OXY-CFB-300 COMPOSTILLA PROJECT

IEAGHG-OCC3

Presented by:

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0- INTRODUCTION - ENDESA CCS ACTIVITIES

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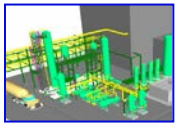
PRE-COMBUSTION

Coal



- ELCOGAS
- IGCC

GN

- Gas reformer

POST-COMBUSTION

- Calcium looping (LA PEREDA)
- Chem. Absorption (COMPOSTILLA)
- Physical Absorption
- Membranes
- Cryogen.

OXY-COMBUSTION

- Direct
  - C.Cycle
  - Pulv. Coal
  - CFB. (OXYCFB300MW)
- Indirect
  - Chemical Looping

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0- INTRODUCTION PROCESS EEPR PHASE 1

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0- INTRODUCTION

CCS VALUE CHAIN

- **CAPTURE TECHNOLOGY**

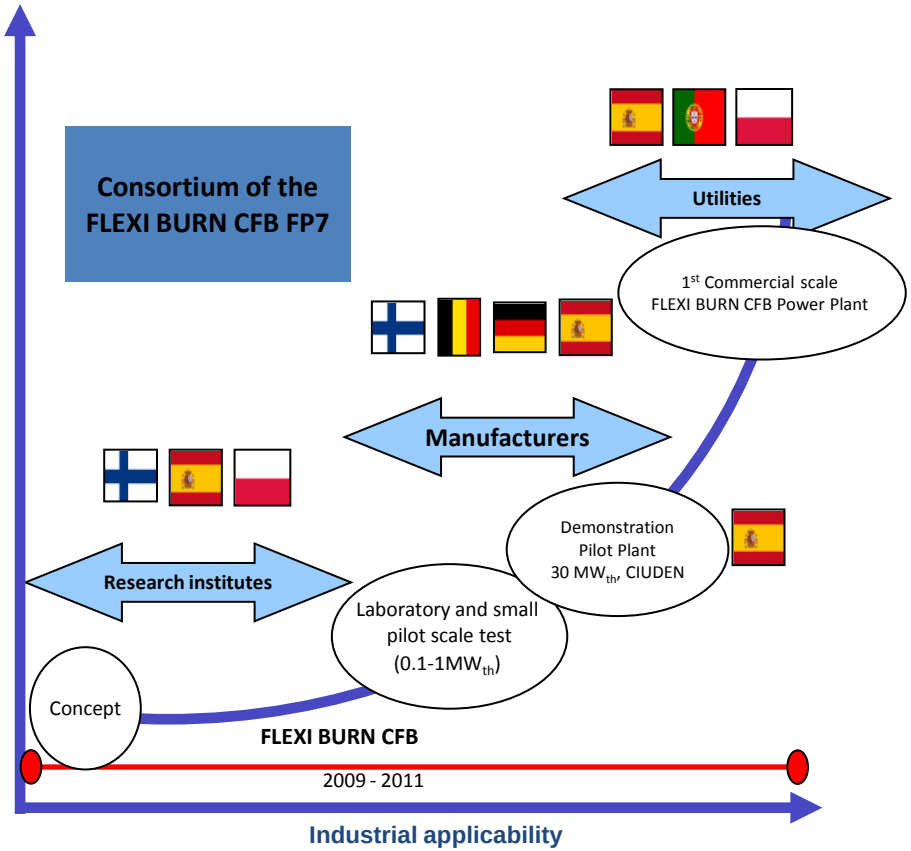
  OXY - CFB Supercritical Boiler; wide fuel (domestic and imported) design range, including biomass

- **CO2 TRANSPORT**

  14" underground pipeline; 147 Km
  5,500 t/day; ~ 150 -110 bar

- **CO2 STORAGE**

  Deep saline formation
  Duero and Ebro basins



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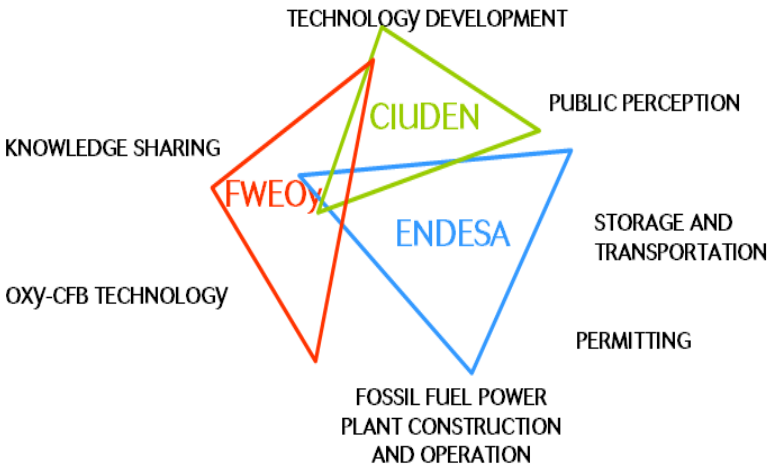
EEPR – BENEFICIARIES

ENDESA GENERACION

CIUDEN

FOSTER WHEELER



ENDESA GENERACION

- General coordination and project management.
- FEED Capture, Transport and Storage.
- Permitting.
- Knowledge Sharing.
- Feasibility Studies and Risk Analysis.

CIUDEN

- CCS Technology Development Centres promoter
- Public Perception.
- Knowledge Sharing.

FOSTER WHEELER

- OXY-CFB Technology developer and provider.
- ASU-CPU integration.
- Knowledge Sharing.

