Gas decarbonisation pathways for the Baltic Regional Gas Market Countries

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This project is carried out with funding by the European Union via the Structural Reform Support Programme and in cooperation with the Directorate General for Structural Reform Support of the European Commission
Objective: Provide recommendations for development of new legislative framework for decarbonising the Baltic Regional Gas Market by 2050

Running from February 2022 to October 2023
Gas decarbonisation pathways
Four scenarios of gas decarbonisation in Baltic + Finland market

BAU

REN-ME

REN-H2

Cost-Min

H₂

SNG
Impacts of energy efficiency and direct electrification measures in reducing overall gas demand have been considered in demand projection.
<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Assumptions of pipeline gas</th>
</tr>
</thead>
</table>
| **Business as usual** | Hydrogen blending – 5 Vol%  
Biomethane projections – based on NECP targets  
NG- Remainder                                             |
| **REN-Methane**    | Hydrogen blending – 10 Vol%  
Biomethane projections – reach the maximum economically feasible potential by 2050  
NG- phased out gradually by 2050  
SNG- Remainder of pipeline mix                              |
| **REN-Hydrogen**   | Hydrogen blending – **10 Vol%** until **2040**, **100 vol%** from **2041**  
Biomethane projections – based on NECP targets  
NG – phased out by 2040                                     |
| **Cost minimal**   | Maximum cap  
Hydrogen – 10 Vol%  
Biomethane – Maximum potential  
NG – phased out by 2040  
SNG                                                           |
Key findings of gas supply scenario planning

1. Gas supply will be reduced by 2050, considering the energy efficiency and electrification

2. BAU scenario still needs natural gas

3. Biomethane surplus can flow across the region and cover regional demand
Key findings of gas supply scenario planning

Existing **Klaipeda, Inkoo** and planned **Skulte** terminals are sufficient to satisfy the region’s **NG demand**; however, the region’s LNG import dependency will gradually decrease by 2050.

Based on the optimization results, no flow from **GIPL** to the region.

Regional **cross border flows** reduce by 2030 but increase by 2050 as renewable gas is integrated into the regional gas market.

Different utilisation of **Inčukalns** UGS storage in REN-H2 vs REN-Methane/C.M. scenarios.

The REN-Hydrogen scenario, benefits lower LCOE-H2 and the REN-Methane has lower LCOE-M.
CM scenario presents the fastest emission reduction
Action plan for decarbonisation of the Baltic Regional Gas Market
The EU Energy System Integration Strategy highlights that energy policies should follow a hierarchy for cost-effective decarbonisation.

1. A ‘circular’ energy system with energy efficiency as the core principle

2. Greater direct electrification of end-uses

3. Use of renewable and low-carbon fuels for hard-to-decarbonise applications

Energy efficiency and direct electrification measures reducing overall gas demand are not included in this action plan but should be prioritised ahead of policies substituting natural gas by renewable and low-carbon gases.
Action sets of the plan

- Action set 1 - Governance of gas system decarbonisation
- Action set 2 - Gas market design and integration
- Action set 3 - Support and requirements for renewable and low-carbon gas production and/or consumption
- Action set 4 - Infrastructure planning
- Action set 5 - Energy and carbon taxation
Decarbonisation hierarchy

1. Energy efficiency
   2. Direct electrification
      = Reduction of gas demand

3. Use of biogas/biomethane

4. Use of hydrogen/derivatives

Actions to decarbonise the gas system

1) Governance structure
   4a) Infrastructure planning coordination
   5a) Energy excise taxes
   5b) Carbon taxation
   2b) Energy certification system
   4c) Gas quality standards

1) Transversal actions

2a) BRGM integration

3a) Support for biogas/biomethane

3b) Support for hydrogen

3c) Consider ban on new gas connections / boilers

2c) Liquid hydrogen market

4b) Connection req. and planning

Specific actions

Trinomics
Risks addressed

• Significant risks exist for efficiently achieving decarbonisation of regional gas system

• 7 risks were identified as main ones (out of 16 assessed)

• The action plan addresses all main risks – however, some risks such as related to the macro-economic context and geopolitical events, will require generic policies and actions
Action plan roadmap

