



# Belchatow CCS Project

PGE Polska Grupa Energetyczna S.A.

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#### Introduction

In 2009 PGE Belchatow Power Plant initiated activities aiming at construction of a demonstration CCS plant.

The CCS plant was intended to be integrated with the 858 MW power unit, hereinafter also referred to as Base Plant, that since September 2011 has been running at Belchatow Power Plant Division.





#### Integration with 858 MW power generation unit

The new 858 MWe power generation unit was originally not designed to be "Capture Ready". This means that some modifications to the unit needed to be implemented in the course of its construction to ensure an integration of the CCP.

The key modifications included:

- Re-engineering and re-location of the equipment from the area identified for the CCP
- Tie-in for off-take and return of cooling water required for the CCP
- Tie-in for off-take and return of flue gas to the main flue gas ducts

The scope of work was completed on 30<sup>th</sup> October 2010 as a part of the EPC turnkey contract dedicated to the new 858 MWe power generation unit





## Technical specifications of the CCS Plant (Basis of Design)

The Bełchatów CCS Project included the following key components:

- The power generation unit with the gross capacity of 858 MWe, supercritical parameters, efficiency 42%, lignite fired
- **Carbon Capture Plant (CCP)** of size equivalent to 260 MW, capture efficiency 85%, utilizing the Advanced Amine Process (AAP) & its integration with the 858 MW unit, scaled to capture approximately 1,8 million tones of CO<sub>2</sub> per annum, a slipstream of the flue gas equivalent to 33.3% of total flue gas flow was extracted from a tie-in connection point located downstream one of the wet FGD absorbers
- CO<sub>2</sub> Transportation: this component comprised the construction of the (buried) pipeline and the associated infrastructure to transport the compressed CO<sub>2</sub> from the Carbon Capture Plant to the storage site
- **CO<sub>2</sub> Storage**: this component covered injection of pressurized CO<sub>2</sub> into the ground (deep saline aquifers) for permanent storage and the associated facilities



#### **Carbon Capture Plant (CCP)**



- Dec. 11<sup>th</sup>, 2009 the first CCP Environmental Decision was issued.
- Feb. 23<sup>rd</sup>, 2010 r. a building permit for the CCP was validated
- At the beginning of 2010 the AAP scheme was changed into 2nd generation flow scheme, which should result in CCP operating costs reduction, especially considerable steam consumption drop. The 2nd generation flow scheme resulted in several changes in the context of number and size of equipment
- In 2010 FEED documentation, additionally was extended of the part of works including detail engineering process for the critical equipment
- Finally the entire FEED and Detailed Engineering documentation were delivered by the Contractor on June 6<sup>th</sup>, 2011.

# The next step was planned: selection of the Main Contractor of CCP in turnkey contract formula

#### **Belchatow CCS Project**

## Transport component (1)

- In 2009 the Feasibility Study for CO<sub>2</sub> pipeline was prepared
- Moreover transport preparatory work programme: started : June 2012, terminated : January 2013,
- Work scope covered:
  - Comprehensive pipeline routing
  - Preliminary technical analysis of the CO<sub>2</sub> pipeline
  - Preliminary technical analysis of pipeline depressurisation conditions
  - The entire documentation concerning plots' owner registry
- The analysis resulted in seizing the optimal CO<sub>2</sub> pipeline diameter i.e. 300 mm and the maximum possible distance between the block valves and associated depressurization columns (to 16 km)
- Consequently the total number of communes that the pipeline would run through equals 16, pipeline length ~142 km
- The entire documentation concerning plots' owner registry total number of plots – 4097





#### Storage component (1)



#### 2009 - 2011 Phase I of the storage component: "Site selection".

Within Phase I of storage component geological examination two of the three storage structures under consideration, i.e. Lutomiersk-Tuszyn (up to Bełchatów) and Wojszyce, was ongoing and included 2D seismic, drilling tests, gravimetric and additional specific research in appraisal wells dedicated to  $CO_2$  migration, i.a. reservoir and seal rocks magnetic resonance, advanced sonic, well inclination, electrical formation imaging, element spectroscopy, formation pressure, isolation scanner, sidewall cores, minifrac, strength measurement, compression tests, etc. The third potential storage site, Budziszewice, had adequate geological data archived and available. Therefore, only data reprocessing and new interpretation was considered for this  $CO_2$  storage site location.

Drilling rig at the Wojszyce and Lutomiersk – Tuszyn sites





Protected area of the appraisal well at the Wojszyce site (Kaszewy-1 hole).

## Storage component (2)



- In February, 2012 the Wojszyce structure (North part of Lodzkie Voivodeship) was selected for the Phase II of the storage component implementation, i.e. Site Characterization with the Budziszewice structure as an alternative.
- The main reasoning behind the choice of Wojszyce was:
  - Relatively simple anticlinal structure without faulting and thick, homogeneous caprocks
  - High excess capacity
  - Only one existing and properly abandoned well
- Following the above, activities had been undertaken within the Phase II: "Selected Site Characterization" and a tendering procedure aiming at selection of the Coordinator of the Phase II of the storage component. was commenced in March 2012.
- This tender had, however, to be cancelled two times:
  - in July 2012 as the only one submitted offer did not fulfil the qualification criteria of the tender
  - In January 2013, because the only one submitted offer exceeded significantly the planned budget.

