Shale Gas Development: Polish Experience

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Globalization of shale gas resources

Europe (in bcm):
- France: 5,097
- Germany: 226
- Nederland: 481
- Norway: 2,350
- UK: 566
- Denmark: 651
- Sweden: 1,160
- Poland: 5,295
- Turkey: 424
- Ukraine: 1,189
- Lithuania: 113
- Others: 538

North America (in bcm):
- USA: 2,441
- Canada: 1,784
- Mexico: 1,444

South America (in bcm):
- Venezuela: 311
- Columbia: 538
- Argentina: 2,191
- Brazil: 6,399
- Chile: 1,812
- Uruguay: 594
- Paraguay: 1,755
- Bolivia: 1,359

Africa (in bcm):
- South Africa: 13,733
- Libya: 8,211
- Tunisia: 509
- Algeria: 6,541
- Morocco: 311

Asia (in bcm):
- China: 1,783
- Indie: 1,444

Source: EIA, World Annual Outlook, 2011
Europe’s Potential Shale Gas Resources

Assessment for:

- **Eastern Europe (excluded Poland):**
  - 65 Tcf (1.84 Tcm) of technically recoverable resource

- **Western Europe**
  - 372 Tcf (10.5 Tcm) of risked technically recoverable

- **Poland:**
  - 187 Tcf (5.29 Tcm) of risked technically recoverable resource
Shale gas in Poland

From 2007 to July 2011 the Minister of the Environment granted **92 concessions for prospection** and exploration of shale gas fields

- 8 exploration wells completed by July 2011
- 15 exploration wells planned in 2011
- First horizontal well + multi-stage fracturing planned in summer 2011
- First reserves estimation and first potential production in 2-3 years

Source: Ministry of Environment
Dynamics of shale gas development

Source: Ministry of Environment
Business partners involved in shale gas exploration

- **United States companies:**
  Chevron, ExxonMobil, Realm Energy, San Leon Energy, Marathon Oil, ConocoPhillips, BNK Petroleum, Halliburton, Schlumberger

- **European companies:**
  Total, ENI, Sorgenia, RAG, Emfesz/DPV

- **Polish companies:**
  PGNiG, Orlen Upstream, Lotos Petrobaltic, Sillurian

- **United Kingdom:**
  3 Legs Resources (Lane Energy); Cuadrilla, Composite Energy,

- **Canada:**
  Talisman Energy, Oculis Investmentsts, Indiana Investments, Saponis Investments, LNG Energy

- **Australia:**
  Strzelecki Energia
Improving effectiveness of drilling

Source: Schlumberger
Infrastructure challenge
Institutional structure

- Ministry of State Treasury
- Ministry of Finance
- Ministry of Regional Development
- Ministry of Foreign Affairs
Principal legal acts

- Geological and Mining Law with related Regulations
- Act of Freedom of Economic Activity
- Act on Environment Protection Law
Environmental challenges: Water

Poland’s water resources available:
37 331 059 m³/24h = 13 626 mcm/year

Current use of ground water:
1 585 mcm/year

Current water use:
about 11,6%
Hydraulic fracturing: water needs

One well vertical and horizontal

18,000 m³

Ten wells vertical and horizontal with 20% water re-use

144,000 m³

Amount of water that city of Warsaw uses in 24h

400,000 m³

Source: Polish Geological Institute
Protection of water aquifer
Fracturing Fluid

99.5 % water & sand, 0.5 % chemical additives
Water management

Water sources

Water demand

Hydraulic fracturing fluids preparation

Treatment

- Filtration
- Chemical
- Mechanical
- Membranes
- Thermal

Flow back fluids

Utilization and disposal

Source: Małgorzata Woźnicka, PIG
New technologies related to water

- **CleanSuite™ Technologies**
  - **CleanStim™ Formulation** - A new hydraulic fracturing solution made up of ingredients sourced entirely from the food industry
  - **CleanStream® Service** - Enhances environmental performance by reducing the volume of conventional biocides required
  - **CleanWave™ Water Treatment System** - Enables recycling of flow back and produced water at the wellsite

Source: Halliburton
Limiting level of noise
Surface use: multi-well pad drilling

Source: Pawel Poprawa, PIG
Environmental challenges: *Natura 2000*
Population density in Poland

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Instytut Geografii i Przestrzennego
Zagospodarowania PAN, 2002
http://www.igipz.pan.pl/miasto/home.htm
Population density: shale gas exploration

Poland

Source: Lane Energy
Shale gas exploration site: Poland

Source: Lane Energy Poland
## Economic benefits of shale gas development

### Estimated Job Gains from Shale Gas Development by Basin

<table>
<thead>
<tr>
<th>State</th>
<th>Shale Play</th>
<th>Year</th>
<th>Job Gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>Fayetteville</td>
<td>2008</td>
<td>9,683</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Haynesville</td>
<td>2009</td>
<td>57,637</td>
</tr>
<tr>
<td>Texas</td>
<td>Barnett</td>
<td>2008</td>
<td>132,497</td>
</tr>
<tr>
<td>Pennsylvania and West Virginia</td>
<td>Marcellus</td>
<td>2009</td>
<td>57,357</td>
</tr>
</tbody>
</table>

### Economic Benefits from Developing the Pennsylvania Marcellus Shale

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Added</td>
<td>2,792</td>
<td>1,166</td>
<td>1,502</td>
<td>5,460</td>
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<tr>
<td>Taxes</td>
<td></td>
<td></td>
<td></td>
<td>2,036</td>
</tr>
<tr>
<td>Number of Jobs per well</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>31</td>
<td>12</td>
<td>19</td>
<td>62</td>
</tr>
</tbody>
</table>

Source: CEPE Manhattan Institute
Łebień – where the first well has been drilled
Costs of a moratorium (New York)

- An end to the moratorium would spur over 14 billion USD in economic output;
- Some 15,000 to 18,000 jobs could be created in the Southern Tier and Western New York;
- Another 75,000 to 90,000 jobs could be created if the area of exploration and drilling were expanded to include the Utica shale and southeastern New York;
- Localities and the state stand to reap $1.4 billion in tax revenues if the moratorium is allowed to expire.

Source: CEPE Manhattan Institute
Thank you for your attention!