<table>
<thead>
<tr>
<th>Action sets</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</thead>
<tbody>
<tr>
<td>1 - Governance of gas system decarbonisation</td>
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<tr>
<td>2 - Gas market design and integration</td>
<td>1) Governance structure and strategy</td>
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<td></td>
<td>2a) Gas market integration and access</td>
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<td>2b) Energy certification system</td>
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<tr>
<td>3 - Support and requirements for renewable and low-carbon gases</td>
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<td></td>
<td>3a) Support measure for methane gases</td>
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<td>3b) H₂ support measures</td>
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<td>3c) Consider legal ban on new connections/boilers</td>
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<td>4 - Infrastructure planning</td>
<td>4a) Infra. planning coordination</td>
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<td>4b) Conn. requirements, T/D coordination</td>
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<td>4c) Gas quality standards</td>
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<tr>
<td>5 - Energy and carbon taxation</td>
<td>5a) Energy taxes</td>
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<td></td>
<td>5b) Carbon taxes</td>
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</table>
Scenarios’ costs and public support considerations

Scenario costs

- CAPEX for renewable gas production in three decarbonisation scenarios: ~ 11 B€
- OPEX represents > 90% of total costs, driven by LNG imports
- All decarbonisation scenarios should lead to lower costs to consumers by 2050
  - But attention is needed in the 2030 timeframe

Levelised cost of energy

- Biomethane: could reach 50-60 EUR/MWh by 2050
- Hydrogen: could reach 145-160 EUR/MWh
- High uncertainty: deployment depends on targets, resource availability, LNG, ETS & elec. prices

Policy considerations

- Public cost of most actions rated as low, requiring especially additional human resources
- Energy networks should in principle not be subsidised (except R&D)
- Biogas production & upgrade: (temporary) subsidy could be justified and linked to LNG prices
- Renewable hydrogen production: subsidy necessary to kick-start deployment, but challenging to set level of support
Recommendations to policymakers

- Energy efficiency and direct electrification measures reducing overall gas demand should be prioritized.

- Governance, infrastructure planning and energy/carbon taxation measures are no-regret measures and do not depend on the exact pathway.

- Policymakers should pay attention to the fact that despite the existence of some actions with low complexity, most are rather complex.

- An important choice concerns the development of a dedicated hydrogen network at the national and regional level.

- Quick implementation of the actions is paramount for maximising the societal net benefits of decarbonising the region's gas system.
Thank you for your attention, please contact us for more information

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This project is carried out with funding by the European Union via the Structural Reform Support Programme and in cooperation with the Directorate General for Structural Reform Support of the European Commission
Back-up

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REN gas production investment - CM Scenario

