Polish CCS Demonstration Plant fully integrated into new unit 858 MW in Belchatow Power Plant (EBSA)

PGE Górnictwo i Energetyka Konwencjonalna S.A.
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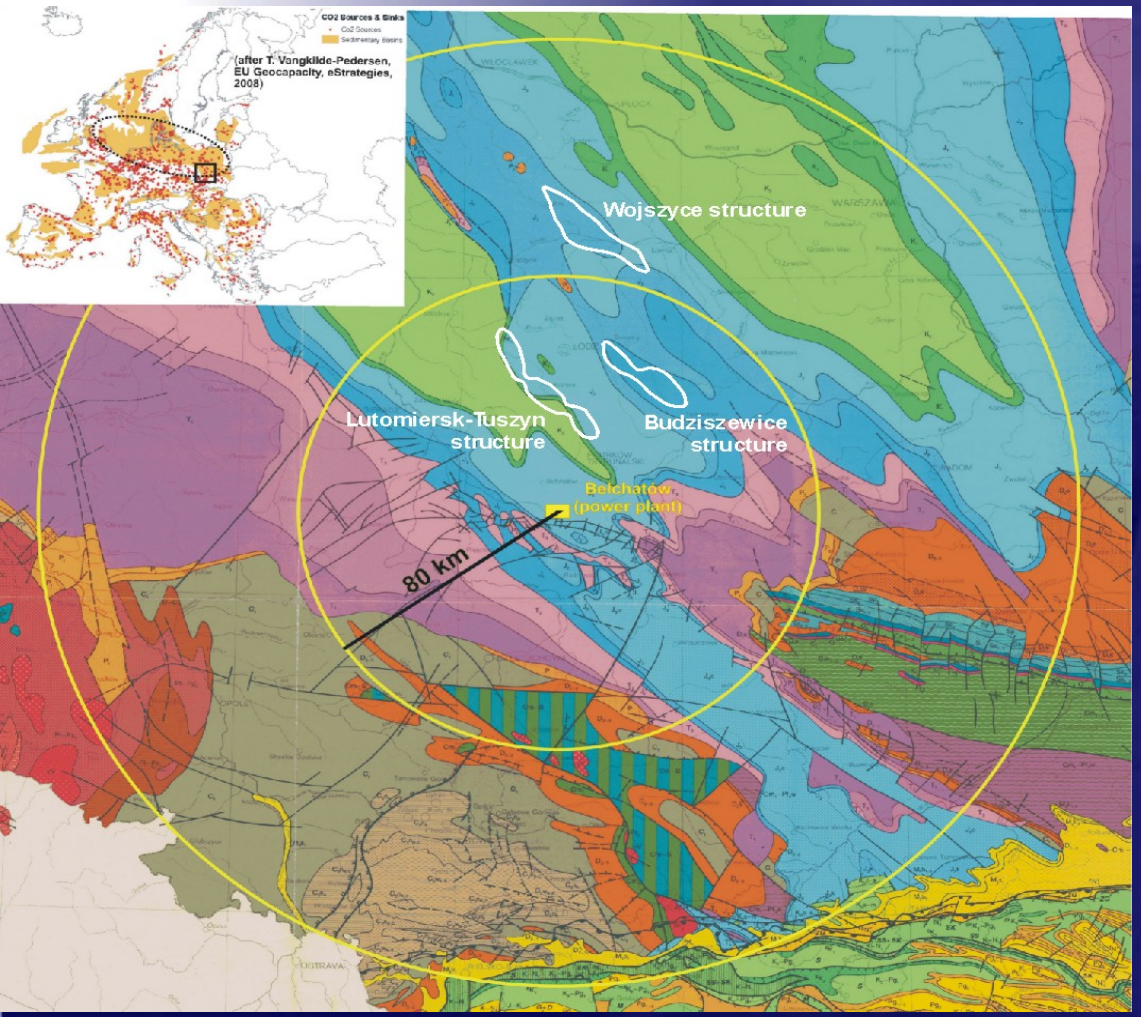
1. Project Overview

