Clean Coal Technologies in KIC-InnoEnergy Project

Prof. Tomasz Szmuc
Agenda

1. KIC concept
2. Results of the first call
3. KIC-InnoEnergy
4. CC PolandPlus – Clean Coal Technologies
5. Current development state and next steps
Poland - KRAKÓW

Kraków, former capital of Poland

JCC Day, 7-8 Sept. 2010
The former capital, now a center of science, art, culture, and higher education

over 220 000 students at 31 universities
Selected important dates

- 1257 – the location of the city according to Magdeburg Law
- 1364 – The King Kazimierz Wielki founded Krakow Academy – Jagiellonian University
- 1596 – The King Zygmunt III Waza moved capital to Warsaw
- 1919 – foundation of Academy of Mining (AGH)
- 16.10.1978 – Cracow Archibishop Cardinal Karol Wojtyła elected as a Pope - John Paul II
Technical University, founded in 1919 as the Academy of Mining

Rapid growth in the 20s, after the World War II (University of Mining and Metallurgy), and in 90s

JCC Day, 7-8 Sept. 2010
• One of the oldest and biggest Polish technical universities

• **15 faculties, 29 specializations**, more than 160 fields of engineering

• Over **35 000 students**

• Over 150 000 graduates have passed through the halls our university

• **2 033 researchers** including more than 500 associate and full professors

• Own attended campus area
University campus
Faculty of Mining and Geoengineering
Faculty of Metals Engineering and Industrial Computer Science
Faculty of Electrical Engineering, Automatics, Computer Science, and Electronics
Faculty of Mechanical Engineering and Robotics

**Faculty of Geology, Geophysics and Environmental Protection**
Faculty of Mining Surveying and Environmental Engineering
Faculty of Materials Science and Ceramics
Faculty of Foundry Engineering
Faculty of Non-Ferrous Metals
Faculty of Drilling, Oil and Gas
Faculty of Management

**Faculty of Energy and Fuels**
Faculty of Physics and Applied Computer Science
Faculty of Applied Mathematics
Faculty of Applied Social Sciences

Interfaculty School of Biomedical Engineering
KIC concept

(Knowledge Innovation Communities – KIC)

JCC Day, 7-8 Sept. 2010
EIT – European Institute of Innovation and Technology

KIC – Knowledge and Innovation Community

CC – Colocation Centre

JCC Day, 7-8 Sept. 2010
Call for KIC Proposals
2 April, 2009

Areas:
1. Sustainable Energy
2. Climate Changes Adaptation and Mitigation
3. Future ICT Society

Submissions until 27 August 2009, 5 p.m.

JCC Day, 7-8 Sept. 2010
• **Sustainable Energy:** KIC InnoEnergy
  [http://eit.europa.eu/kics1/kic-innoenergy.html](http://eit.europa.eu/kics1/kic-innoenergy.html);

• **Climate Changes Mitigation and Adaptation:** Climate-KIC

• **Future ICT Society:** EIT ICT Labs
KIC-InnoEnergy Thematic Scope

**CC BENELUX**
- Thematic Coordination
  - Intelligent energy-efficient buildings and cities

**CC IBERIA**
- Thematic Coordination
  - Renewables (wind, CSP, photovoltaics, wave and tidal energy)

**CC ALPS VALLEY**
- Thematic Coordination
  - Sustainable nuclear & renewable energy convergence

**CC SWEDEN**
- Thematic Coordination
  - European Smart Electric Grid and Electric Storage

**CC POLAND PLUS**
- Thematic Coordination
  - Clean Coal Technologies

**CC GERMANY**
- Thematic Coordination
  - Energy from chemical fuels

JCC Day, 7-8 Sept. 2010
Integration of the knowledge triangle – practical approach will boost innovation in Europe

- KIC Mobility Programme
- KIC Explore House
- New curricula
- Culture of life-long-learning

- KIC Knowledge Market
- Exploration mechanisms
- Innovation network research
- Entrepreneurs/ inapreneurs
- Financial Nurturing

- KIC Innovation Market
- Multi-disciplinary joint-projects
- Open & Cross Innovation
- State-of-the-art IP policy
- Exploitation mechanisms
KIC InnoEnergy will be run like a business through a flexible and effective organizational structure.