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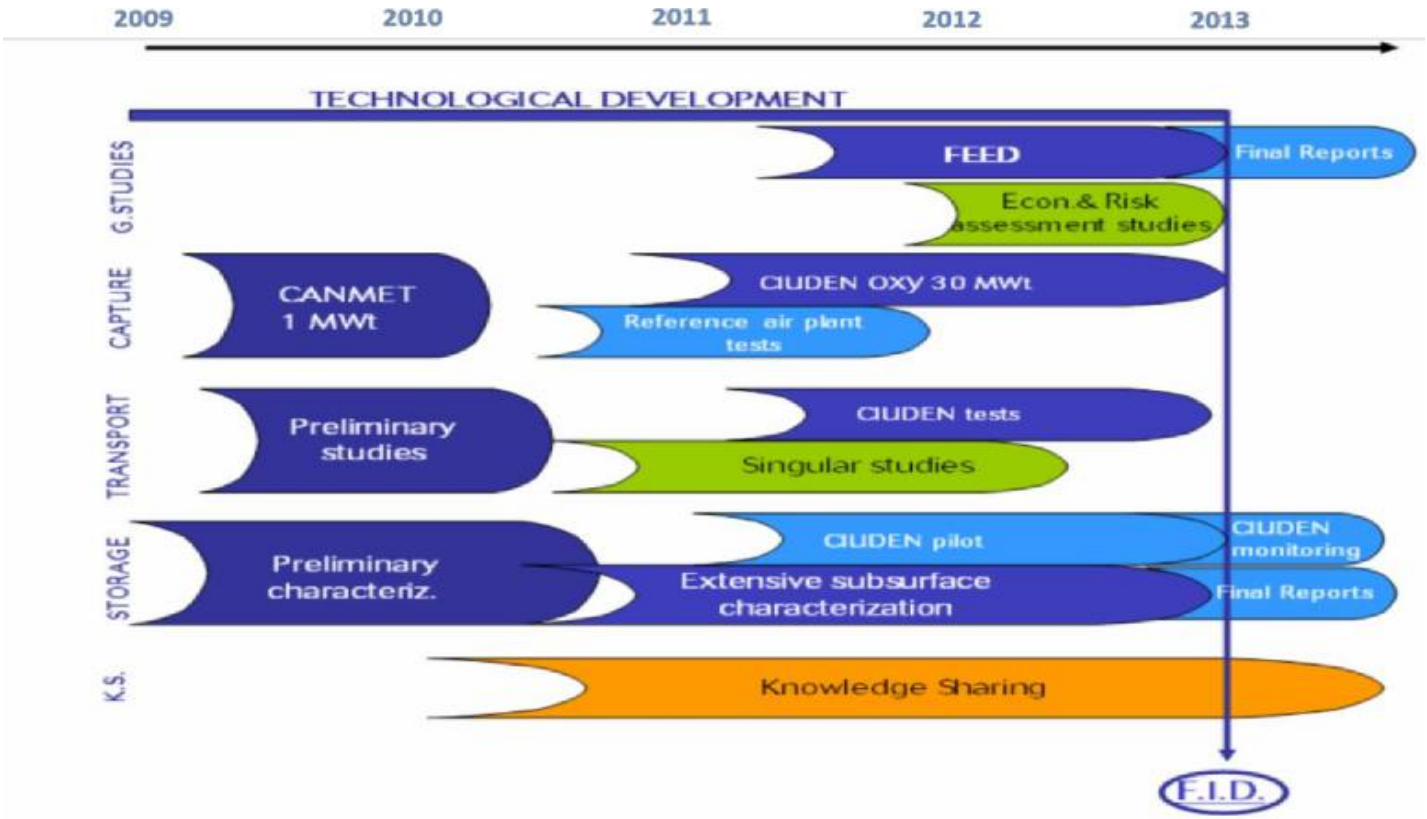
0- INTRODUCTION



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1- CAPTURE OXY- FUEL COMBUSTION PROCESS

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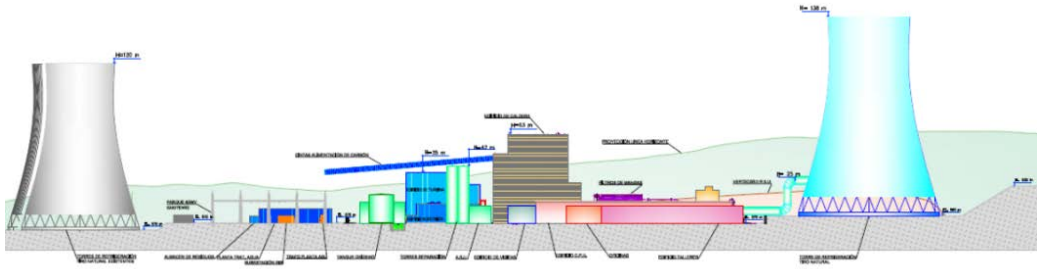

