Technology Development Programme
CO₂ Capture, Transport and Storage

BRUSSELS 3rd European Coal Days November 15th 2012
Compostilla Clean Coal Projects
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CIUDEN - An initiative of the Spanish Administration

CIUDEN was created by the Spanish Government in 2006 as a R&D institution fully conceived for collaborative research in CCS and CCTs. An initiative to strength to social, industrial and technological base in Spain and Europe.
CIUDEN – Full chain CCS

TECHNOLOGY DEVELOPMENT

CAPTURE

TRANSPORT

STORAGE

INNOVATION
CIUDEN’s Technology Development Centre for CO₂ Capture and Transport

COMPOSTILLA II Power Station ENDESA

CIUDEN es.CO₂ Centre
es.CO₂ - Technical data

Oxycombustion

Pulverized Coal
20 MWth

Circulating Fluidized Bed
30 MWth

Biomass Gasifier 3 MWth

DeNOₓ
Dedust
DeSOₓ

CO₂ purification and compression

Fuels: anthracites, bit & sub-bit coals, pet coke, biomass, coal wastes
es.CO₂ - Aerial view

PC BOILER
20 MWth

FLUEGAS
CLEANING

FLUEGAS
RECIRCULATION AND MIXING

CFB BOILER
30 MWth

BIOMASS GASIFIER

CO₂ TRANSPORT RIG

CO₂ PURIFICATION

TECHNICAL BUILDINGS AND CONTROL ROOM

FUEL PREPARATION
es.CO₂ - CO₂ Transport experimental facility

<table>
<thead>
<tr>
<th>Transport loop, P</th>
<th>Doping Area, D</th>
<th>Experimentation zones, E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of tube coils</td>
<td>10</td>
<td>Number</td>
</tr>
<tr>
<td>L_{eq}, m̂</td>
<td>300</td>
<td>SO₂, NOₓ</td>
</tr>
<tr>
<td>Ø_{nom, in}</td>
<td>2”</td>
<td>H₂O, CO, H₂S, H₂, CH₄</td>
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<tr>
<td></td>
<td></td>
<td>N₂, O₂, Ar</td>
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</tbody>
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es.CO₂ - Control room and operation
CCS laboratory

Control of capture plant process parameters

Coal characterization

Petrophysical and petrographic characterization of reservoir and seal rocks

Water and gas analysis

Research on durability and reactivity of materials
CIUDEN’s Technology Development Centre for CO₂ Geological Storage

Location: Hontomín (Burgos) On-Shore Site
Under construction, **operative in 2013**
Site Characterization

3D Seismics
- CO2 Injection Area

Injection Area

Time slice
- 950 ms TWT
CIUDEN’s Technology Development Plant for CO$_2$ Geological Storage

This installation will be devoted to real scale experiments in deep porous rock formations to test and develop new technologies in storage engineering.

The location fulfils the internationally established geological criteria for installations of this kind, such as depth, porosity, thickness of the seal and reservoir formations and water salinity.
OBJECTIVES:

• To allow the hydraulic characterization of Cretaceous formations, more sensible in case of eventual CO2 leakage events.

• To detect the existence of hydraulic connections between the formations located upwards the seal formation.

• To provide the needed infrastructure to start the tasks related to groundwater monitoring prior and during CO2 injection & storage phases.

LOCATION & DESIGN
- 3 boreholes: Upper Cretaceous & Utrillas Fm.
- Prognosis of H-I & H-A

DRILLING & INSTRUM.
- Control of hydrogeological & drilling parameters.
- Development of the lithological column.
- Geophysical Logging.
- Installation of devices & pressure+quality dataloggers.

CHARACT. TESTS
- Pulse, slug or one borehole tests: Low K intervals.
- Pump tests: permeable intervals.
CIUDEN´s Technology Development Plant for CO$_2$ Geological Storage

1. Permanent seismic network
2. Superficial monitoring emission
3. Gravimetry
4. Geophysical logging
5. Piezometric level sensor
6. Shallow hydrogeological well
7. Hydrogeological logger
8. Seismovie
9. SAR Techniques

Hontomín Site characterization:
Surveys in surface

Shallow wells
CIUDEN’s Technology Development Plant for CO₂ Geological Storage

HI – Hontomín Injection well
HA – Hontomín Auscultation well

Injection Plant
CIUDEN´s Technology Development Plant for CO₂ Geological Storage
Wells Geometry, Completation & Instrumentation

Depth in meters; sizes in inches
H.S.: 1:10 / V.S.: 1:10.0000

3rd European Coal Days 2012
Concepts and strategies will be tested for efficient CO₂ injection:

- **Continuous** CO₂ injection (conventional CO₂ injection).
- CO₂ injection at **fluctuating flowrates**: increasing the CO₂ dissolution rate.
- **Liquid** CO₂ injection (cold injection): improvement of the energy efficiency and enhancement of the storage operation.

Hydrogeochemical tests will be developed to identify **thermo-hydro-chemical-mechanical** properties of the reservoir and caprock formations. The characterization tests planned at the Hontomín TDP include:

- **Hydraulic** (pumping-injection) tests.
- Tracer tests (conservative and reactive tracers) (**push-pull**).
- Injection-extraction of CO₂ with gaseous tracers (**CO₂ push-pull**).
Safety & Risk Analysis: Probabilistic Model

Objective:
To develop a risk probabilistic assessment model related to deep geological CO2 Storage in saline carbonate aquifers, proved with results from experimental activities at real scale in Hontomin TDP
CIUDEN´S STRATEGIC LINES

-Ciuden´s facilities cover the full C02 chain at large-pilot scale (Capture, Transport and Geological Storage), to be considered as a real demo project. This set of first-of-its-kind contributes towards commercial deployment of CCS, improving coal fired power plants efficiency.

-Establish European and International partnerships involving leading CCS technology representatives (Coal producers, utilities companies, government authorities, technology designers and suppliers, policies makers, etc)

- Increase the knowledge of the technology and expertise in Europe.

- Inform policy makers, establish guidelines for permitting and identify options for cost reductions.

- Build the trust of the general public and to gain acceptance toward CCS.

- Centre core of innovation, training and investigation of excellence in energy.
CIUDEN is willing to become Europe’s demo facilities for Carbon Capture, Transport and Geological Storage
Thanks for the attention

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