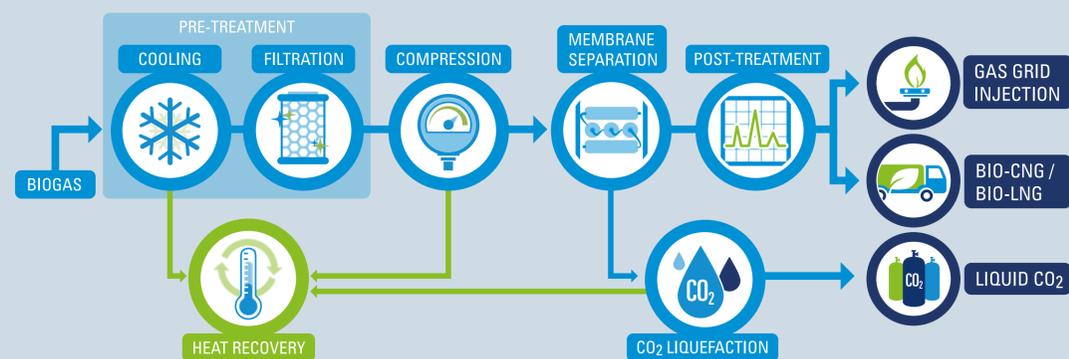


Centralized biomethane injection points are the most cost-effective and scalable solution for Latvia in the short- to mid-term.

They enable multiple small and medium-sized producers to access the gas grid without requiring individual infrastructure.

Biomethane could substitute up to 50% of Latvia's natural gas use, with the right support measures.



Schematic overview of membrane-based biogas upgrading and biomethane pathways [Source: "Tech: Biogas upgrading: membrane technology," Bright Renewables]

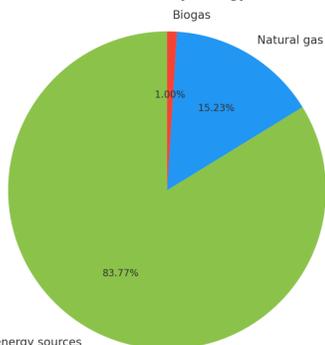
Membrane separation is the most suitable upgrading technology due to its efficiency and adaptability.

Introduction

Latvia has untapped biomethane potential- estimated at up to 4 TWh per year- yet currently only two injection points exist in the national gas grid.

This study explores **sustainable integration pathways for biomethane**, aiming to reduce fossil gas dependency, support rural development, and contribute to EU climate and energy targets.

Breakdown of Primary Energy Sources



A **scenario-based, multi-criteria approach** is applied to evaluate upgrading technologies, infrastructure models, and their technical-economic feasibility in the Latvian context.

Methodology

This study used a scenario-based multi-criteria analysis (MCA) to evaluate biomethane integration options for Latvia's gas grid.

Three scenarios were assessed: 1) on-site injection, 2) regional upgrading with grid access, and 3) direct supply to end-users.

Evaluation criteria included CAPEX, OPEX, scalability, environmental impact, grid compatibility, and operational complexity. Criteria were weighted based on literature and expert judgment to reflect policy and market priorities.

Results

The second scenario- regional upgrading with centralized grid injection proved to be the most balanced and cost-effective solution. It significantly reduced capital and operating costs compared to full on-site upgrading, while maintaining the same income potential.

	CAPEX (€)	OPEX (€/year)	Estimated income (€/year)	Payback period (years)
1 st scenario	17 050 000	1 112 275	1 400 000	59.2
2 nd scenario	6 400 000	808 400	1 400 000	10.8
3 rd scenario	5 200 000	757 847	1 400 000	8.1

While the third scenario had the shortest payback, its lack of scalability and grid integration makes it less suitable for long-term national implementation.

Conclusions

- Centralized biomethane injection (Scenario 2) offers the best balance between cost, scalability, and grid integration for Latvia.
- Although Scenario 3 has the shortest payback period, it lacks compatibility with national energy infrastructure and limits future expansion.
- Scenario 1, while technically robust, is economically unviable due to high CAPEX.
- With appropriate policy support and investment, biomethane could cover up to 50% of Latvia's natural gas demand, contributing to energy independence and climate targets.