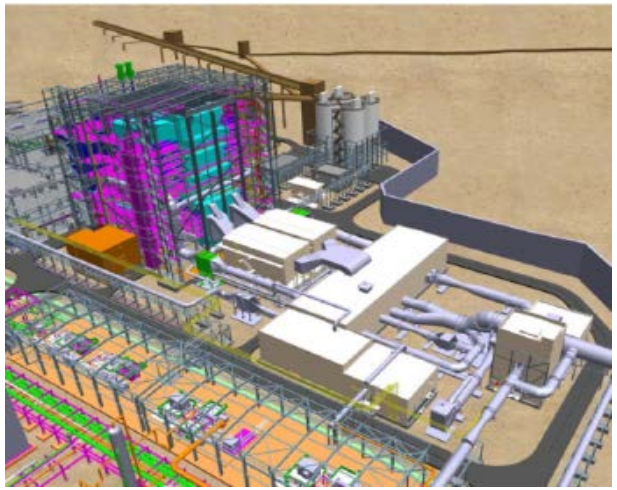

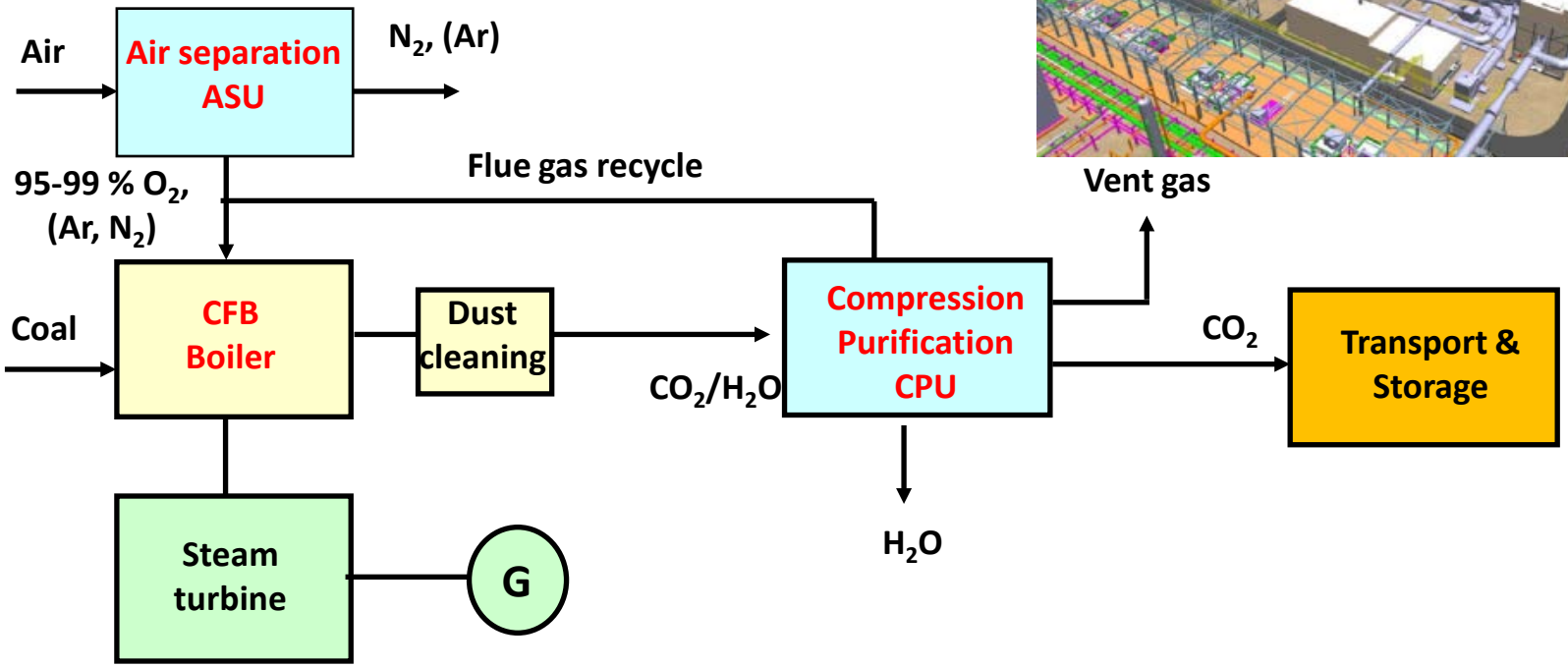

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1- CAPTURE – ASU

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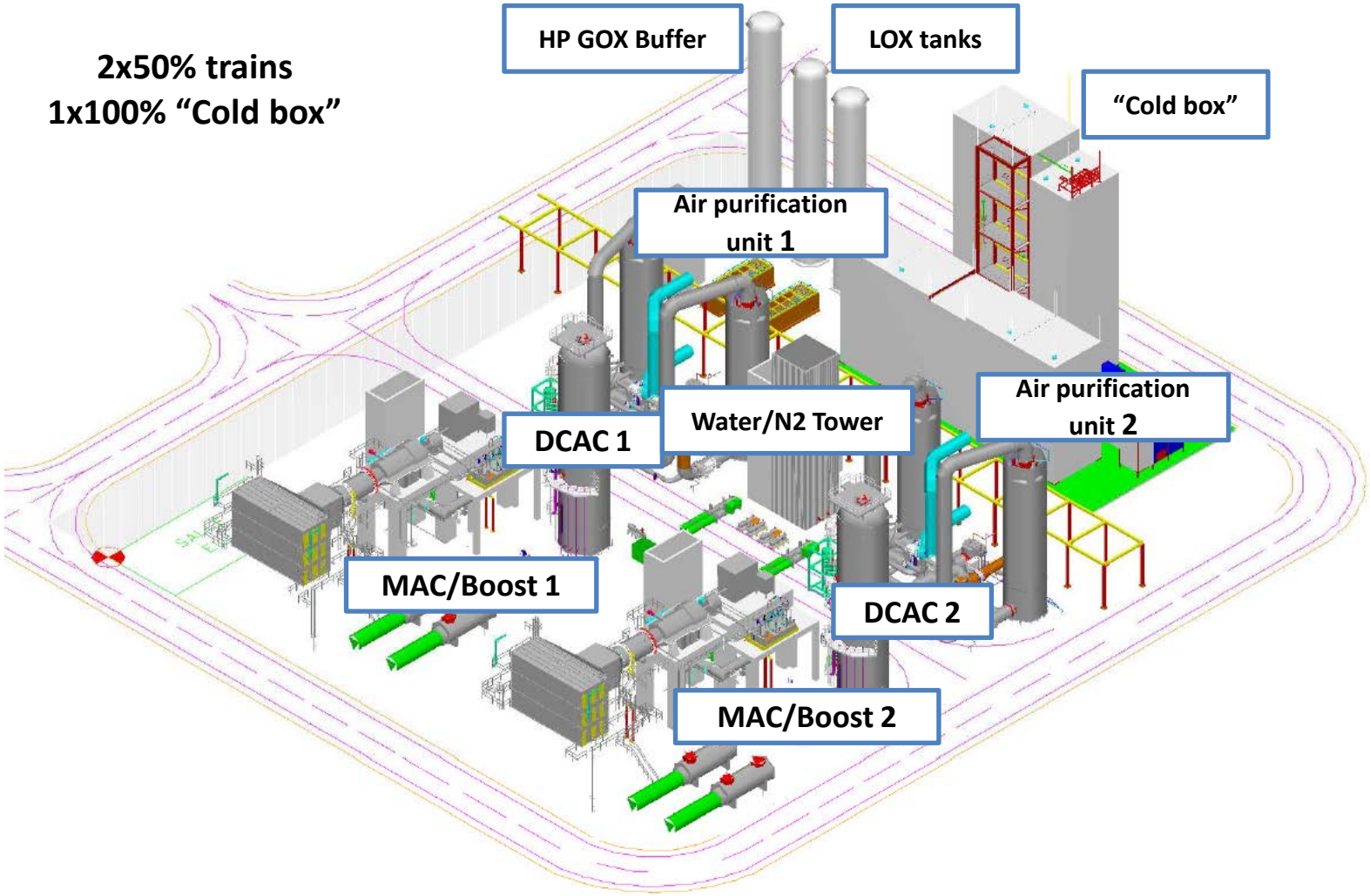
2x50% trains
1x100% "Cold box"