Technical specification of CCS Installation

- Post-combustion technology based on „advanced amine process”
- 1.8 million tonne of CO_2 captured and stored per annum, 235 tph
- Capture rate 90%
- Amount of flue gas corresponds to 260 MWe
- CCP heat consumption: 2.2 GJ/tone CO_2 (30,1 MWe)
- Gross capacity of 858 MW Power Plant with CCP: ~827.9 MWe
- CCP energy consumption: ~40.0 MWe
- Anticipated new power plant efficiency without CCP: ~41.7%
- Anticipated new power plant efficiency with CCP (with vapour to amine regeneration, without CCP equipment demands): ~39.8 %
- Transport of compressed CO_2 in supercritical conditions using pipeline to storage site within 60-140 km
- Storage at deep saline aquifers
- Investment cost: 2.3 bln PLN (approx. 767 mln USD)

Three potential storage structures



- **Budziszewice –**

  Structure in distance of 60 km

- **Lutomiersk-Tuszyn –**

  located between 45 and 60 km in north of Belchatow Power Plant

- **Wojszyce –**

  maximize chance of finding suitable storage site for CO_2, an area further north about 115 km from Belchatow has been screened for potential structures seems most promising

Entire CCS Project Schedule

- **Capture installation**
  - Building permit validation: 22 Feb 2010 - completed
  - Completion of Capture Ready modifications: Jun 2010 - partially completed
  - Mechanical completion: December 2013 - to be confirmed following selection of CCP contractor
- **Transport**
  - Building permit: Aug 2013
  - Construction completion: Nov 2014
- **Storage**
  - Storage site selection - 1st half of 2011
  - Permit application and storage site construction start up: Dec 2012
  - Construction completion: Dec 2014
  - Injection permit: Dec 2014
- **Optimization process completion and CCS final acceptance - Dec 2015 - We still believe it is possible to meet this deadline for entire CCS value chain completion.**

CCS – Partners of Belchatow Power Plant

- **Capture island**
- *Alstom Group* – Partner in development of „advanced amine" technology
- *Dow Chemical* – Supplier of a selected solvent to capture CO_2 from industrial flue gas stream
- **Integration – „Capture ready"**
- *Alstom Group*
- **Transport**
- *Gazoprojekt* – Feasibility Study
- Contractor for engineering and construction – to be selected
- **Geology**
- *Polish Geological Institute (PIG) and Schlumberger* – Support during first appraisal phase
- Additional subcontractors – PBG Ltd, Geofizyka Toruń, Sp z o.o., PRWiG

Critical tasks

- Completion of geological work (phase I) and storage site selection - I half of 2011
- Completion of capture component FEED study to move to contracting phase
- Setting forth procedures for further evaluation of CCS components
- Public awareness campaign

CCS Project benefits

- Development of CCS Project including full chain of components: capture, transport and safe geological CO_2 storage
- Storage site and transportation pipeline of CCS Installation set standard model for other large CO_2 Emitters in Poland
- Implementation of demonstration scale CCS Installation and advanced status facilities enables widespread commercialization for large scale fossil fuel power generation unit
- This clean coal technology will give necessary boost to similar projects within Poland and Europe
- Realization of CCS Project provides local employment in economic crisis and develops CCS skills and knowledge within Poland and Europe

2. Financial structure of the Project

CCS financial structure

- **Grants:**
  - **EEPR – 180 mln EUR – Grant Agreement signed with EC, May 5th, 2010.**

- **Financial Sources Under Consideration**
- NER 300
- Norwegian Financing Mechanism
- Polish-US Cooperation Funds
- European Investment Bank
- European Bank for Reconstruction and Development
- Domestic sources
- Other (Australian Funds)

- **Own funds**

3. Project Risks

CCS Project risks

- Technology is not mature yet, risk of scaling up from pilot to industrial level,
- Project is not commercially viable - Necessity of optimal project financial structure concept
- Legal risk – implementation of CO_2 storage Directive into Polish Law
- Power net efficiency reduction caused by CO_2 capture process
- Possibility of lack of public acceptance for CCS, and particularly concerning CO_2 transport and geological storage especially on Lutomiersk – Tuszyn area, additionally amplified by some local environmental NGO's

Financial Risks (1)

1. Overestimation of Revenues:

- **CO_2 Emissions Rights Pricing** – Risk that the price of the right to emit CO_2, which presently does not cover forecasted CCS operating, maintenance, financing and capital costs, does not increase adequately to cover forecasted CCS operating, maintenance, financing and capital costs, undermining the economics of the investment. (Inability to Recover Costs)

