Strategic Vision
of Polish, Czech and Slovak Industrial Regions Participation
in European Hydrogen Economy Development

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Hydrogen Economy: A Bridge to Sustainable Energy
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The Team (still open)

- Central Mining Institute, GIG, Katowice
- Institute of Chemical Processing of Coal, Zabrze
- Institute of Energy, Warsaw
- Institute of Opencast Mining, Wrocław
- Institute of Chemical Fibres, Łódź
- Southern Energy Concern (PKE)
- Kedzierzyn Kozle Nitrogen Works
- Zdzieszowice Coke Plant
- EJK Sp z o.o., Gliwice
- Ostravsko - Karvinske Doly
- Moravian – Silesian Region
- The Union for the Development of the Moravian-Silesian Region (NGO)
- Kosice Steel Plants
- Kosit a.s.
- US EPA National Risk Management Research Laboratory, Cincinnati, OH
- Integrated Process Technologies, Boulder, CO
- Los Alamos National Laboratory through ZECA Corporation
Security of supply in Europe and the role for coal
Considerations: enlargement

Poland
- bigger than the entire existing EU industry
- restructuring to continue
Security of supply in Europe and the role for coal

Working forecasts: solid fuels baseline scenario

Gross Inland Consumption

- 2000:
  - Solid fuels: 15%
  - Oil: 41%
  - Natural gas: 23%
  - Nuclear: 6%
  - Renewables: 15%

- 2030:
  - Solid fuels: 12%
  - Oil: 36%
  - Natural gas: 34%
  - Nuclear: 9%
  - Renewables: 9%
Comparative Energy Inputs to World Electricity Generation by Type of Fuel (Mtoe)

from CSIS Report
Hard and brown coal in Poland

With the current production of 102 million tons (in 2000) country resources of hard coal will suffice to meet the own demand for this fuel for almost 500 years that is twice as long as the world's average.

Brown coal reserves are estimated at nearly 14 billion tons. It is utilized almost exclusively by the energy industry, with 98% used by large power plants.
Present and future options

- Hydrogen economy testing system based on coke oven gas
- Low and zero emission coal based energy and hydrogen production technologies
- Energy and hydrogen production with sequestration
Coke oven gas an existing background for regional development of hydrogen supply

- Poland produces $2 \times 10^9 \text{ Nm}^3/\text{year}$ of coke oven gas.
- It is considered as no-market value, waste gas stream
- It contains more than 50% of hydrogen
- After separation and cleaning up, it could be considered as low-cost hydrogen source to supply Regional Hydrogen Network for transport purposes
# Coke oven gas composition

<table>
<thead>
<tr>
<th>Basic components (%V)</th>
<th>Raw gas</th>
<th>Synthesis gas</th>
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<tbody>
<tr>
<td>H₂</td>
<td>56,0</td>
<td>64,54</td>
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<tr>
<td>CH₄</td>
<td>26,0</td>
<td>0,73</td>
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<tr>
<td>CₙHₘ</td>
<td>2,30</td>
<td>0,05</td>
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<tr>
<td>CO</td>
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<td>CO₂</td>
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<td>O₂</td>
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<td>N₂</td>
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<td>2,99</td>
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<tr>
<td>H₂O</td>
<td>2,23</td>
<td>0,35</td>
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<tr>
<td>Contaminations (g/m³)</td>
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<tr>
<td>H₂S</td>
<td>0,500</td>
<td>0,730</td>
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<tr>
<td>NH₃</td>
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<td>0,029</td>
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<tr>
<td>HCN</td>
<td>1,000</td>
<td>0,563</td>
</tr>
</tbody>
</table>
What should be done in short term?

- Elaboration and implementation of efficient technology for production of fuel cell quality hydrogen from coke oven gas
- Design, construction and testing of regional hydrogen storage and distribution network for filling up „hydrogen cars”
Expected European and Regional benefits

• Opportunity for testing in technical scale of real hydrogen production-storage-distribution infrastructure

• Possibility of demonstration and implementation the CO$_2$ storage sequestration technology in deep coal seams with enhanced production of methane (acc. to Recopol I and Recopol II EU IP)

• Coal based hydrogen economy could be important driving force for sustainable development of the Region
Examples of separation technologies to be developed

- Hydrogen separation and cleaning (membranes, adsorption, absorption)
- Oxygen separation for cost cutting
- Deep $H_2S$ removal from hydrogen
- Utilisation of waste gas from separation system
Practical comments

- 100 000 t/year of pure $H_2$ can be produced
- 250 t/day of $H_2$ can be used as a car fuel
- Assuming 10 kg of $H_2$ per car it makes 25 000 fillings/day
- It is sufficient for building of apr. 15–30 tank station network
- Creation of the common network of Nitrogen Works in Kędzierzyn – Koźle and $H_2$ tank stations can be the background of stable $H_2$ supply system
Zero Emission Coal Technologies

Very ambitious long-term plan:

Hydrogen production and CO$_2$ sequestration in one process
Low emission high efficiency hydrogen and electricity production for Polish - Czech Silesia Region
Central European Vision of Technology Development for efficient Clean Coal – Hydrogen – Electricity Production

Milestones

• **to 2008** – technology development of large scale production of fuel cell quality hydrogen from coke oven gas and from other currently available industrial gas mixtures containing hydrogen

• **to 2012** – design and implementation of local hydrogen gas network for energy and urban transport application

• **to 2020** – demonstration plant for hydrogen generation and clean electricity production from solid, carbon containing energy carriers

• **to 2025** – demonstration of the technology with assisted sequestration of carbon dioxide in minerals and/or coal seams
EU – US Collaboration Expected

- US is seen as a key partner for development of European hydrogen programme
- Hydrogen from coal belongs to long-term priorities of US hydrogen programme
- Silesians plans for restructuring post-mining areas assume continuation of coal use for clean production of energy
The United States and European Union convened the first bilateral “U.S.-EU Joint Meeting on Climate Change Science and Technology Research” in Washington on February 5-6, 2003,

- Development of international codes and standards including testing and certification;
- Pre-competitive research and development on critical enabling technologies including: polymer electrolyte membrane (PEM) fuel cells, non-precious metal catalysts, high temperature membranes, solid oxide fuel cells,
- Hydrogen storage concepts (e.g., carbon nanostructures and complex metal hydrides), refueling technologies and procedures, and hydrogen production;
- Data exchange on hydrogen energy technology and fuel cells; and
- Benchmarking of development and deployment strategies for hydrogen energy technologies and fuel cells.
Our Target: 

Creation of EU US Technology Center for 
Joint Development and Implementation of competitive Clean - Coal Based Energy and Hydrogen Production and Distribution Systems
It should be the part of US and European Technological Answer to Foreign Oil Dependence