



# The world's first Zero-Emission Power & Chemical Complex, Kędzierzyn 2015

Silesia's Green Coal Solutions  
Polish answer for the challenges of the EU energetic and climatic policy



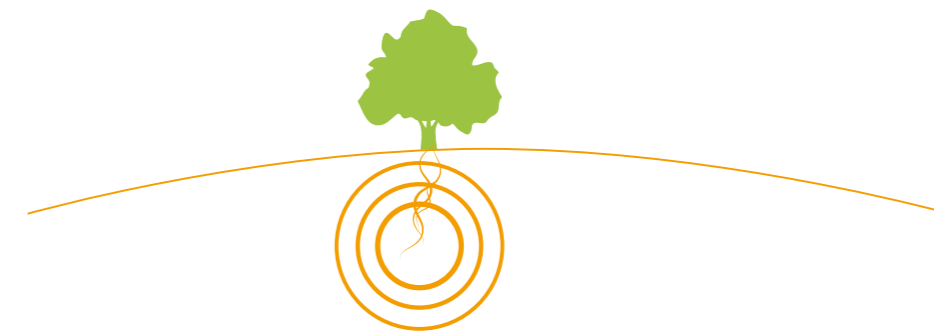
# Introduction

**Over 95% of the Polish power engineering sector is dependent on coal;** Poland also enjoys one of the world's biggest deposits of this natural resource. **Coal has been and will continue to be the fundamental natural resource for Polish economy.** What hinders the effective use of coal is, first and foremost, significant carbon dioxide emissions. That is why the Polish economy's strategic objectives for the coming years should include the development of economically viable and environmentally-friendly methods of reducing CO<sub>2</sub> emissions.

This issue has gained importance in view of the requirements Poland is expected to fulfil under the EU Climate Package, adopted at the end of 2008. This package has practically **imposed upon Poland the obligation to capture around 60% of CO<sub>2</sub> emissions on the European Union scale.** Therefore it seems justified that Poland should become the site for demonstration facilities, which will enable the development and testing of Clean Coal Technologies.

Introducing such solutions poses a great challenge both to public institutions and companies involved in the project. Research and the investment process must be accompanied by educational campaigns aimed at persuading the public to accept such solutions and helping to overcome the natural fear of new technologies.

Another equally important objective is **the internal diversification of energy supplies and creating solutions that will help Poland gain independence from external providers, mainly from Russia.** This is a prerequisite for improving Poland's and the European Union's energy security.





Zakłady Azotowe Kędzierzyn S.A. (ZAK S.A.) is one of Poland's biggest producers in the chemicals sector. Owing to its sixty years of experience our company has established a strong and stable presence both on the domestic, as well as on the European market. Our mission focuses on dynamic and sustainable development. That is why the company invests heavily in new technologies and tries to introduce bold and cutting-edge solutions in the area of production processes, as well as management. The range of products offered by ZAK S.A. is addressed mainly to the agricultural sector and the plastics, paints and varnishes industry. We continuously strive to improve our products and find new innovative solutions and initiatives. Our company produces both nitrogen fertilizers (16 percent share of the Polish market), OXO alcohols (the sole producer in Poland, a nearly 10 percent share of the European market), as well as innovative phthalate plasticizers (approximately 73% and 6% share of the domestic and European market, respectively). ZAK is a stable and financially sound company. In 2007 the consolidated sales revenue amounted to PLN 1.67 bn, while the net profit nearly tripled from 2006, reaching PLN 115.3 m. ZAK S.A., as a socially responsible company, is also involved in environmental protection activities. Our company participates in the "Responsibility and Care" programme, as well as co-operates with the local forest district office, continuing to reduce the volume of waste disposed of and pollutants in the industrial wastewater. Moreover, one of our priorities includes cutting down the emissions of air pollutants.

Krzysztof Jałosiński, President of the Management Board, ZAK S.A.



