Discussion on potential joint research on key decarbonization issues of mutual interest

Leaded by Co-Chairs Work Stream 2 “Internal Markets”, Russia-EU Gas Advisory Council

29th meeting of the EU-Russia Gas Advisory Council’s Work Stream on Internal Market Issues (GAC WS2), Berlin, Germany, 21 October 2019
HOW to decarbonize: Gazprom’s three-steps cooperative vision ("Aksyutin’s pathway")

**Step 1: Structural lower-carbonization**
- The switch from coal in power generation and petroleum motor fuels to natural gas

**Step 2: Technological lower-carbonization based on existing technologies & infrastructure**
- Rapid reduction of GHG emissions
- The use of methane-hydrogen fuel in energy and transport w/o costly infrastructural changes

**Step 3: Deep technological lower-carbonization based on innovative technologies’ breakthroughs**
- Achieving the EU’s 2030 climate targets based on the existing gas infrastructure
- Transition to hydrogen energy based on efficient low-emission technologies of hydrogen production from methane

**TOTAL GHG EMISSIONS IN THE EU, 2016**

| Ex. LULUCF | 4.3 bln t CO₂-eq. | 13-18% | 25-35% | ~80% |

The expert assessment is made on the basis of data on:
- Carbon intensity from different fuels (U.S. Energy Information Administration estimates);
- Carbon footprint of various motor fuels (European Natural gas Vehicle Association report, 2014-2015);
- EU GHG emissions (1990 – 2016 National report on the inventory of anthropogenic emissions by sources and GHG removals by sinks not controlled by the Montreal Protocol, IEA)


A.Konoplyanik, IGU Stategy Comm meeting, SPB, 03.10.2019
How to cooperate & implement three-steps “Aksyutin’s pathway”?  

Cumulative effect of step’ 1 measures  
Cumulative effect of step’s 1+2 measures  
Cumulative effect of step’s 1+2+3 measures

Step 1 cooperative measures

Substitution:  
(1) Coal by gas in heat & electricity production,  
(2) Petroleum products by gas in transport by:  
- Compressed gas,  
- LNG

Potential incremental export of Rus gas for H2 production & of H2 production technologies (either of Rus origin or jointly developed by RF & EU)

Step 2 cooperative measures

Methane-hydrogen mix (MHM) as fuel gas for compressor stations (CS) at pipelines, both in RF & EU, based on H2 production technologies at CS on-site without CO2 emission

Step 3 cooperative measures

H2 production without CO2 emission (based on Russian, EU &/or on jointly developed under RF-EU cooperation technologies) as its cost-competitive advantage compared to PTG/electrolysis (too much energy intensive & thus too costly) and/or Steam Reforming with obligatory CCS (CCS as incremental immanent cost component up to 30+%)

Small-scale LNG for Black Sea & Danube region
Step 1 cooperative measures
Prospects of creation of Black Sea-Danube/CSEE ssLNG market

1-4 = ssLNG supplies to SEE (1 = from NS area by barges; 2 = through Turkish Straits (limited); 3 = from Black Sea RF plant by sea-river vessels; 4 = by trucks via N. Italy); 5 = supplies within Rheine-Danube waterway by barges/see-river vessels; 6 = ssLNG fueling stations

Black Sea ssLNG plant at RF coast

Step 1 Measures

<table>
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<th>Black sea plant</th>
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<tr>
<td>Location</td>
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<td>Delivery countries</td>
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Draft proposals for joint RF-EU research (1)

• Prospective topic:
  – Assessment of aggregated demand for ssLNG within Black Sea-Danube area (bunkering (sea/river vessels), trucks (intra- & inter-city transport), off-grid households) and prospective sources of its competitive supply

• Prospective participants:
  – EU side:
    • Academic/research level: IENE (research center for SEE energy), ...
    • Intergovernmental level:
      – Energy Community Secretariat (know-how & information hub for SEE),
      – Organisation for Black Sea Economic Cooperation (regional development organisation)
      – EU institutional support
    • Business level: OMV, ...
  – RF side:
    • Gazprom & its affiliations/institutes:
    • ...

WS2GAC cochairs proposal for joint RF-EU research, Berlin, 21.10.2019
Step 2 cooperative measures
Draft proposals for joint RF-EU research (2)

• Prospective topic:
  – Assessment of prospects & potential effects of implementation of adiabatic methane conversion (AMC) technology at the compressor stations within Russia & EU gas grids (200+ CS in Russia & ... CS in the EU) – and beyond

  • Pioneering exercise (in favour of recent Baumgarten’s 60th Anniversary – the key gas delivery point within USSR/Russia-EU cross-border gas supply chain): Prospective effect of implementing AMC technology within cross-border gas supply chain from Nadym-Pur-Taz through Baumgarten to Waidhaus

• Prospective participants:
  – EU side: Gas TSOs, ENTSOG, ...
  – RF side: Gazprom, ...
Step 3 cooperative measures
The impact of low-temperature non-equilibrium microwave-induced plasma on hydrocarbon gas molecules

Step 3
Measures

The hydrocarbon gas conversion takes place in a closed plasma-chemical flow reactor in the absence of oxygen and at ambient pressure.

Source: NATIONAL RESEARCH TOMSK POLYTECHNIC UNIVERSITY

All other conditions being equal, & under technologically neutral regulation, methane pyrolysis might win competition in hydrogen production with two other key technologies.

CC(U)S is needed!!! => additional imputed costs (CAPEX + OPEX) => add. 20/30+%  

| Steam reforming of natural gas | CH$_4$ + 2H$_2$O $\rightarrow$ 4H$_2$ + CO$_2$ |
| Water electrolysis | 2H$_2$O $\rightarrow$ 2H$_2$ + O$_2$ |
| Methane pyrolysis | CH$_4$ $\rightarrow$ 2H$_2$ + C |


Methane pyrolysis: major task – to speed up commercialization (scaling effect) to enter & move through “learning curve” for this technology(ies).
Approximate potential areas of preferential use of key H2 production technologies in Europe under state regulation based on “technological neutrality” principles

- P2G nuclear
- Steam reforming plus CC(U)S
- Methane pyrolysis & similar (w/o CO2)

Based on conversations with Ralf Dickel

Source of map: ENTSOG
Draft proposals for joint RF-EU research (3)

• Prospective topic:
  – Quantitative and qualitative assessments of economic & ecological effects for the three H2 production technologies
  – Analyzing alternative system approaches for the 3 technologies
    • Where to do this in EU/in RF/..
    • Who to do this (Producers, mid-streamers, TSOs,..)
    • How to progress on the learning curve (large pilots)
    • How to finance pilot?

• Prospective participants:
  – RF side: Tomsk, Samara, etc...
  – EU side: Karlsruhe, BASF, Madrid, etc...
Possible Additional Cooperative Measures?
Thank you for your attention!

WS2 GAC Co-chairs