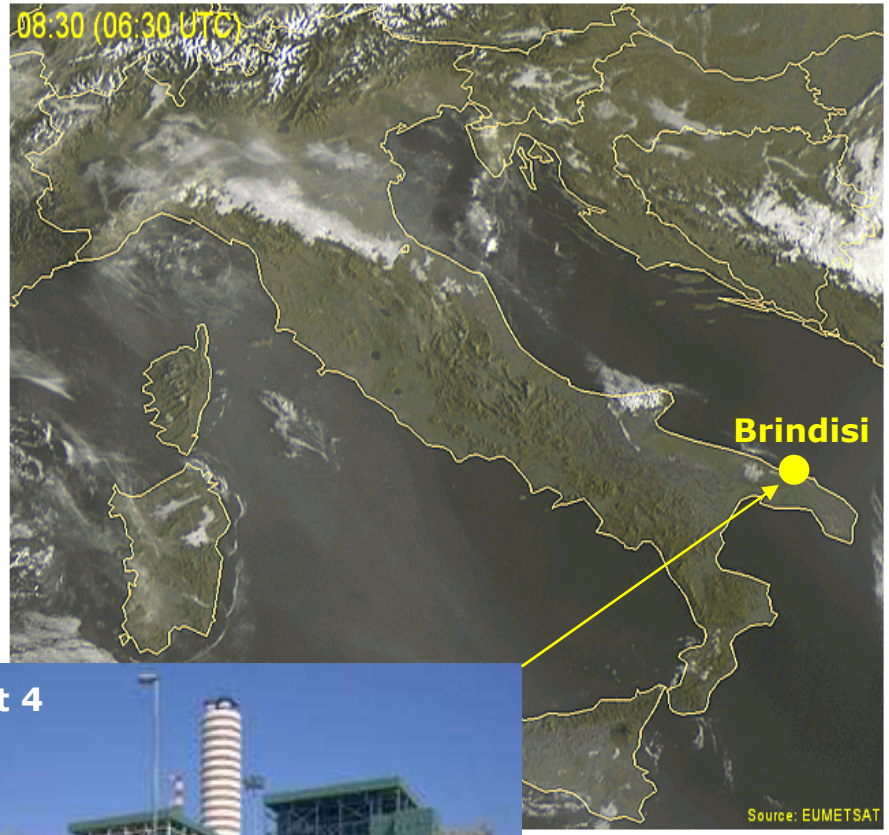


Activities carried out in the frame of the EEPR Grant Agreement signed in December 2009 with European Commission