The primary objective of our operations is to increase our value in the eyes of shareholders, which is why we are strongly involved in developing and promoting state-of-the-art and environment-friendly technologies, enabling us to meet the growing requirements posed both by ever more stringent environmental norms, as well as by fierce competition.

Our company forms part of the Tauron Polska Energia group, which today is one of Poland's biggest business entities with the capital of nearly PLN 14 billion. The group employs around 20 thousand staff, of whom 6 thousand work for our company. The chance to operate as part of the group's organisational structure provides us with enormous potential and enables us to draw upon the joint expertise and know-how, as well as to apply the economies of scale, essential for large-size investments. Moreover, our strong position is further reinforced by the fact that in 2007 our company's consolidated revenue amounted to PLN 3.6 billion, with the net profit of PLN 137.6 million.

Południowy Koncern Energetyczny S.A. (PKE S.A.) is Poland's second largest energy producer. Our company's share of the domestic installed electrical power capacity stands at 14% and amounts to 4.9 GWe, with a 16% share of the local heat generation market, amounting to 2.4 GWt.

PKE S.A.'s production has always been based on bituminous coal – a strategic raw material, whose share in our energy output amounts to 95%. Investments in clean coal technologies are a natural stage in our company's development, making it possible to generate power in an environment-friendly and emission-free way. Our company has been deeply involved in environmental activities. Over the past few years we have modernized the Jaworzno Power Plant, reducing its SO<sub>2</sub> emissions by 21,835.9 Mg annually and dust emissions by 1,189.7 Mg. Moreover, we have reduced noise emissions in Łaziska and Siersza Power Plants, in order to minimize their environmental impact. Our company is planning further development – by 2020 we will have constructed additional power blocks with the capacity exceeding 2000 MWe.

Jan Kurp, President of the Management Board, PKE S.A.



The concept developed by the ZAK-PKE consortium foresees the establishment of a **zero-emission facility combining power engineering with chemical production**, unique on a global scale. The project to be realised in Silesia's Kędzierzyn-Koźle offers a fresh outlook on Clean Coal Technologies. Moreover, it serves as a perfect example that environment-friendly solutions can be highly effective in economic terms, both for the companies choosing to invest in them and for the country's power industry as a whole.

The combination of power engineering and chemical production facilities, as well as the opportunity for co-operation with other entities, makes it possible to optimize the costs and introduce a multi-dimensional application of the technologies tested.

The aim of the installation is to implement the principles of EU's energy and environmental protection policy in terms of:

- **reducing CO<sub>2</sub> emissions** in order to minimize greenhouse gas emissions;
- providing the possibility for **biomass incineration** in order to increase the share of energy obtained from renewable sources;
- increasing the **use of primary energy to optimize the mining of non-renewable energy resources**.