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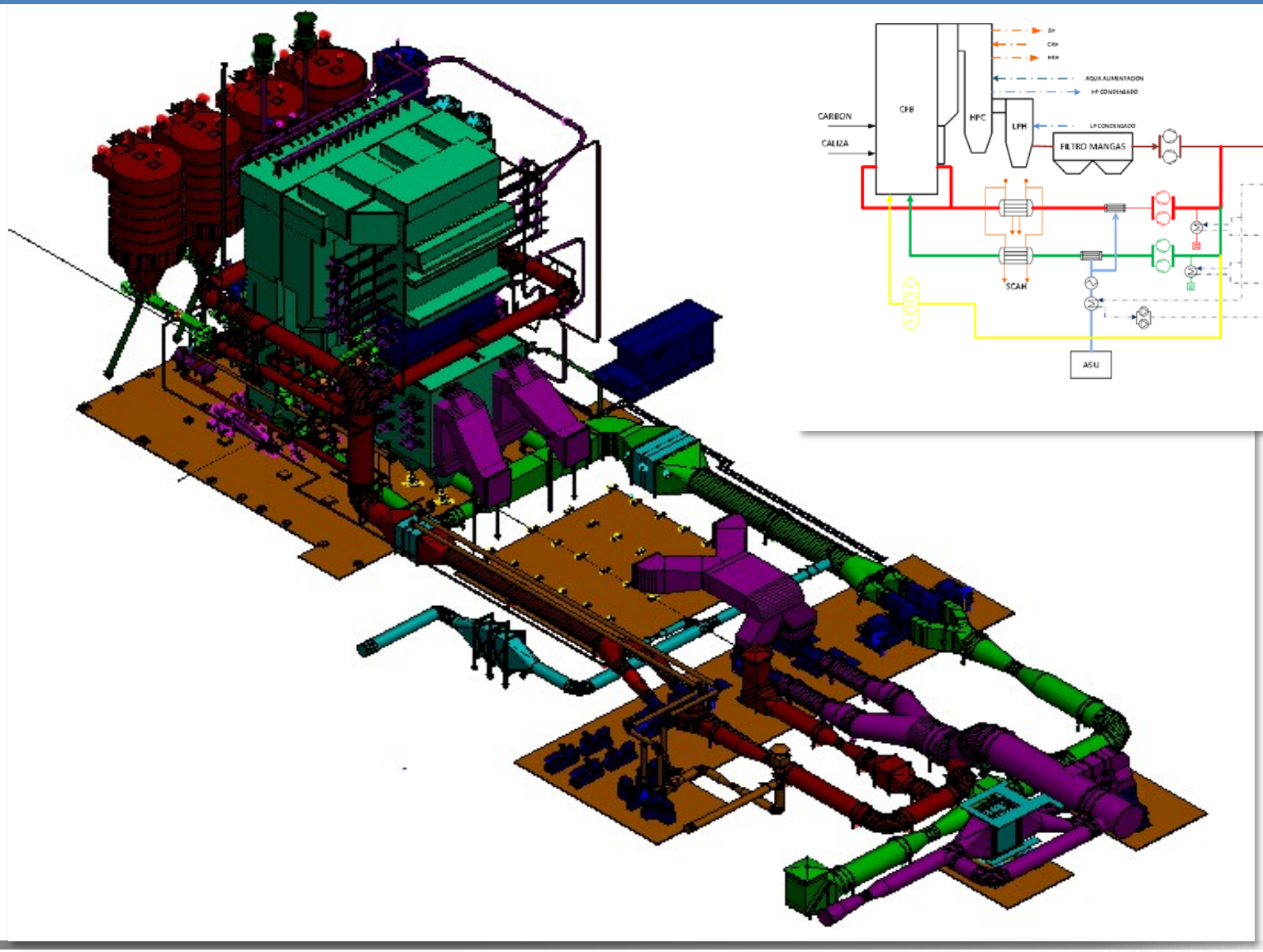
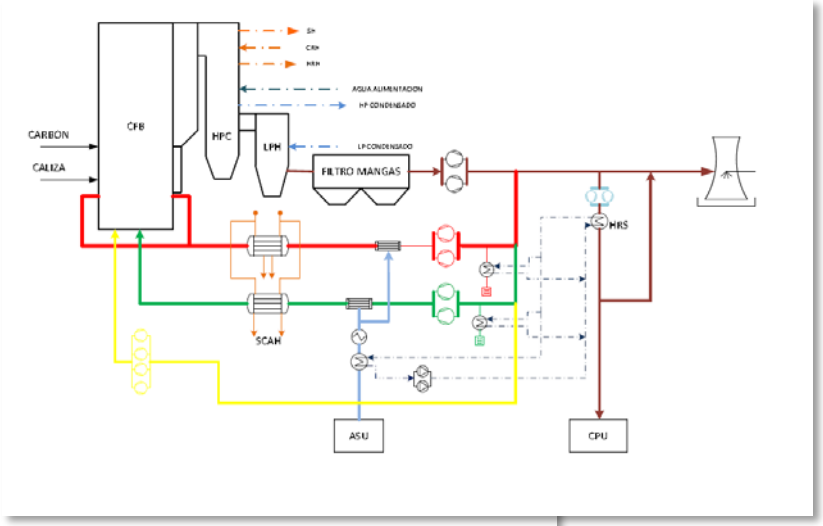
1- CAPTURE – BOILER





