**Figure 1.**

**Economic interpretation of “Hubbert’s curves” (acc. to Konoplyanik)**

$\text{Hubbert’s curves}$

$\text{Potential peak of “Hubbert’s curve” is at least two investment cycles away from now...}$

\[ \text{Deep horizons, deep offshore, Arctic, } \text{shale gas}, \text{ CBM, biogas, gas hydrates, etc...} \]

\[ \text{Deep horizons, deep offshore, Arctic, heavy oil, } \text{shale oil}, \text{ tar sands, GTL, CTL, BTL, etc...} \]

US shale gas (& oil) revolution converted shale O&G from “non-conventional” to “conventional” energy resources since made them competitive with incumbent conventional energies. $\Rightarrow$

Shale O&G have moved to the area below (inside of) “Hubbert’s curves” – the area of conventional energies (in economic sense) from the area above (outside of) “Hubbert’s curves” – the area of non-conventional energies. $\Rightarrow$

This moves O&G peaks of “Hubbert’s curves” upside-right & prolongs “hydrocarbon’s era” for the mankind. $\Rightarrow$

This means (acc. to Konoplyanik), we are living within left rising branch(es) of energy markets development “Hubbert’s curve(s)”

A. Konoplyanik, GECF, Doha, Qatar, 15.10.2018
Figure 2.

Evolution of international O&G markets: correlation between market development stages, contractual structures, pricing mechanisms and multi-facet competition at the rising branch of “Hubbert’s curve”

<table>
<thead>
<tr>
<th>Stage of Market Development</th>
<th>Pricing Mechanism's Development Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Competitive</td>
<td>Long-term contracts + cost-plus pricing =&gt; LOWER investment price (physical energy market(s))</td>
</tr>
<tr>
<td>Intensive Growth</td>
<td>Long/mid/short-term contracts + net-back replacement value pricing =&gt; UPPER investment price (physical energy market(s))</td>
</tr>
<tr>
<td>Mature Market(s)</td>
<td>Futures contracts / derivatives + futures pricing (exchange) =&gt; trade price (paper energy market(s))</td>
</tr>
</tbody>
</table>

Competitive choice is “in addition to” and NOT “instead of” rule !!!

A.Konoplyanik, GECF, Doha, Qatar, 15.10.2018
Figure 3.

Evolution of international O&G markets: correlation between market development stages and markets liquidity at the rising branch of “Hubbert’s curve”

Energy as:
- Material good
- Commodity
- Financial asset

Stage of market development
- Initial growth
- Intensive growth
- Mature market(s)
- Paper energy market(s)

Energy markets vs Churn rates

<table>
<thead>
<tr>
<th>Energy, marketplace</th>
<th>Churn (appr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global oil (NYMEX, ICE)</td>
<td>2000</td>
</tr>
<tr>
<td>US Gas (Henry Hub)</td>
<td>300-400</td>
</tr>
<tr>
<td>NWE gas (TTF)</td>
<td>25-45</td>
</tr>
<tr>
<td>NWE gas (NBP)</td>
<td>10-15</td>
</tr>
<tr>
<td>Other EU gas</td>
<td>3-5 &amp; less</td>
</tr>
<tr>
<td>EU GTM benchmark</td>
<td>8</td>
</tr>
<tr>
<td>Vision EU gas business</td>
<td>15</td>
</tr>
<tr>
<td>Global large-scale LNG (OTC/daisy chains)</td>
<td>(single digits?)</td>
</tr>
</tbody>
</table>

Pricing mechanism’s development stages:
1. Cost-plus
2. Escalation formulas (Based on alternative fuels prices)
3. Based on futures prices (Commodities markets)

(*) arbitrage operations

A. Konoplyanik, GECF, Doha, Qatar, 15.10.2018
Figure 4.

World Energy: The Change of Paradigm?

<table>
<thead>
<tr>
<th>SUPPLY</th>
<th>DEMAND</th>
</tr>
</thead>
</table>
| - Hubbert peak (curve)  
- Hotelling rent (theorem)  
- Chevalier turning point  
- STP (resource rent, economy of scale)  
- International law (access to resources) | - Economic growth (industrial-type, supply centralization & concentration)  
- Population growth |

Future energy supplies (NRES) more costly & limited (depletion rent) => low-cost NRES wins more rent, development of high-cost NRES delayed

<table>
<thead>
<tr>
<th>SUPPLY</th>
<th>DEMAND</th>
</tr>
</thead>
</table>
| - STP (technological rent, e.g. US shale revolution => Hotelling anti-theorem) | - Four steps in departure from oil since 1970-ies  
- Energy efficiency (delinking energy demand & economic growth, post-industrial-type)  
- COP-21 (upper limit/GHG emissions)  
- New type of economic growth in poor(est) DE (non-industrial, decentralized) & in DME (post-industrial) |

Future energy supply less costly & plentiful (partly due to demand limitation?) => competition among energy suppliers increases => low-cost NRES wins & takes all market, high-cost NRES cut-off

Competition at international gas markets tightens

DE - developing economies,  
DME - developed market economies,  
STP – scientific & technical progress  
COP-21 – Paris climate agreement 2015  
("Conference of Parties")  
NRES – non-renewable energy sources
Figure 5.
Two forming circles of future gas supplies to Europe: “disrupted” circle of global LNG supplies and integral with internal backup circle of Russian pipeline gas supplies

- Europe for Russian pipeline gas supplies - destination market;
- Europe for LNG (US LNG) supplies - balancing market within global arbitrage deals (plus destination market in Eastern Europe with “security premium” for delivery “molecules of freedom” - to take-off a competitor)