ZEPT- R&D Supporting Activities

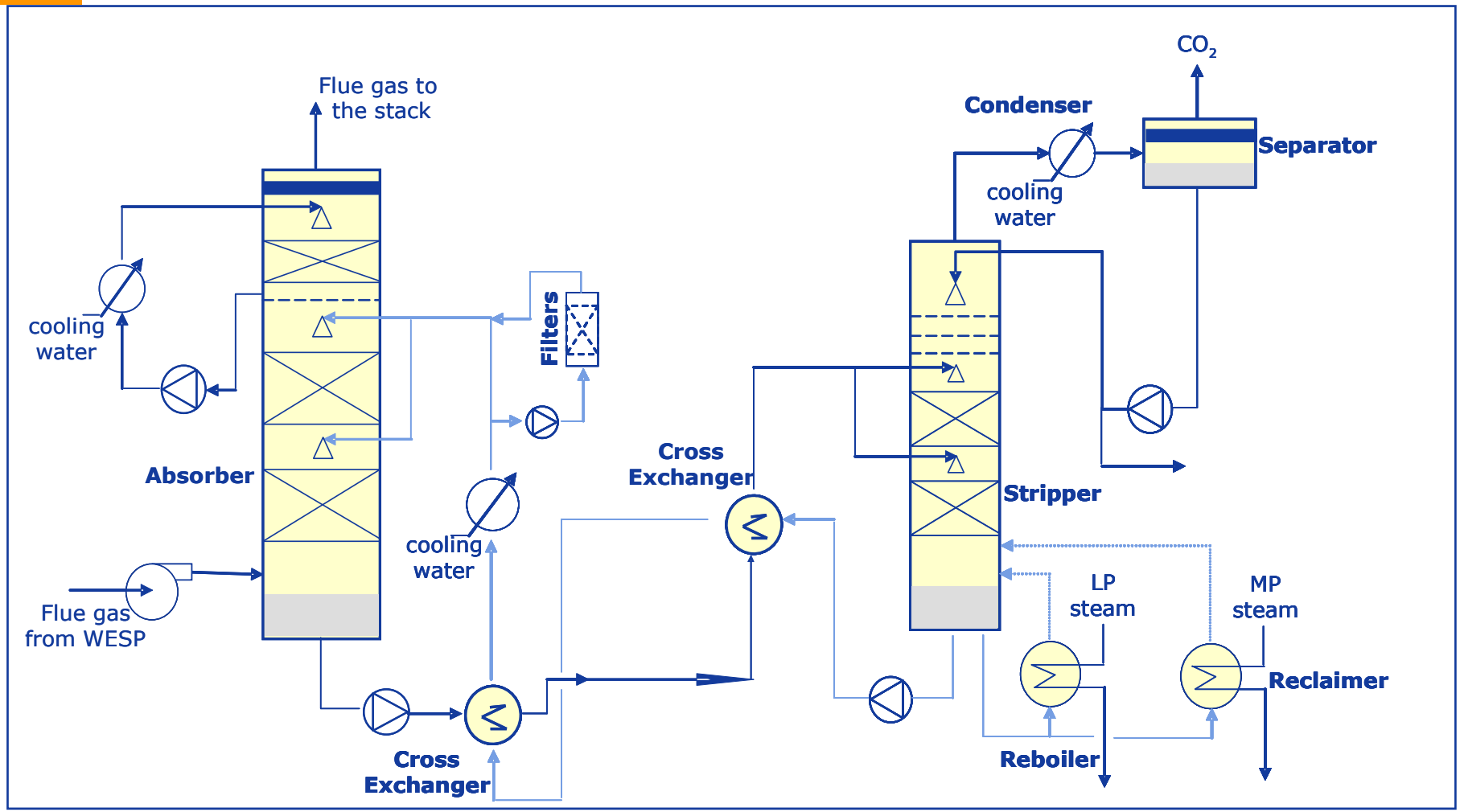
CO_2 capture pilot plant

- At the site of **Brindisi** coal fired power station a pilot plant for CO_2 separation via amine scrubbing is under commissioning. The plant is installed on the Unit 4.
- The plant is composed by a flue gas pre-treatment section (able to remove completely the particulate and the SO_3 and to reduce SO_2 level below 20 mg/Nm^3) and by a CO_2 separation unit
- The plant size is **10.000 Nm^3/h**, capturing about **2,5 t/h of CO_2**
- Goal to: gain experience in CCU designing and operation, and assess the environmental impact of the process