**ADVISORY BOARD**
1. IP Board
2. Scientific Advisory Board

**EXECUTIVE BOARD**
CEO selected

**DIRECTORS**
1. of Education
2. of Innovation
3. of Technology

**CC**
- Benelux
- Iberia
- Alps Valleys
- Sweden
- Poland
- Germany

**LIGHTHOUSE INNODRIVER**
- ...

**THEMATIIC PROJECT 1**

**THEMATIIC PROJECT 2**
- ...

**KIC**

**CC**
Objectives

1. Independent consulting in terms of technology development, emerging markets, ... (including legal, social, environmental aspects)
2. Main customers politics (nation./EU/international) + industry
3. Strategic perspective – 2015 one of European consultants in energy system assessment
Performs prospective studies of relevant technological innovations to improve performance and efficiency of equipment (equipment and materials) and processes associated with the energy consumption of the industry.
Convergent technologies (ConTeNT)

Where different technologies evolve independently and mutually towards serving similar and common needs, share the methods to expand creativity and skills, to face differently to complex challenges.

Getting a better benefit from all promises based on synergies between key strategic resources.
Living European labs for energy services

Map existing and upcoming test platforms and projects in energy services on an European level to develop the common strengths. Based on a requirement specification for test beds describe performance objectives and present resource usage to define competitive concepts to speed up the innovation chain.

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KIC InnoEnergy will be run like a business with a sound and monitored business plan, focused on results (KPIs)

### Education for Innovation

<table>
<thead>
<tr>
<th>Year</th>
<th>PhD students</th>
<th>MSc students</th>
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<tbody>
<tr>
<td>2010</td>
<td>111</td>
<td>150</td>
</tr>
<tr>
<td>2011</td>
<td>208</td>
<td>315</td>
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<td>349</td>
<td>485</td>
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<tr>
<td>2014</td>
<td>389</td>
<td>545</td>
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### Projects for Innovation

<table>
<thead>
<tr>
<th>Year</th>
<th>Lighthouse Innodriver</th>
<th>Thematic projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>4</td>
<td>26</td>
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<tr>
<td>2011</td>
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<td>2013</td>
<td>5</td>
<td>38</td>
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<tr>
<td>2014</td>
<td>5</td>
<td>38</td>
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### Innovation Infrastructure

<table>
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<tr>
<th>Year</th>
<th>Lighthouse Innodriver</th>
<th>Thematic projects</th>
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<tbody>
<tr>
<td>2010</td>
<td>€9m</td>
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</tr>
<tr>
<td>2011</td>
<td>€12m</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>€12m</td>
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<tr>
<td>2013</td>
<td>€12m</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>€12m</td>
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</tr>
</tbody>
</table>

### Sources 1st full year – €110m

- **National/regional**
  - Formal partners: 31%
  - EU funding: 15%
  - Other: 25%
  - EIT grant: 21%
- **EU funding**
  - Formal partners: 8%
  - EIT: 50%
  - Other: 15%

### Uses 1st full year – €110m

- **Education for Innovation**
  - Formal partners: 28%
  - EIT: 11%
  - Other: 11%

### Total KIC budget

<table>
<thead>
<tr>
<th>Year</th>
<th>Formal partners</th>
<th>EIT</th>
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<tbody>
<tr>
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<tr>
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<td>2013</td>
<td>€150m</td>
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<tr>
<td>2014</td>
<td>€156m</td>
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**JCC Day, 7-8 Sept. 2010**
CC PolandPlus - Main Partners

AGH University of Science and Technology

Jagiellonian University

Silesian University of Technology

Wrocław University of Technology

LOTOS - Crude oil production, refining and distribution

PGNiG - Oil and gas exploration production

Tauron Polska Energia - Production, distribution of energy

Central Mining Institute - Boilers manufacturer

Rafał - Manufacturer of chemicals

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CC PolandPlus - localization

Univers./Res.Instit.