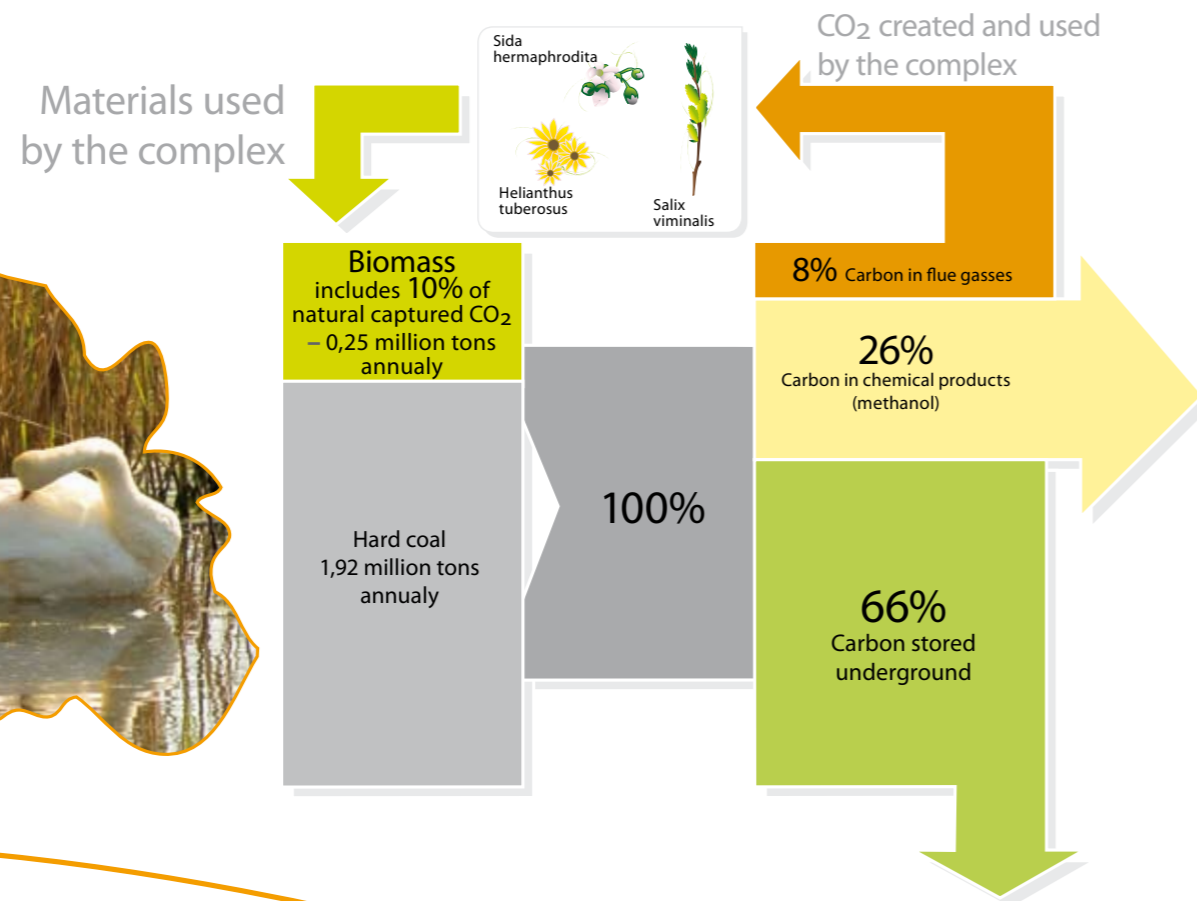
Moreover, **the facility is to enable the testing and further development of nearly 20 new technologies**, which can later be successfully exported to other countries whose economy is based on coal, such as China, India or Russia.



# Project Description

The future **Zero-Emission Energo-Chemical Complex** will enable the **simultaneous generation of clean electrical power, heat and synthesis gas (syngas), as well as the storage of carbon dioxide emitted in the production process.** In co-operation with a number of other facilities in the European Union we wish to demonstrate and test the latest carbon capture and storage (CCS) technologies useful for the Polish energy sector.

The Kędzierzyn-Koźle complex will comprise two modules: a heat and power generating plant and an installation producing syngas to be used by an adjacent nitrogen plant. A technologically innovative combination of a power generating and a chemical facility. **This will enable effective use of the captured CO<sub>2</sub> in the production of advanced fertilizers and plastics, as well as chemical raw materials, such as methanol, urea and hydrogen, and – in the future – also synthetic fuels.** The application of CO<sub>2</sub> will also make it possible to increase gas production in Poland and foster the rapid development of carbochemistry in the future.