ZEPT – R&D supporting activities

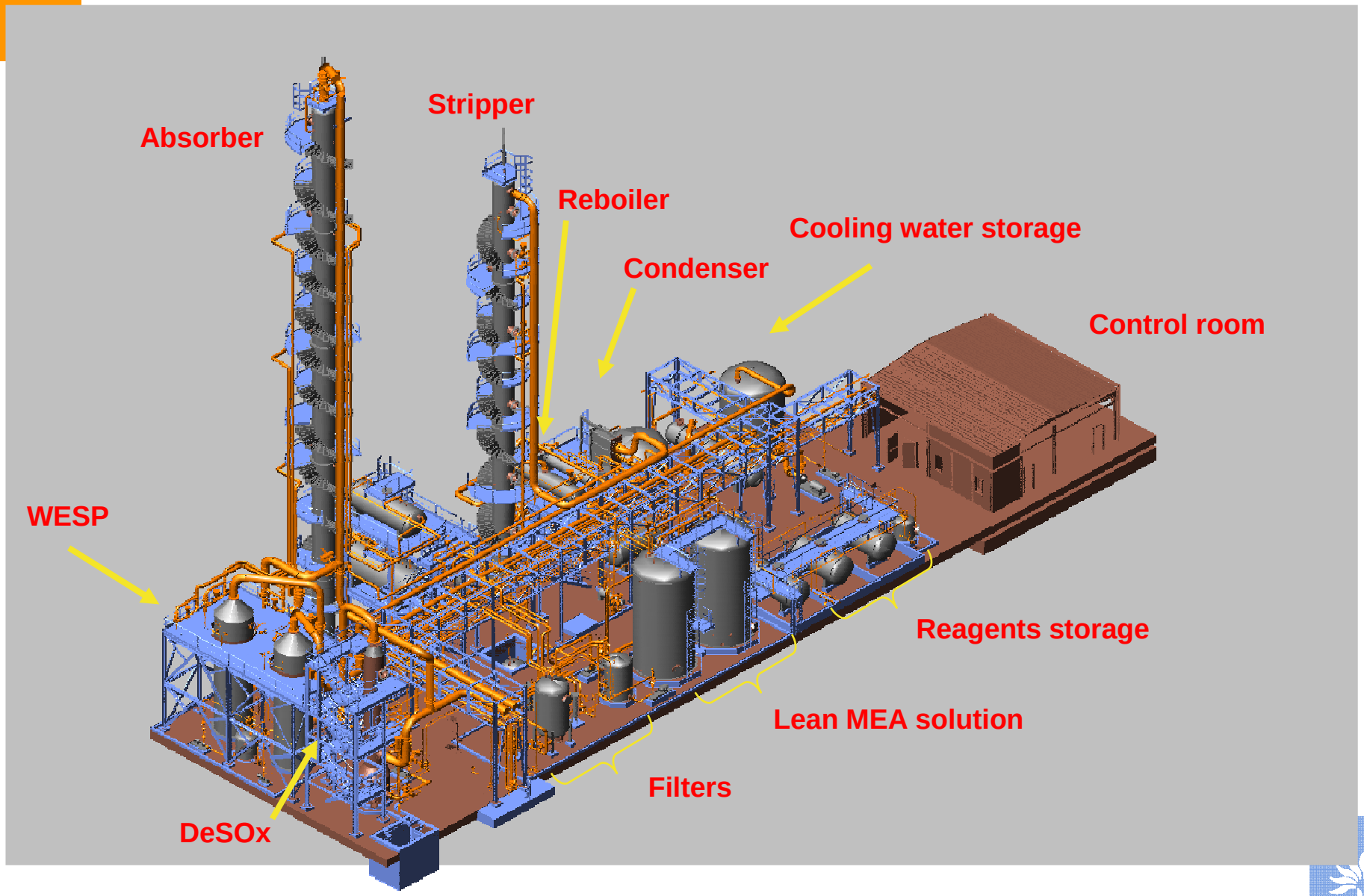
CO_2 capture pilot plant



The CO_2 separation unit

ZEPT – R&D supporting activities

CO_2 capture pilot plant



ZEPT- R&D Supporting Activities

CO_2 capture pilot plant

Pilot Plant Operation: since June 2010

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ZEPT – R&D supporting activities

CO_2 capture pilot plant

Research Program

- **Operational experience with base solvent (MEA 20%- 30%+ inhibitors)**
  - Assessment of the MEA absorption technology: (reliability, environmental impact, power consumption and capture performance)
  - Definition of operating procedures
  - Cost evaluation at different operating conditions for retrofit application.
  - Flue gas composition: CO2 stream and emissions

- **Testing of advanced solvents and inhibitors**
  - An experimental program to test some advanced solvents and inhibitors has been set up with the aim to reduce power consumption, limit solvent degradation and improve environmental performances.
  - The pilot plant is flexible enough to allow the test of different kind of innovative liquid solvents. Enel is available to discuss with developers the terms for testing them.

