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# Piotr D. Moncarz Consulting Professor, Stanford University, Corporate VP, Exponent Inc.

■ The world economy is in a downward spiral. Developed economies must offset high labor prices with technologically upgraded industrial structure and freedom from politically charged, expensive, imported energy.

Poland's energy situation is troubling. Once a major exporter of coal, the country is now a net importer. Most of Poland's electricity is from coal, a threat to its economy as the European Union begins to tax  $CO_2$  emissions. Two-thirds of Poland's natural gas comes from its eastern neighbors. All liquid fuels are imported.

The solution is in Underground Coal Gasification (UCG), an extraction of energy from underground coal without the mining operation. In a pyrolysis process the coal reacts with oxygen at a temperature hot enough for a reaction without incineration.

The Polish Laboratory of Rational Technologies, led by Dr. Bohdan Żakiewicz, with other Polish researchers and investors, is implementing UCG technology based on the Żakiewicz Method.

The key elements of the Żakiewicz Method are a vertical shaft at a level just above the coal seam, directional drilling tubes spread in a fan-like pattern in the seam over a 5-sq-km circle. Oxygen, water and  $CO_2$  are injected into this underground reactor and heat, synthetic fuel gases and hydrogen is extracted. No coal is left behind and up to 250 MW of electricity, synthetic fuel and hydrogen are obtained from one shelf.

The Żakiewicz Method positions Poland as a leader in the clean coal technology race while reducing its dependence on foreign energy and  $CO_2$  emissions. The opportunity requires Polish government support to the UCG researchers, entrepreneurs and investors. The UCG race winners will become technology exporters and clean energy leaders in the world.



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### TECHNOLOGY

However, they have also shown that higher cost and lower reliability make this technology more expensive than conventional coal generation.

## Polish attempts to store CO<sub>2</sub>

While the technology to capture carbon dioxide from flue gas is relatively well developed, the serious problem of how to store it is yet to be solved. Poland does not have as good underground storage facilities as do countries which have extracted crude oil or natural gas reserves, thus leaving behind natural storage chambers underground. Storing carbon dioxide under the sea bed is not an option since the Baltic Sea is too shallow.

Poland also lacks suitable legal regulations for the underground storage of carbon dioxide. "With regard to the storage of carbon dioxide, Poland trails far behind other European Union countries," says Marek Ściążko, director of the Institute for Chemical Processing of Coal (ICHPW) in Zabrze. "To be able to even think about building an experimental emission-free power plant, we must quickly catch up to other countries."

Still, Poland has garnered some experience in amassing carbon dioxide underground. In 1995, Poland was the first country in Europe to use technology to amass carbon dioxide in gas reserves in Borzęcin. The then Institute of Mining of Oil and Gas (IGNiG), which today is the Oil and Gas Institute, and Polish oil and gas firm PGNiG built the first European industrial facility to store acidic gases that were a byproduct of natural gas extraction. Over a period of 12 years, almost 3 million cubic meters of gas containing carbon dioxide was pumped into this facility. This was a unique, experimental test site and as such was chosen for further and detailed research under the auspices of the European Union's Seventh Framework Program.

Ewa Dereń



# eu Flagship program

Andrzej Siemaszko, Government Group of European Technology Platform for Zero Emission Fossil Fuel Power Plants:

A critical solution for combating climate change is a widescale deployment of Carbon Capture and Storage (CCS) technology. Without CCS, the EU's target to reduce  $CO_2$ emissions by 60 percent by 2050 is simply not achievable. In 2006, the European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP) outlined the technology and deployment "roadmap" necessary to achieve this goal.

The Flagship Program was presented for the first time in 2007. The program was developed by ZEP experts—scientists, industry and environmentalists, united in their support for CCS as a key solution for combating climate change—within a portfolio of solutions, including renewable energies and energy efficiency.

The Flagship Program is targeted at the development of 10-12 full-scale CCS demonstration projects integrating all aspects of  $CO_2$  capture, transport and storage—including technology, infrastructure, the environment, health and safety, legal and regulatory issues and funding. A Europe-wide network of demonstration plants should be operational by 2015 to ensure the strategic goal is met: to make CCS commercially viable for all new fossil fuel power plants by 2020.

Global climate change is a serious environmental challenge that requires credible action. It is clear that coal will remain the backbone in the global supply of energy. To reduce emissions of  $CO_2$ , we have to develop and implement Clean Coal Technologies such as coal gasification (for instance IGCC), improved and highly efficient combustion (such as oxy-fuel) and post-processing which can be accompanied by carbon capture and geological sequestration.

Poland is in a very specific situation since its production of electric energy is 96-percent dependent on hard coal and lignite. Poland has (some say unfortunately) become a focal point of European Energy-Climate Policy. The total cost of modernizing the power sector and building new power plants is estimated as 50 billion euros. For instance, the largest European single-source  $CO_2$  emitting power plant in Belchatów (PGE) has announced a strategy for retrofitting existing units of 4,500 MWe and developing a new clean 858 MWe unit.

Having very rich coal deposits Poland wants to take a lead in developing and implementing other Clean Coal Technologies. There are plans for a pilot plant in Poland to demonstrate Underground Coal Gasification technology developed by Prof. Bohdan Żakiewicz. Southern Poland Power Company PKE together with Kędzierzyn Nitrogen Company ZAK have announced the construction of the first clean energy-carbochemistry complex in the EU with CCS producing both electric power and synthetic fuels and fertilizers. There is information that Puławy Nitrogen Company may follow suit. Production of synthetic fuels from coal would improve Polish security of energy supply with respect to imported oil and gas. Poland together with northern Germany have potentially the largest European on-shore deep saline aquifer reservoir suitable for CO<sub>2</sub> sequestration in Mesozoic sediments. Recently, a national program for defining the best sequestration sites has been launched.

Poland needs European support to manage all the challenges it is facing. If Poland succeeds in transforming its economy towards a low-emission one, it will be success for all of us: Poland, Europe and the whole world.