# Zero Emissions

## Absolutely Clean Complex

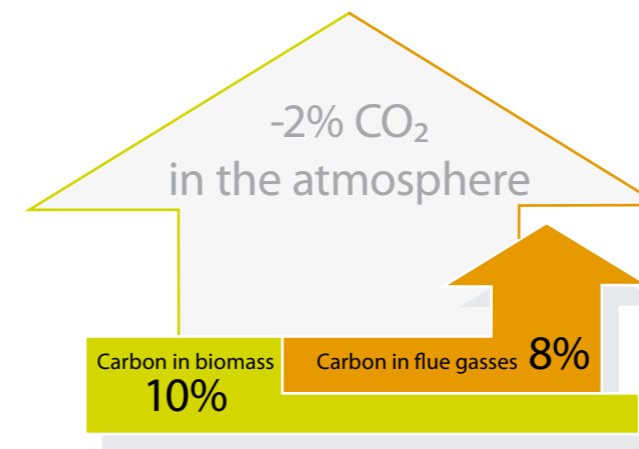
The complex will be entirely environmentally-friendly. The combination of coal gasification technology (IGCC) and carbon capture and storage (CCS), as well as the supplement of up to 10% biomass in the combustion process **will, for the first time ever, yield negative carbon emissions.**

The complex will apply two methods of utilizing CO<sub>2</sub> generated in the process of coal gasification:

- 66% – storing CO<sub>2</sub> underground in the deep layers of porous rock dating back to the Jurassic and Triassic period, located at the depth of over one km,
- 26% – chemical “trapping” of CO<sub>2</sub> in methanol, urea and other chemical products of ZAK S.A.

The total reduction of CO<sub>2</sub> emissions will amount to nearly 3.3 million tons annually (92%).

Taking into account the biomass (10%), a renewable energy source excluded from the carbon balance, **it is even possible to achieve a negative result, i.e. -2% of CO<sub>2</sub> emissions.**



# Coal Gasification

A MILESTONE ON THE WAY TO ENERGY INDEPENDENCE  
AND SYNTHETIC COAL-BASED FUELS

**Many European countries, including Poland, face the challenge to achieve both internal diversification of energy sources and the greatest possible independence from external energy supplies.**

For countries whose economy depends on coal, such as Poland, the most attractive technologies include those involving coal gasification. Such technologies make it possible to combine power generation with the production of chemicals.

**In the future, owing to such solutions, it will be possible to produce natural gas substitutes, full assortment of compounds based on carbon including synthetic fuels.**

This project involves the construction of two coal gasification reactors, enabling the production of syngas. The construction of a third reactor would eliminate the need for ZAK to import natural gas.



# ZAK-PKE Project

A Stimulus For Upper Silesia

EU policy is highly restrictive when it comes to traditional coal processing and combustion in power plants. That is why Poland needs to modernize its power engineering sector. If we want to continue using Polish natural resources, i.e. coal, we need to implement Clean Coal Technologies.

**The ZAK-PKE investment is located in Upper Silesia – a region responsible for the greatest CO<sub>2</sub> emissions in the European Union (over 30%). Due to this location our project will help to reduce emissions where it is most needed.** Accompanied by a research programme and the application of 20 unique state-of-the-art technologies, the project may contribute to the creation of a Region of Knowledge and Innovation in Upper Silesia and Małopolska, developing Clean Coal Technologies.

The pilot scheme in Kędzierzyn will also pave the way for modernizing other power plants belonging to PKE: Jaworzno, Łagisza, and Siersza.



# CCS a chance for cross-border development



The Kędzierzyn-Koźle demonstration facility will employ carbon dioxide capture and storage technologies. **Nearly 66% of carbon dioxide generated (around 2.4 million tons annually) will be pumped into natural geological reservoirs.**

Porous sandstone deposits from the Jurassic and Triassic period located over one km below the ground are considered optimal for carbon dioxide storage. **Poland has the right geological structure and areas suitable for CO<sub>2</sub> injection can be found near Łódź and Częstochowa.**