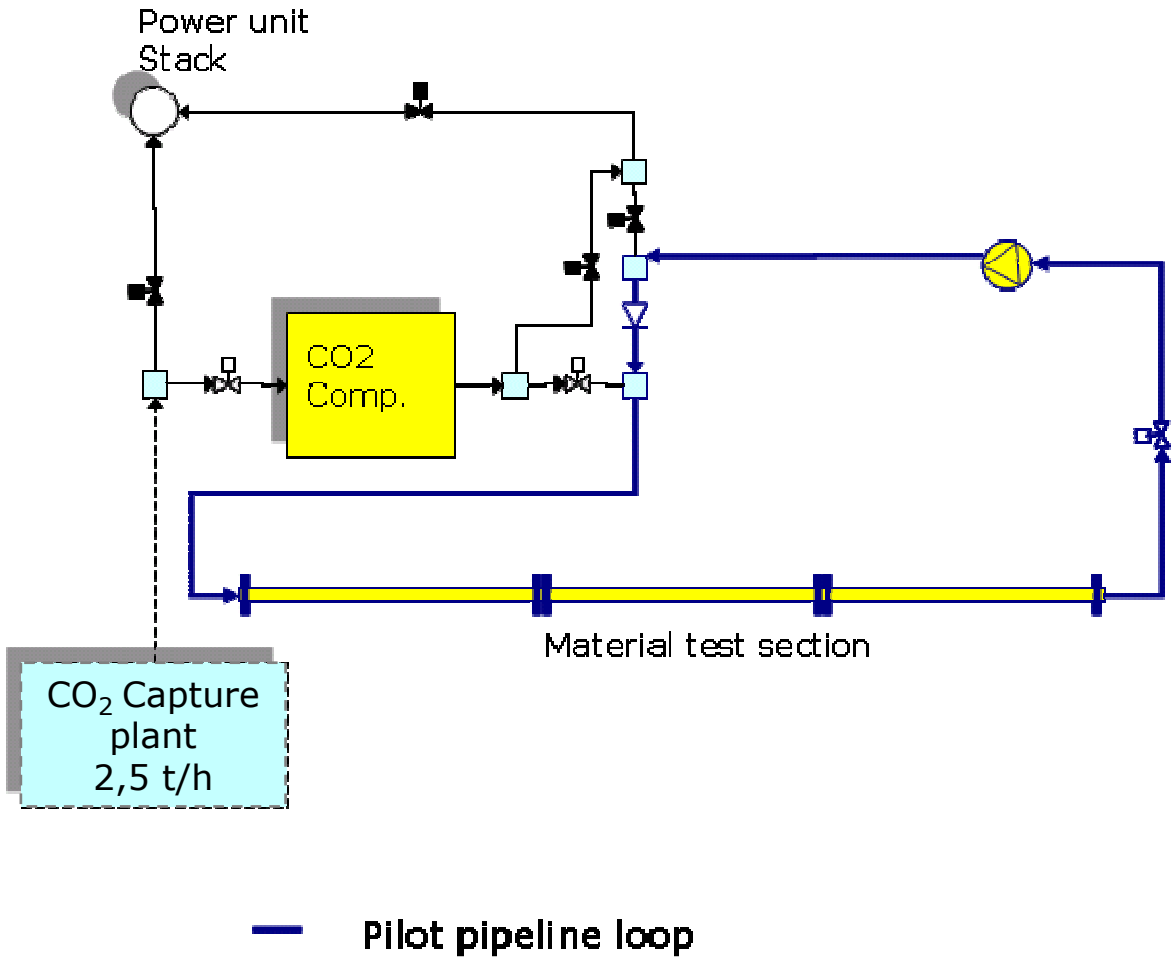
ZEPT- R&D Supporting Activities

CO_2 pilot pipeline

Furthermore in the frame of the Eni - Enel cooperation a CO_2 pilot pipeline will be built in Brindisi.