Industry

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Clean Coal Technologies
Thematic areas

1. Development of coal/lignite gasification technologies

2. Improving efficiency of energy production and reduction of emissions

3. CO₂ geologic sequestration

4. Nuclear co-generation. Nuclear – coal synergy, including CO₂ recycling
Technical objectives

- Materials for high efficiency “zero-emission” fossil fuel power plants
- Advanced materials for clean coal technologies
- Materials for nuclear power plants (HTR, LWR and LFR)
- Renewable energy materials (fuel cells, wind, biomass, photovoltaic, off-shore, ...)
- Development of characterisation and modelling methods of power plant components made from innovative materials
Development of coal/lignite gasification technologies

**Project:**
Development of a coal gasification technology for high-efficiency fuel and power production

**Partners:**
AGH, GIG, IChPW, SUT, TAURON, PKE, KTH, PKW, ZAK, KGHM

**Project budget:**
89.8 mln PLN (22.5 mln Euro) **including:**
- 80 mln PLN (ca. 20 mln Euro) –financial support of NCBiR
- 9.8 mln PLN (ca. 2.5 mln Euro) –contribution of Commercial Partners

JCC Day, 7-8 Sept. 2010
Development of coal/lignite gasification technologies

Project:
Multi-fuel energy generation for Sustainable and Efficient use of Coal (SECoal)

Partners:
SUT, WUT, CzUT, GIG, UJ, ICE-PAS, TU Stuttgart, KIT, KTH, BZF, Industry: Tauron, PGE Turow, Matra, Foster Wheeler, Rafako, Coal mines ...

JCC Day, 7-8 Sept. 2010
Project:
Upgrading of gas produced by underground coal gasification gas streams

Partners:
GIG, PGNiG, Catalonia Institute for Energy Research, KTH coal mines, ...
Improving efficiency of energy production and reduction of emissions

Project:
Advanced near zero emission Coal fired Power Plant (ACPP)

Partners:
SUT, WUT, CzUT, AGH, GIG, TU Stuttgart, KIT, KTH, BZF
**CO₂ geologic sequestration**

**Distribution of sedimentary basins potentially suitable for the CO₂ storage**

Central European Permian-Mesozoic basin (outlined), is the biggest European sedimentary basin - it extends from England to Poland across the North Sea, Netherlands, Denmark and Germany. Polish territory belongs to the eastern arm of this vast basin.

Main European sedimentary basins (after FP6 EU GeoCapacity project)

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CO₂ geologic sequestration

Project:
Integration of CO2 Sequestration with EOR-CO2 technology in the Polish off-shore fields

Partners:
AGH, U. Upsala, LOTOS, ...
Nuclear co-generation.
Nuclear – coal synergy, including CO₂ recycling

**CO₂ Recycling with Nuclear Power for Synthesis of Hydrocarbons**

- Hydrocarbons are better fuels than H₂ (energy content, safety, transport etc.)
- no H₂ infrastructure required
- NPP produces locally H₂ from water (electrolysis or thermochemical)
- CO₂ sequestration can be dropped
- Total CO₂ emission halved
- works also with CO₂ extraction from air
- economically attractive even more so with CO₂ tax

Coal-Fired Power Plant

Nuclear Power Plant

JCC Day, 7-8 Sept. 2010
Nuclear co-generation.
Nuclear – coal synergy, including CO₂ recycling

Project:
Coal Liquefaction with Carbon Dioxide Recycling in Nuclear Cogeneration (CL-CDR)

Partners:
AGH, GIG, CEA, U. Upsala KIT, KTH, TU Stuttgart, ZAK, PGE, TAURON, EDF, AREVA, ABB, coal mines, LOTOS, ...
# Educational Plan

<table>
<thead>
<tr>
<th>PolandPlus AHG+SUT</th>
<th>2010</th>
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<th>2012</th>
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<tbody>
<tr>
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<td>0</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MSC in CCT</td>
<td>0</td>
<td>15**</td>
<td>30</td>
</tr>
<tr>
<td><strong>KIC - level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD in SustEnergy</td>
<td>5*</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MSC in SustEnergy</td>
<td>0</td>
<td>30***</td>
<td>40***</td>
</tr>
</tbody>
</table>

*) - PhD in **Smart Grids Technological Platforms** (coordinated by KTH)

**) - MSc in **Gasification of Coal**

***) - MSc in: **Smart Grids Technological Platforms, Sustainable Fuel Economy, Sustainable Energy Development**

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Prospective structure

**SE: Societas Europaea**

Ltd – Company Ltd
F – Foundation

- **SE₁**
  - Ltd/F
- **SE₃**
  - Ltd/F

EIT
1. Creation of management structure, elaboration of related documents, etc.

2. Finalisation of Business Plan for 2011-2013

3. Creation of legal structure of CC PolandPlus and election of related bodies

4. Full operational functionality – before 1 January 2011
Thank You!