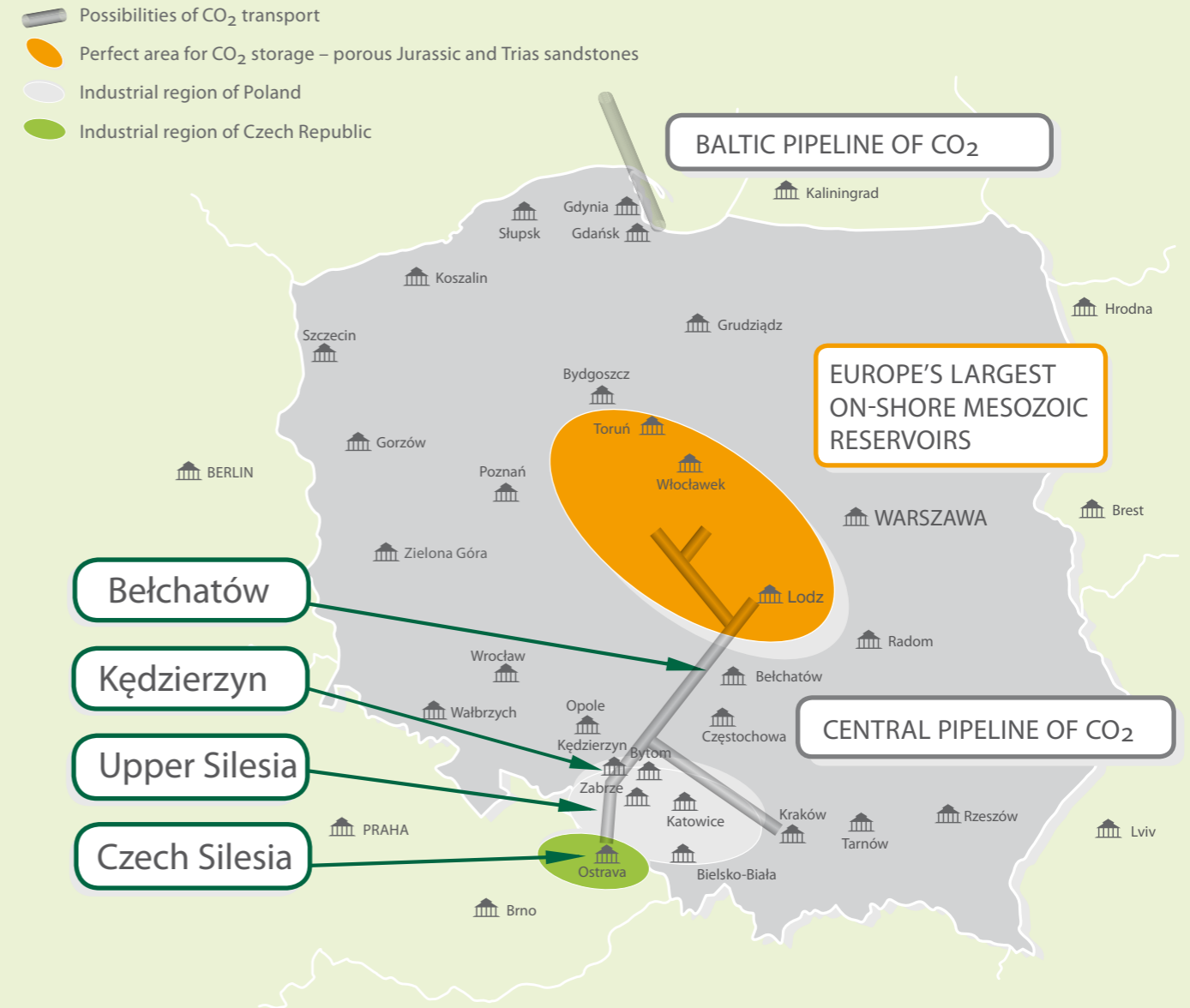
In order to transport the captured CO<sub>2</sub> to its final storage location a pipeline will be constructed. Its transmission parameters **will enable participation by other emitters from Upper Silesia, who decide to implement CCS installations (e.g. steel works, mines, other power plants).**

There is also scope for **cross-border co-operation in the project and extending the pipeline to include the interested entities from the Czech Republic and Slovakia, mainly from the industrial Czech Silesia region.**

The project will **provide the infrastructure for a widespread implementation of the CCS technology following the tests conducted in the Kędzierzyn-Koźle demonstration facility.**