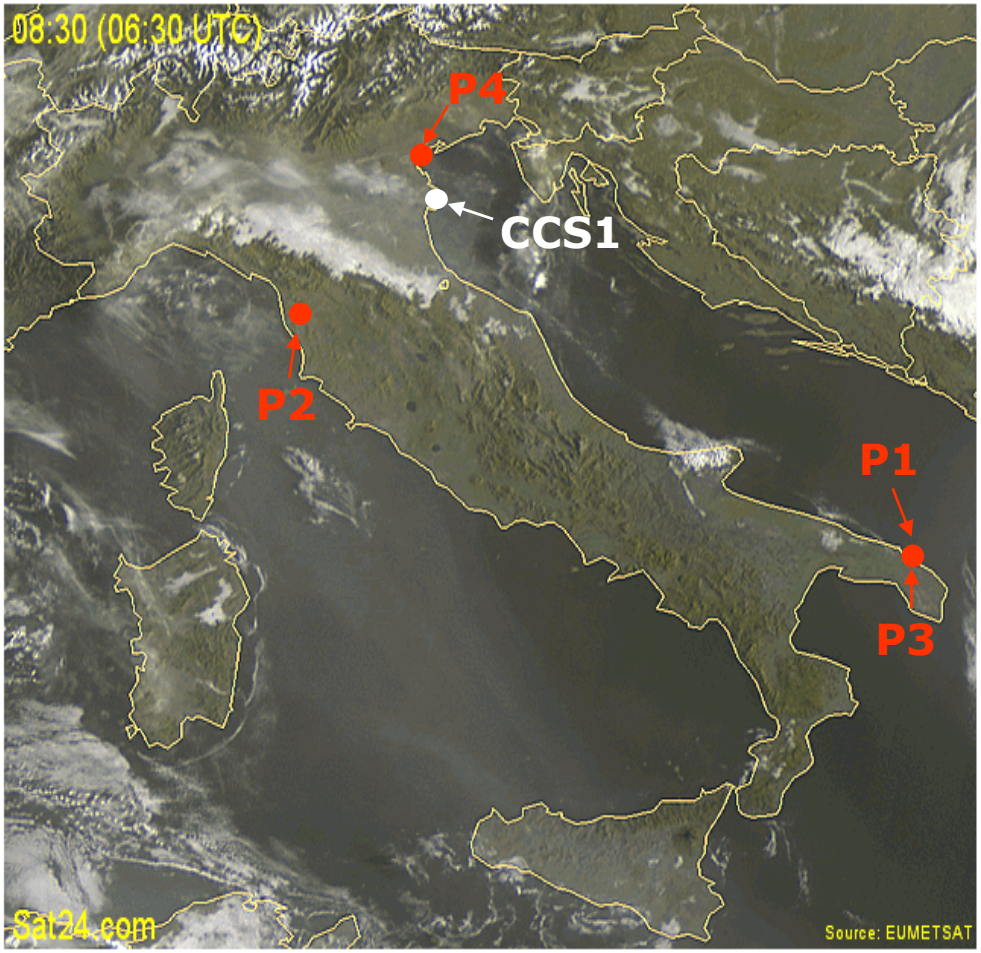
This will allow to collect experimental data to be used to:

- Validate design models (both stationary and dynamic) of the CO_2 transport line
- Optimize operating procedures
- Study corrosion problems (if any) related to the presence of impurities in the CO_2 stream



Operation by 2012

Summary of Enel's initiatives on CCS in Italy



Pilot Plants		Size	Status
P1	Post-combustion capture	2,5 t/h CO_2	In operation
P2	Atmospheric oxy-combustion	3 MW_{th}	In operation
P3	Pressurized oxy-combustion	5 MW_{th}	In operation
P4	Hydrogen combined cycle	16 MW_e	In operation

CCS demo plants		
CCS1 -Porto Tolle post-combustion demo	250 MW_e (eq.)	Detailed feasibility study in progress

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Thank you
for your kind attention