- **CO_2 Emissions Rights Legislation** – Risk that CO_2 emissions legislation that adequately supports the price of CO_2 emissions rights is not implemented, preventing EBSA from covering the CCS operating, maintenance, financing and capital costs from the savings that EBSA achieves by reducing emissions of CO_2. (Inability to Recover Costs)

- **Electricity Price-CO_2 Emissions Rights Price Divergence** – Risk that the price of electricity and the price of emitting CO_2 diverge such that it is more cost effective for EBSA to sell the electricity used to capture, transport and store the CO_2 than to generate the costs savings by reducing CO_2 emissions. (Inability to Recover Costs)

Financial Risks (2)

2. Underestimation of Costs:

- **Energy Intensity** – Risk that the electricity required to capture, process and store the CO_2 is materially higher than presently forecasted generating/ operating costs that are materially higher than presently forecasted and preventing EBSA from recovering its CCS-related operating, maintenance, financing and capital costs. (Increase in Costs, Inability to Recover Costs)

- **Capital Expenditures** – Risk that the actual capital costs are materially higher than presently forecasted requiring materially higher CO_2 emissions prices to enable EBSA to recover its CCS-related operating, maintenance, financing and capital costs. (Increase in Costs, Inability to Recover Costs)

- **Operating and Maintenance Costs** – Risk that the operating and maintenance costs are materially higher than presently forecasted preventing EBSA from recovering its CCS-related operating, maintenance, financing and capital costs. (Increase in Costs, Inability to Recover Costs)

Financial Risks (3)

3. Technology:

- **Competitive/Alternative Technologies** – Risk that a competitive or alternative technology turns out to be more cost-effective negatively impacting the price of CO_2 emissions, and as a result, the EBSA facility cannot compete on a relative CCS operating, maintenance, financing and capital cost basis nor can it generate adequate income. (Competitive Dislocation, Inability to Recover Costs)

- **Technology Failure** – Risk that CO_2 capture or storage technology, such as equipment, chemical process, etc., are unable to sustain adequate operating levels, and as a result, EBSA is unable to operate the facility at levels that enable to recover its CCS-related operating, maintenance, financing and capital costs. (Inability to Recover Costs)

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Financial Risks (4)

4. Lack of Commercial Financing:

- **Financing from Preferential Sources** – Risk that EBSA cannot achieve an adequate level of preferential funding, which would cause a negative assessment by undermining the economics of the investment and the investment decision. (Lack of Financing)

- **Repayment of Preferential Financing** – Risk that preferential funds must be repaid or penalties paid due to a failure to achieve the environmental goals of CCS project or the necessity to abandon the CCS project due to causes beyond EBSA's control, such as a failure to receive CO_2 storage permits. (Lack of Financing)

- **Commercial Financing** – Risk that commercial financing institutions reject financing the CCS project as a result of a negative evaluation of this innovative demonstration investment. (Lack of Financing)

4. Current Status of the Project

Current Project Status and Plans

- **Capture**
- modification to unit's flue gas system and main cooling water system (capture ready)– completed
- FEED phase – 90% advanced
- contracting structure of CCP – almost agreed
- design and construction of pipeline steam extraction – under ordering
- **Transport**
- feasibility study done and depicted three routes included in Lodz Voivodeship Zoning Master Plan
- turn key contractor would be selected after storage site selection
- preparatory permitting activities would start asap.
- **Storage**
- 2D seismic work, drilling tests, gravimetric and non-conventional research have been performed within area of two structures (2,000 km^2)
- modelling and site selection in 2011 and further development of storage component afterwards through selected site characterisation and storage site localisation and necessary permitting

5. Other CCS Project – EEPR – knowledge sharing

Another EEPR Projects

- **Jaenschwalde**, Vattenfall, Germany, oxyfuel + post combustion, probably onshore (180 mln EUR)
- **Porto-Tolle**, Enel, Italy, post combustion, offshore (100mio EUR)
- **Rotterdam**, E.ON + Electrabel, Netherlands, post combustion, offshore – (180 mio EUR)
- **Compostilla**, Endessa. Spain, oxyfuel, probably onshore (180 mln EUR)
- **Hatfield**, Powerfuel Power, UK, IGCC, offshore, (180 mln EUR)

Thank you for your attention

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