# Possibilities of carbon transport and storage



# Schedule

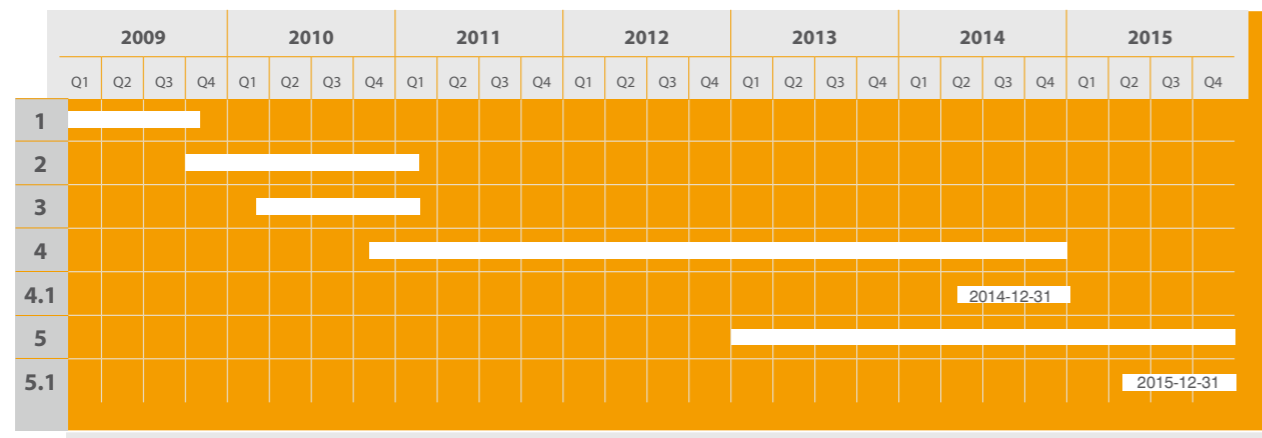
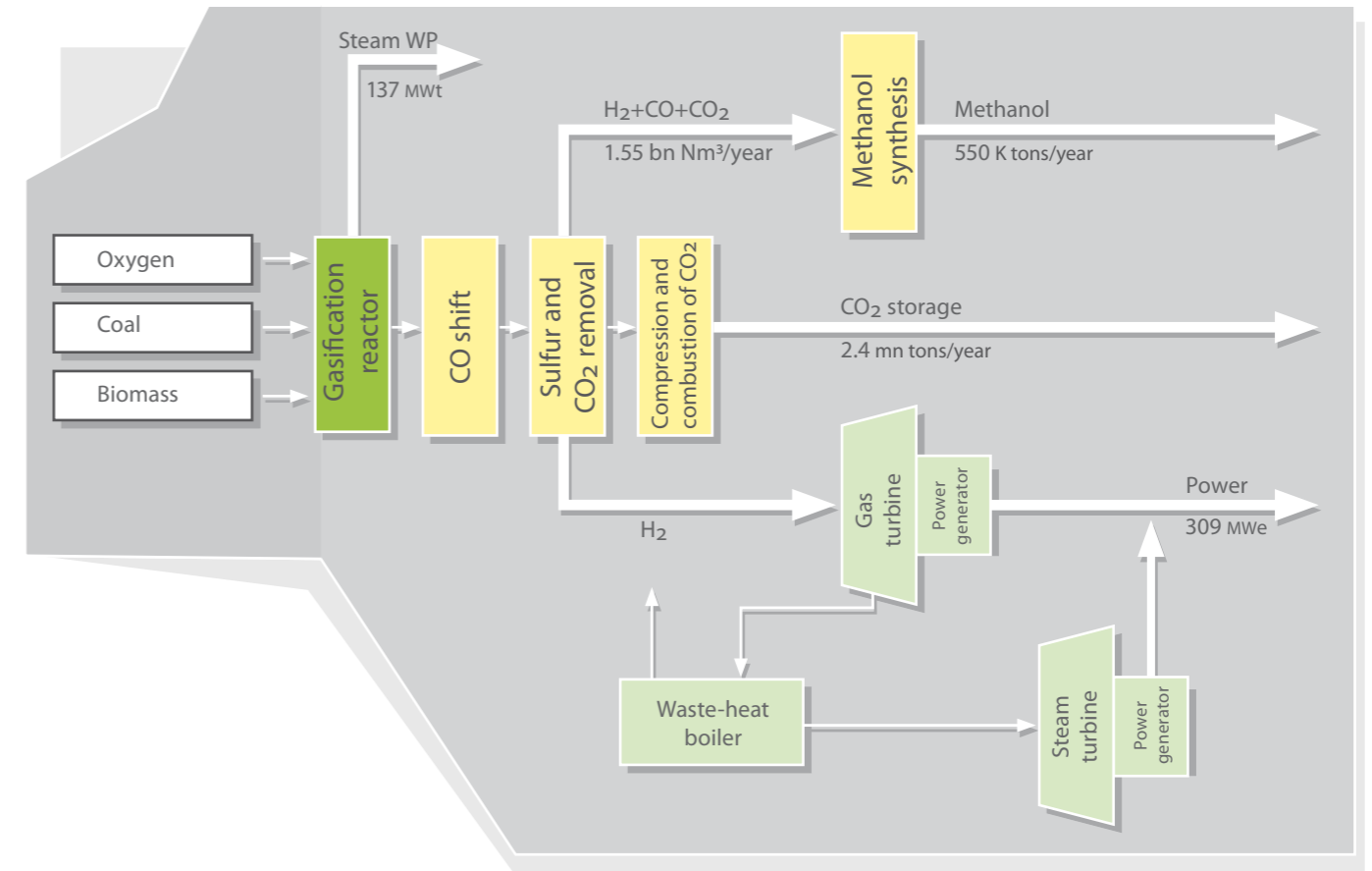
Time is money