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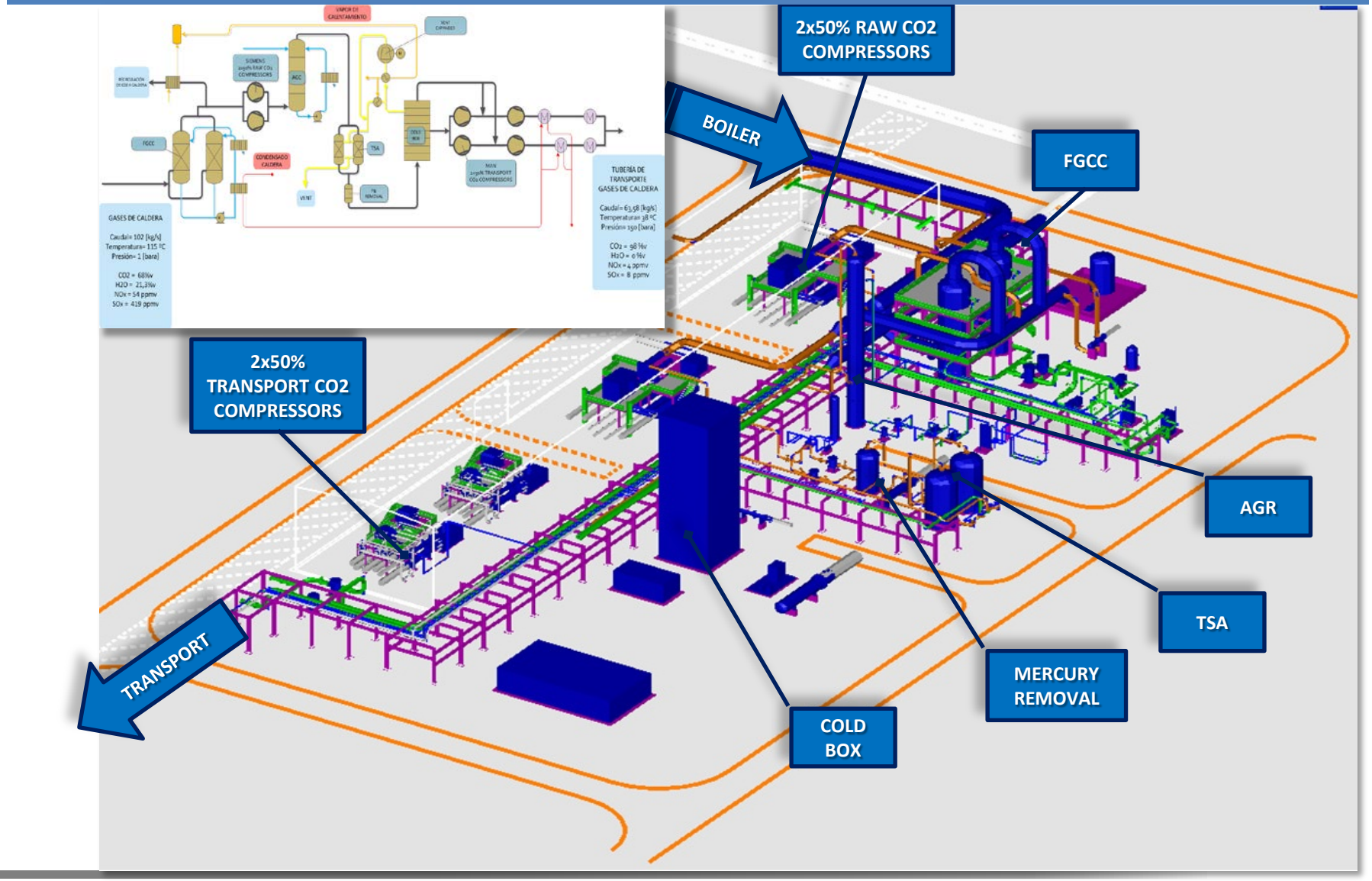
1- CAPTURE – CPU



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1- CAPTURE – MAIN DATA

Power plant Characteristics	Air	Oxy
-FUEL (kg/s)		
COAL	28,5	30,9
LIMESTONE	7,44	7,99
Oxidant(Air/O2)	272	58,4
-Power		
-Gross power (MW)	299,8	345,2
-Auxiliary consumption (MWe)		
ASU	-	38,5
CPU	-	19,2
Others	29,8	34,8
-Net power, without compressor (MWe)	270	252,7
Efficiency % (PCI)	41,1	35,4

CO2 parameters (without compressor)	
CO2 Captured (% weight CO2)	91%
CO2 Captured (ton/yr)*	1.287.007
CO2 Emitted (ton/yr)*(OXY+AIR)	218.417
*5606 equivalent operating hours OXY mode 394 equivalent operating hours AIR mode	
CO2 Captured (g/kWh)	908,5
CO2 Emitted (g/kWh)	89,8
CO2 Avoided (g/kWh)	766,8

Compression for transport and injection of CO2	
Compressor consumption (MWe)	15
Efficiency with compression % (PCI)	33,3

