The role of gas in the European energy system. Decarbonization strategies of energy companies.
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Global Renewable Energy Development

Total amount of investments in renewable energy within the last 10 years exceeded 2.9 trillion US dollars.

Since 2010, net additions of renewable power generation capacities were the biggest among all energy resources and already reached 600 GW.

However, the key challenges of increasing the share of renewables in the power mix has not yet been met:

- Intermittent power generation
- Lack of efficient energy storage

Source: Bloomberg New Energy Finance

Source: IEA
The EU’s Renewable Energy Directive sets a mandatory target of 20% of renewable energy sources in the final energy consumption by 2020.

To achieve this target, the EU countries have to achieve their individual targets of RES share in the final energy consumption.

The most ambitious targets set in Iceland and Norway – 72% and 68%, respectively.
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Energy Transition in Germany

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- In December 2017 the share of wind and solar energy in the power mix fluctuated between 4.5% and 32%.
- On December, 1st 2017 the share of wind and solar energy in the power mix dropped to 4.5%, occasionally – 2.2%.
In December 2017 the share of wind and solar energy in the power mix fluctuated between 11% and 77%.

On December, 19th 2017 the share of wind and solar energy in the power mix dropped to 11%, occasionally – 5.3%.

All these periods occurred during winter months, when power system is working in harsh conditions.
## Gas Advantages in Power Generation

<table>
<thead>
<tr>
<th></th>
<th>Gas</th>
<th>Coal</th>
<th>Nuclear</th>
<th>Hydro</th>
<th>Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low capital costs for power plant construction</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Low operational costs for power generation</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Short period for power plant construction</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Low pollutions</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Availability of construction sites</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Possibility of power system balancing</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Independency of energy production from weather conditions</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

**The role of gas in European energy system.**

**Decarbonization strategies of energy companies.**
Long-term Strategies for Energy Companies

The Paris Agreement recognizes that countries need to conduct assessments of their vulnerabilities to climate change and undertake adaptation planning processes. Similarly, there is a current need for energy companies to develop a comprehensive understanding of the implications of climate change on their businesses.

Companies consider their current resources, infrastructure investments, future fossil fuel demand, research and development, and technology in order to identify the reliable development strategy.
Pathways to Decarbonization

Decarbonization

Operational efficiency
Development of RES
Technology innovations

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### Pathways to Decarbonization

<table>
<thead>
<tr>
<th></th>
<th>Shell</th>
<th>Equinor</th>
<th>Total</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational efficiency</strong></td>
<td>SmartFields, CCS, Flying Nodes, Shell MMLS Liquefaction technology</td>
<td>Sub-sea compression station, WS Seabed Rig, TAIL, Drill Plan, Cloud Data Storage, CCS</td>
<td>Pazflor, CCS, Subsea-to-shore technology</td>
<td>WATS, Plant Operations Advisor Intelligent system</td>
</tr>
<tr>
<td><strong>Development of RES</strong></td>
<td>Airborne Wind energy (AWE) - Kite Power Systems, Bioethanol production</td>
<td>20% of CAPEX in RES by 2030, Hywind, Photovoltaic technology solutions, Biofuel technology</td>
<td>25% of investments in RES by 2022</td>
<td>Hydrogen plant, Solar’s Mono2 silicon, Biofuel production</td>
</tr>
<tr>
<td><strong>Ventures</strong></td>
<td>Shell Technology Ventures, Engineering companies</td>
<td>Equinor Energy Ventures</td>
<td>Total Energy Ventures</td>
<td>BP Ventures</td>
</tr>
</tbody>
</table>
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Win-win solution

«Gas can undoubtedly play a very prominent role when it comes to the decarbonisation process of the energy system».

Prof. Dr. Klaus-Dieter Borchardt
Thank You for Attention

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