# CAPEX and OPEX – funding opportunities PGE Polska Grupa

Given the demonstration character of CCS Project, PGE GiEK SA would prefer to arrange non-refundable financing support as much as possible. The following sources of financing were expected to provide the basis for funding the CCS Project:

- European Energy Plan for Recovery (EEPR) grant agreement was signed on 5<sup>th</sup> May 2010.
- Emissions Trading Scheme "NER300" Programme the application was submitted on 9<sup>th</sup> February 2011
- Norwegian Financial Mechanism (NFM) Memorandum of Understanding was signed on 10<sup>th</sup> June 2011
- Domestic Financing Mechanism





The Betchatów CCS Demonstration Project for Carbon Capture and Storage (CCS) run by PGE Górnictwo i Energetyka Konwencjonalna Społka Akcyjna

CC:

## Public engagement activities

The strategic impact of public understanding and acceptance of the CCS concept is substantial in enabling its widespread commercialization. Outreach activities particularly concerning  $CO_2$  transport and geological storage:

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• Since September 2009 were organized meetings and workshops with authorities from regional and local level.

• Since September 2009 to the end of August 2010 outreach team provided the external public engagement campaign according to I Phase of the storage component development for communities, where geological examination and tests were ongoing.

• 2010/2011 social groups characterization done by an external PR company.

• Twenty five briefing meetings in March 2012 have been held in the community offices of the local authority representatives in Lodzkie Voivodeship.

• Since July 2012 PGE had been conducting an informative campaign concerning the preparatory work for  $CO_2$  transportation pipeline in 16 of the Communities in Lodz Voivodeship.

## Resignation



#### February, 2013 was made the decision to close the Bełchatów CCS Project

The most important threats were:

- Lack of legal and financial framework at the national level for implementation of the CCS Project, in those days reflected by:
  - o lack of support financing of the project within the Domestic Financial Mechanism,
  - delayed implementation of the directive on the geological storage of carbon dioxide into national legal framework
  - lack of legal mechanisms allowing for qualification of the CO<sub>2</sub> transportation pipeline as a public purpose investment, it significantly complicated the process of consultations with local authorities
- Problems with selection of the Coordinator of Phase II of the storage component caused by a lack of interest of the oil & gas companies to invest in the risky and uncertain CCS area facing the perspective of quick benefits in the field of for instance shale gas
- Opposition of the public to geological and geophysical works carried out within the storage component implementation, and to the idea of underground CO<sub>2</sub> storage in general, and in some communes also lack of public acceptance for routing the CO<sub>2</sub> transportation pipeline.

#### Lessons learned (1)



What is necessary:

- Support and involvement of the local, regional and national governments throughout all project phases, as well as a positive public perception especially for both onshore transport and storage, are crucial for creating the advantageous circumstances for the successful implementation
- CO<sub>2</sub> transportation pipeline should be qualified as a public purpose investment to eliminate barriers in the investment process (also specific act of transportation corridors including CO<sub>2</sub> option would be useful)
- Financial support for the project from all levels: EC assistance, national and potentially regional to the investment phase as well as operational phase as long as CCS will fully commercial and competitive
- Productive cooperation between both power plant construction and CCS teams is essential.
- Selection of the proper technology provider, who has to recognize and address in a proper way process dynamics limitations early at the stage of the design process

#### Lessons learned (2)



- To select, examine and characterize a storage site to mitigate all threats and risks concerning CO<sub>2</sub> leakage and to locate the storage site as near as possible to carbon capture plant (risk concerning CO<sub>2</sub> transport aspects evaluation) and also within a quiet sparsely populated area
- To organize a very comprehensive public campaign from the start up of the project implementation, even during the planning phase. Stakeholders have to be informed all the time and feel, that play crucial role in project decisions' process.

#### What is valuable:

- Experience gained from active participation in CCS networks and platforms to share experiences and learn from other CCS initiatives
- Multidisciplinary CCS project character forced to create competent all-party project team: technical, public engagement, permitting, financial, knowledge dissemination specialists with enthusiastic, ambitious people deeply involved in the project
- Valuable technical documentation provided during the project lifetime
- Knowledge and experience obtained in the aspect of the implementation projects being subject of EC financial assistance

New approach R&D



- Carbon capture utilisation is a promising future solution to keep a reduction of the CO<sub>2</sub> emission moving
- CCU takes CO2 from point sources then converts it into commercially valuable products.
- PGE identified CCU topic among strategic R&D areas as follow:



#### We appreciate interesting initiatives to potential cooperation



#### Thank you for your attention



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