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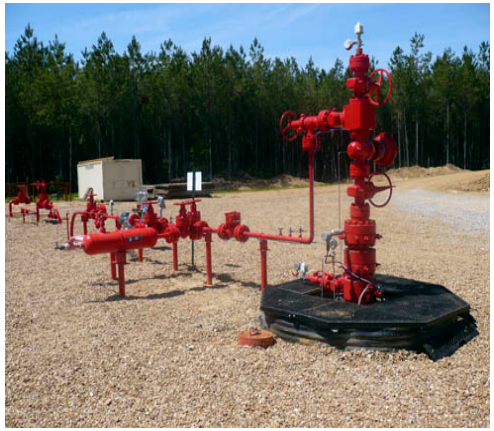
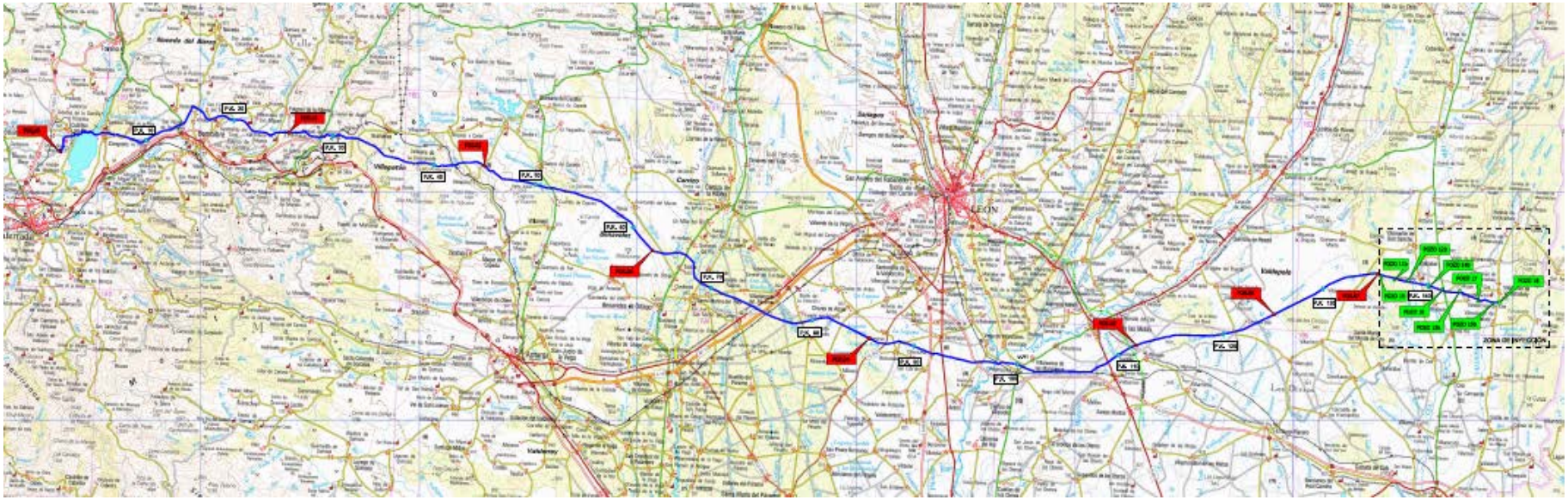
2- TRANSPORT CO_2 LAYOUT APPROACH

CO_2 Transport basics:

- Flow: 63,8 kg/s
- Composition: 97,5 % CO_2
- Distance: 147 km
- Type: Underground steel pipeline





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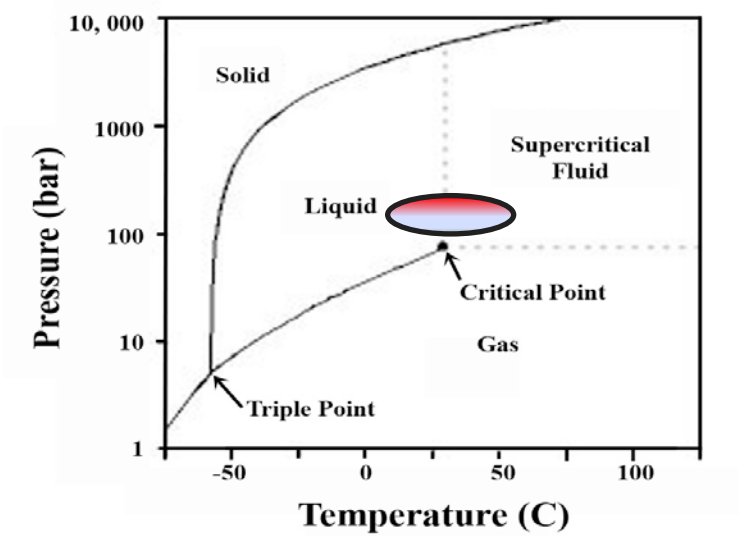
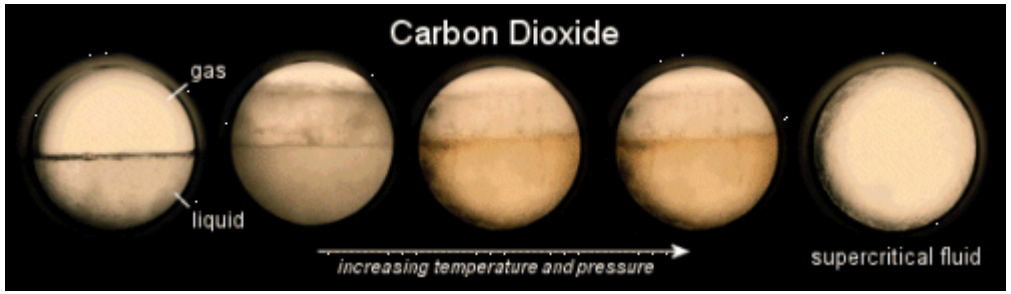
2- TRANSPORT CO_2 DESIGN CONDITIONS

Dense phase (Liquid/Supercritical)





- Behaviour as a liquid (compressible)
- Reduced head losses (Low viscosity)
- Suitable specific volume (aprox. Water density)
- No thermal insulation required

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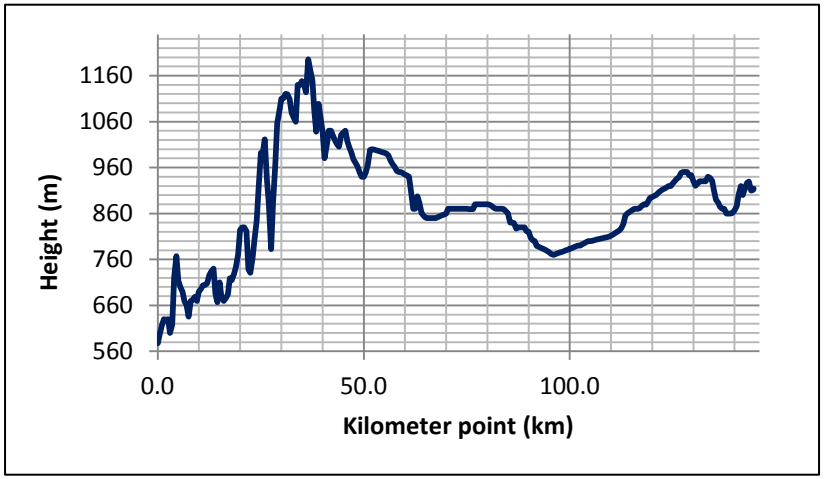
2- TRANSPORT CO_2 BASIC DATA



- No Intermediate Pump station
- Inlet pressure: 150 bar
- Outlet pressure: 100 bar
- Inlet to outlet height difference: 350 m
- Max. height difference: 600 m