Investments (Million Euros) in renewable gas production technologies by 2050

- Biomethane production
- Hydrogen production
- SNG
## Pathways details

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario definition</strong></td>
<td>'Business-as-usual'</td>
<td>'REN -Methane dominant scenario'</td>
<td>'REN -Hydrogen dominant scenario'</td>
<td>'Cost minimal scenario'</td>
</tr>
<tr>
<td><strong>Decarbonisation level</strong></td>
<td>Full gas sector decarbonisation is not achieved</td>
<td>Full gas decarbonisation is achieved</td>
<td>Full gas decarbonisation is achieved</td>
<td>Full gas decarbonisation is achieved</td>
</tr>
<tr>
<td><strong>End-user decisions</strong></td>
<td>Focus on methane-based end-user applications</td>
<td>Focus on methane-based end-user applications</td>
<td>Focus on hydrogen-based end-user applications</td>
<td>Focus on the least cost-based fuel mix (with the hydrogen technical limitation constraints without major investment for retrofitting)</td>
</tr>
<tr>
<td><strong>Major gas carrier</strong></td>
<td>NG is still a major part of the gas demand (followed by biomethane and hydrogen and a small portion of biogas)</td>
<td>Methane (includes biomethane and SNG and followed by H2 and a small portion of biogas)</td>
<td>Hydrogen (followed by a small portion of biomethane and biogas)</td>
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<tr>
<td><strong>Strategy for the gas infrastructure to follow end-user decisions</strong></td>
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<tr>
<td><strong>Gas type expected within a national and cross-border gas infrastructure</strong></td>
<td>NG followed by biomethane and hydrogen</td>
<td>Short term: NG followed by biomethane, SNG, and hydrogen Long-term: Biomethane followed by SNG and hydrogen</td>
<td>Short term: NG followed by hydrogen Long term: NG followed by hydrogen and eventually pure hydrogen</td>
<td>Optimised scenario for the least cost solution (with the hydrogen technical limitation constraints without major investment for retrofitting)</td>
</tr>
<tr>
<td><strong>Hydrogen blending</strong></td>
<td>Up to 5 vol.%</td>
<td>Up to 10 vol.%</td>
<td>Up to 10 vol.% and eventually 100 vol.% pure hydrogen</td>
<td>Retrofitting constraints (on the NG grid infrastructure) are envisioned if the hydrogen blending levels cross the threshold of 10 vol.%</td>
</tr>
<tr>
<td><strong>NG infrastructure</strong></td>
<td>No retrofitting on gas supply infrastructure is envisioned</td>
<td>No heavy retrofitting on gas supply infrastructure is envisioned Technical possibilities of biomethane and hydrogen injection in transmission and/or distribution lines are considered</td>
<td>No heavy retrofitting on gas supply infrastructure is envisioned for blending levels up to 10 vol.% By 2041, total repurposing of the NG grid infrastructure (TSO and DSO lines) is envisioned.</td>
<td></td>
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<tr>
<td><strong>End-user equipment adaptation</strong></td>
<td>No retrofitting constraints for end use applications are considered except for the applications where the end equipment is sensitive to the NG gas quality.</td>
<td>Retrofitting constraints for end use specific applications.</td>
<td>Retrofitting or replacement constraints for end use specific applications.</td>
<td>Retrofitting constraints for end use specific applications.</td>
</tr>
<tr>
<td><strong>Gas supply infrastructure in use</strong></td>
<td>The role of transmission lines remains largely intact. Gas distribution via DSO lines.</td>
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</tr>
<tr>
<td><strong>Deployment of dedicated gas pipelines by TSO and/or DSO</strong></td>
<td>Limited and separated hydrogen networks may exist. New dedicated pipelines are not modelled but a comparative cost feasibility of pure gas supply modes will be provided in a case study (dedicated pipeline vs. gaseous truck transport)</td>
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<tr>
<td><strong>Change of demand between scenarios</strong></td>
<td>Baseline demand projections</td>
<td>Gas demand projections with electrification considerations</td>
<td>Conventional large-scale underground methane storage with an assumption to be able to store blended gas up to 10 vol.% H2 blends. After 2040, surface gas storage options for pure hydrogen.</td>
<td>Conventional large-scale underground methane storage with an assumption to be able to store blended gas up to 10 vol.% H2 blends.</td>
</tr>
<tr>
<td><strong>Plan for excess hydrogen</strong></td>
<td>No</td>
<td>Hydrogen export potential for Estonia is considered</td>
<td>Hydrogen export potential for Estonia is considered</td>
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</table>
Actions of the plan

**Action set 1 - Governance of gas system decarbonization**
- 1) Improve the governance structure and strategic policies for renewable gases

**Action set 2 - Gas market design and integration**
- 2a) Further integrate the Baltic Regional Gas Market and facilitate access for new actors
- 2b) Review energy certification system (including biogas and off-grid gas and extension to low-carbon fuels)
- 2c) Consider measures to develop a liquid hydrogen/derivatives market in the long-term

**Action set 3 - Support and requirements for renewable and low-carbon gas production and/or consumption**
- 3a) Review/introduce coordinated production and/or consumption support measures to foster methane-based gases
- 3b) Assess the need for and implement specific support measures for renewable hydrogen production and/or consumption
- 3c) Consider legal ban on connecting new buildings to the natural gas grid and/or to new gas boilers

**Action set 4 - Infrastructure planning**
- 4a) Increase regional methane/hydrogen/electricity infrastructure planning coordination
- 4b) Review and harmonise connection requirements and coordinated planning for transmission and distribution
- 4c) Review and harmonise gas quality standards where appropriate

**Action set 5 - Energy and carbon taxation**
- 5a) Review energy excise tax across energy products
- 5b) Review/introduce carbon taxation
## Implementation channels

<table>
<thead>
<tr>
<th>1) Governance structure</th>
<th>Energy sector legislation</th>
<th>Regional cooperation initiatives</th>
<th>Renewable energy legislation</th>
<th>Regulatory decisions</th>
<th>Gas quality standards</th>
<th>Energy &amp; carbon tax. legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a) BRGM integration</td>
<td>X</td>
<td>X</td>
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<td>2b) Energy certification system</td>
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<tr>
<td>2c) Liquid hydrogen market</td>
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<tr>
<td>3a) Support for biogas/biomethane</td>
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<tr>
<td>3b) Support for hydrogen</td>
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<td>3c) Ban on new connections/boilers</td>
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<td>4a) Infra. planning coordination</td>
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<td>4b) Connection req. and planning</td>
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<td>4c) Gas quality standards</td>
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<td>5a) Energy excise taxes</td>
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- Table showing various implementation channels and their corresponding legal and regulatory frameworks.
### Relevance to the decarbonisation scenarios

<table>
<thead>
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<th>REN-Methane</th>
<th>REN-Hydrogen</th>
<th>Cost Minimal</th>
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