# Diagram

of Zero-Emission Power & Chemical Complex

The European Union has imposed great obligations on Poland under the Climate Package. Poland needs to dramatically reduce its carbon dioxide emissions, which entails the necessity to modernize almost the entire energy system. **That is why it is of utmost importance that the ZAK-PKE demonstration project be completed by 2015, in order to launch the commercial stage of introducing coal gasification and synthetic fuels production technologies in Poland.** The sooner coal gasification technologies are implemented, the lesser are the financial penalties and the greater the opportunity to profit from commercializing the project.

No	Stage	Start	Completion	Time (months)
1	Feasibility study/basic design	2009-01-01	2009-10-30	10
2	Execution design, documentation for deliveries	2009-10-01	2011-02-28	17
3	Negotiations and obtaining financial means	2010-03-01	2011-02-28	12
4	Construction – technological part	2010-11-01	2014-12-31	50
4.1	Plant commissioning and start-up	2014-05-01	2014-12-31	8
5	Construction – CO <sub>2</sub> transport and storage	2013-01-01	2015-12-31	36
5.1	Plant commissioning and start-up	2015-05-01	2015-12-31	8





# Parameters of Zero-Emission Power & Chemical Complex

Parameters	Unit	Zero-Emission Power & Chemical Complex
Fuel consumption:		
– power coal	mn tons/year	2.09
– biomass	mn tons/year	0.25
Thermal power	MWt	137
Electric Power	MWe	309
Synthesis gas production:	bn Nm <sup>3</sup> /year	1.55
– equivalent metanol quantity	K tons/year 550	550
Captured CO <sub>2</sub>	mn tons/year	3.36
– neutralised (sequestered) CO <sub>2</sub>	mn tons/year	2.4
– equivalent contained in synthesis gas for metanol	mn tons/year	0.96
CO <sub>2</sub> emission	%	8*
Reduction of CO <sub>2</sub> emission	%	92

\* Introduction of biomass into the combustion process can effect in negative total carbon emission





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