Pipeline data:

Length:	147 km
Diameter:	14”
Pipe Quality:	API 5L X70
External coating:	HDPE
Burial Depth:	> 1,5 m

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2- TRANSPORT CO_2 TESTS

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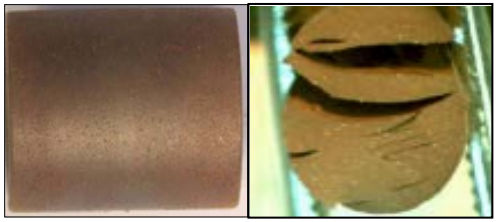
Release dispersion

Available dispersion software validation

Crack Arrest determination

Crack arrestor devices needs

Material behavior



Material selection

CO_2 & impurities Thermophisicals

Real fluid characteristics

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2- TRANSPORT CO_2 STUDIES AND DOCUMENTS

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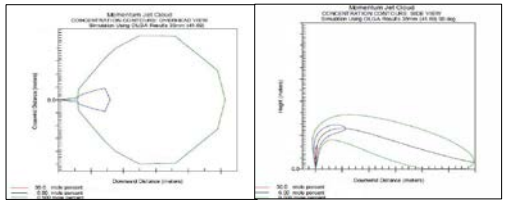
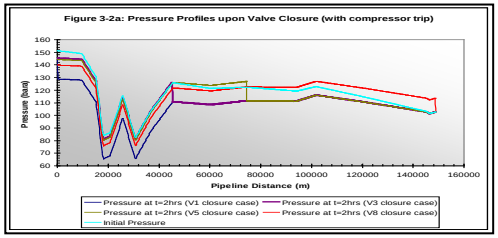
Dispersion studies



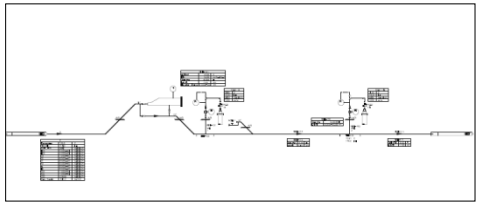
HAZID

LIKELIHOOD OF OCCURRENCE	HAZARD SEVERITY: Negligible (1)	Slight (2)	Moderate (3)	High (4)	Very high (5)
Very Unlikely (A)	LOW	LOW	LOW	LOW	MEDIUM
Unlikely (B)	LOW	LOW	LOW	MEDIUM	MEDIUM
Possible (C)	LOW	LOW	MEDIUM	MEDIUM	HIGH
Likely (D)	LOW	MEDIUM	MEDIUM	HIGH	HIGH
Very Likely (E)	LOW	MEDIUM	HIGH	HIGH	HIGH

Flow assurance studies

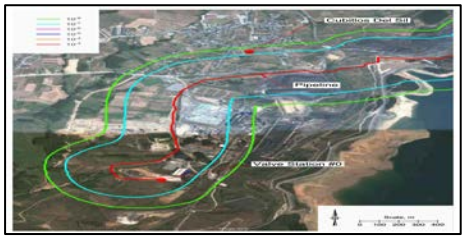


HAZOP

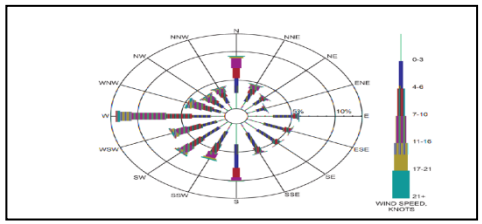


Basic Environmental Assesment

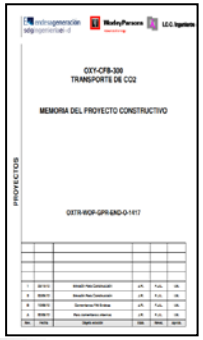
QRA



Environmental Assesment



FEED - Front End Engineering and Design



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3- STORAGE WORKS DESCRIPTION

1. Pre - Screening and ranking storage sites.
2. Sites Assessment.
3. The Site characterization and extensive characterization activities
4. Monitoring and risk management plan base line of CO2
5. Front-End-Engineering-Design (FEED)

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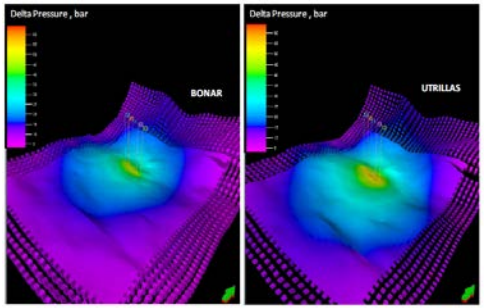
3- STORAGE. SUMMARY AND CONCLUSIONS

1. An appraisal program and feasibility studies were carried out in the Duero basin to investigate its performance as a CO2 storage site.
2. A 3-D seismic survey and five wells was performed, to acquire data for reservoir and cap-rock characterization.
3. The dynamic data collected covered the overall CO2 storage basic parameters (permeability, pressure, temperature gradient, etc).
4. Development of Mechanical and geochemical models for the reservoirs, to confirm the required cap-rock and seals availability and reliability.
5. Several vertical flow simulations in CO2 injectors with transient effects, and associated reservoir geo-mechanics modeling were performed.



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3- STORAGE. SUMMARY AND CONCLUSIONS

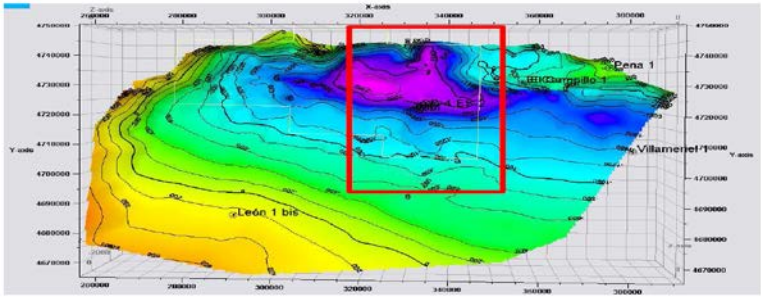
6. Evaluation of capacity, injectivity and containment to define the injection strategy was analized and defined as information for the FID.

7. The risk analysis and risk management were performed following the International references such as IEAGHG, adapted by NETL & European Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide – Guidance Document 2.

8. Based on risk analysis & constraints the monitoring plan was defined, as a basis, deep monitoring wells system were defined.

10. Finally Three injection and Five monitoring wells were established as injection strategy. Detail design of the wells were performed including its drilling program.

11. Duero site is able to storage the total amount of the CO2 produced in the lifetime of the OXY-CFB-300 under safety conditions.



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4- FID CONCLUSIONS - PRELIMINARY

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- **Technical**

• Good forecast feasibility, with certain outstanding operating concerns that shall be fixed during a future construction phase whit additional and focused detailed process simulation and R&D activities

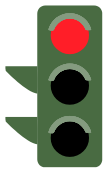
- **Public Perception**

• In general, good social acceptance is achieved in the plant vicinity although some particular contest could arise in the future during final storage permitting steps.

- **Regulatory & Permitting**

• The lack of dedicated authorization norms doesn't allow currently the completion of the required permitting process.
• Regarding the existing electrical system regulation, a commercial size demo-plant requires an specific retribution frame to operate the Plant in the pool market and to ensure a certain operating hours for a minimum of 15 years period.

- **Financial & Economical**



• Specific founding program shall be implemented to compensate the technological risks and the additional operating CCS costs.
• The support of the Administration and technologist Suppliers contribution are essential to complement the Promoters participation.

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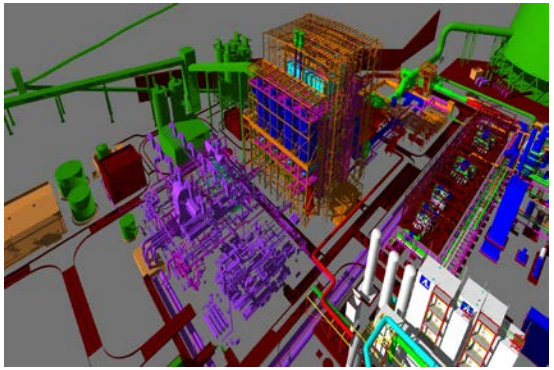
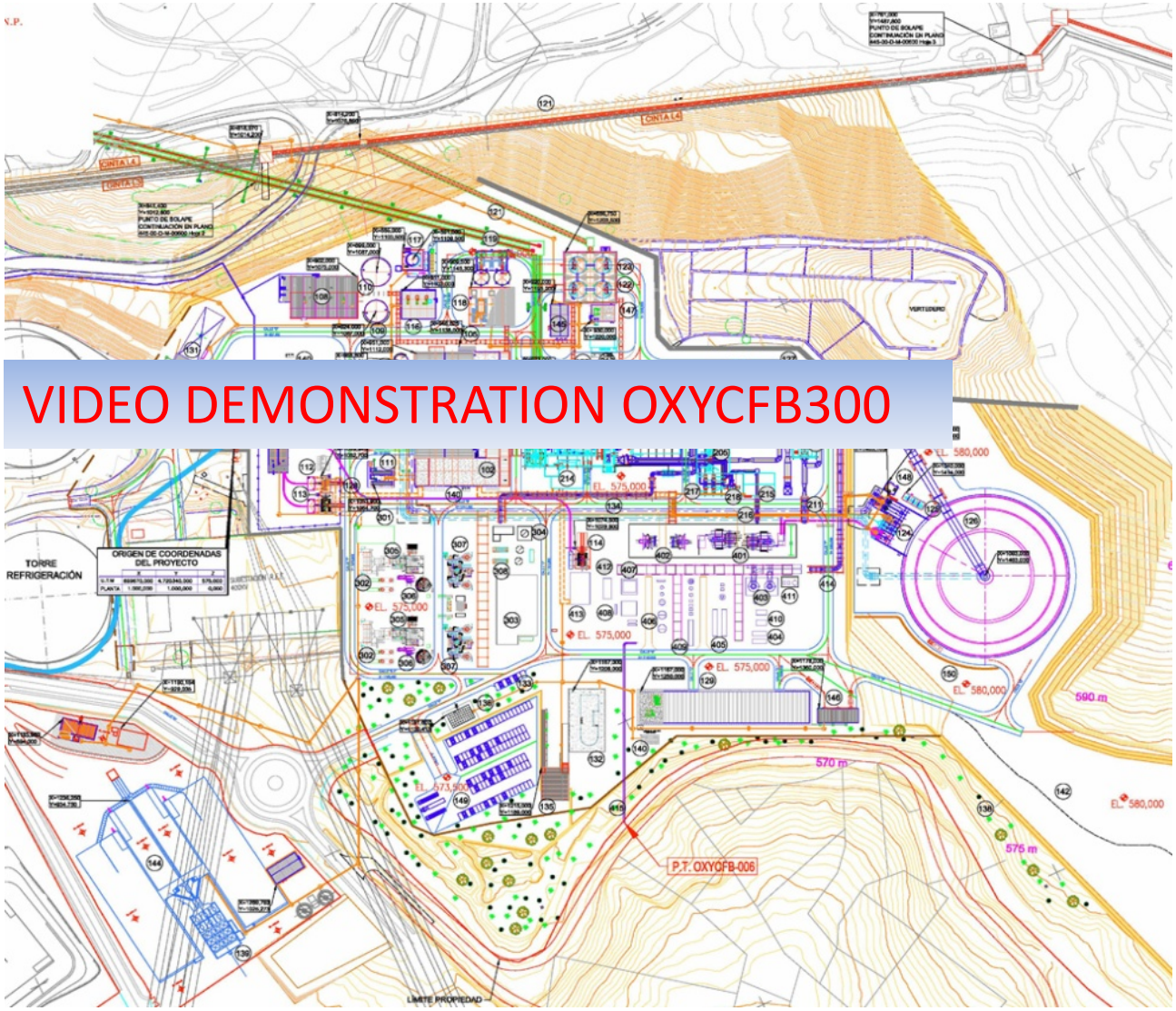
5- VIDEO DEMONSTRATION PLANT





VIDEO DEMONSTRATION OXYCFB300

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5-VIDEO DEMOSTRATION

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