Unlocking the full potential of bioLNG: mass balance liquefaction must remain a viable pathway

BioLNG (liquefied biomethane holding verified sustainability attributes) is a key solution in decarbonizing hard-to-abate sectors such as heavy-duty transport and maritime shipping, where other technologies have to date proved to be less effective, or not viable at all.

Under Implementing Regulation (EU) 2022/996, **two equally valid regulatory pathways** are available for supplying bioLNG. The first is **physical liquefaction**, where biomethane is produced and converted into liquid form at a liquefaction facility directly connected to the production site or to the grid. The second is **mass balance liquefaction** (or liquefaction by equivalence), where gaseous biomethane is injected anywhere in the grid and directly recovered as liquid using the LNG facilities within the interconnected European gas infrastructure. The integrity of the chain of custody is ensured by the implementation of a certified[1] mass balancing system.

The ability to rely on both physical and contractual pathways provides much greater opportunity to develop the sector, enable greater flexibility in infrastructure use, support investments in EU biomethane production, and ensure stable supply of domestic renewable fuels. When mass balance liquefaction allows domestically produced biomethane to reach consumers, consumers have access to a wider range of producers and decarbonised products, and Europe's dependency on imported fossil fuels is reduced.

Against this backdrop, the revision of Implementing Regulation 2022/996 and RED II Annex VI are instrumental to establish the necessary framework to help unlock the EU's bioLNG potential.

Key Messages

- **Mass balance liquefaction provides greater opportunity for a timely and cost-effective decarbonisation** of key hard-to-abate sectors such as heavy-duty transport and maritime shipping. It is already used in gas markets like France and Spain, and it does not require additional infrastructure investments.
- **Reliying uniquely on physical liquefaction would substantially reduce the scope of decarbonised products for end-users** and the scale of emissions reductions that would otherwise be available, slowing down – and raising costs of – decarbonisation.
- **Deviations from the existing methodology for accounting mass balance liquefaction emissions** could undermine the feasibility of this pathway, **depriving Europe of a significant option to decarbonise** in a timely and sustainable manner.

[1] According to international voluntary schemes or national certification schemes recognised by the EC.

BioLNG: a ready-to-use solution for decarbonisation

In a context of surging LNG demand in Europe[2], bioLNG can play a pivotal role as decarbonisation efforts accelerate. The implementation of targets for sustainable fuels stemming from RED III, FuelEU Maritime, and new IMO regulations, present a global market opportunity for biomethane, constituting a significant source of demand for the foreseeable future. Notably, the existing EU LNG import infrastructure can already accommodate the bioLNG growth with no material investment in additional infrastructure beyond truck loading facilities.

We highlight the immediate potential for bioLNG to help decarbonise the heavy-duty vehicles (HDV) and maritime sectors:

- The HDV sector today counts around 6 million trucks[3], largely diesel-fuelled. To meet the **EU GHG emissions reduction targets for HDV of 90% by 2040[4]**, the switch to (bio)LNG represents an effective and readily available solution, which will drive up bioLNG demand.
- **To decarbonise a single LNG-fuelled ship, the annual bioLNG production of more than two[5] small-scale liquefaction plants might be physically necessary**. With more than 500 LNG ships expected to enter the market in the coming years [6], the number of new small-scale liquefaction plants potentially needed is staggering – implying substantial capital expenditures (around **EUR 6 million per small scale facility** is a plausible number; see Annex). This highlights the critical importance of mass balance liquefaction as a decarbonisation solution stirring up biomethane production.

Benefits of mass balance liquefaction

In light of a structurally short bioLNG market, mass balance liquefaction emerges as a credible and scalable pathway to meet the expected rapidly growing demand and further incentivise domestic biomethane production. Compared to physical liquefaction, the mass balance approach offers several advantages:

---

[2] LNG imports in Europe have increased from pre-war levels of 75bcm to current 133bcm per year, rising from around 20% to 37% of total gas imports (Eurostat).
[3] ACEA, Fact Sheet: Trucks, 2023

[4] Regulation (EU) 2024/1610 of the European Parliament and of the Council of 14 May 2024 amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, amending Regulation (EU) 2018/858 and repealing Regulation (EU) 2018/956.

[5] In 2015, an average container consumed 10 kt LNG equivalent; for cruises, the number exceeded 20 kt (OIES). The typical capacity of a small-scale liquefaction plant can be around 4kt-8kt a year.
[6] DNV Alternative Fuels Insights (AFI) platform.

- **Cost effectiveness:** by leveraging the EU's existing infrastructure, mass balance liquefaction avoids the need for substantial capital investments in new liquefaction plants. The utilisation of already highly efficient facilities, often located in LNG-importing countries, will significantly reduce the overall cost of bioLNG.
- **Lower total GHG emissions:** liquefaction at highly efficient large-scale facilities allows for lower energy consumption per liquefied cubic meter, lowering GHG emissions per unit of liquefied biomethane as compared to smaller-scale facilities.
- **Immediate bioLNG availability:** mass balance liquefaction enables a quicker scale-up of bioLNG supply without the immediate need to construct new physical liquefiers. Meeting increased demand would otherwise require a significant expansion of physical liquefaction capacity, adding time (besides costs and emissions).
- **Increased market access for biomethane producers**: as mass balance liquefaction relies on biomethane injected into the gas system, it connects biomethane producers to a larger number of potential consumers.

Policy Recommendations

Considering the above, we believe the following actions are key to unlocking the EU's bioLNG potential and support the decarbonisation of important European hard-to-abate sectors:

- **The recast Implementing Regulation should confirm that mass balance liquefaction** (or "liquefaction by equivalence") **is a viable pathway**, without enforcing a mandatory physical liquefaction step[7]. The underlying condition is that all the volumes considered emerge from infrastructures which are part of the single EU mass-balance system.
- **For accounting emissions in mass balance liquefaction, the revised RED Annex VI should maintain the currently used, and widely accepted ISCC methodology**, which relies on a default value derived on typical EU liquefier energy consumption data[8] multiplied by the national electricity mix. For instance, **such methodology could be officially recognised within the EU regulatory framework**.
- As a next step, to ensure clarity, **the Commission should confirm** – either in the revised Annex VI, or in the forthcoming recast of Implementing Regulation 2022/996 – **that the electricity grid carbon intensity (CI) to be factored into ISCC's formula is the**

[7] According to the Commission Implementing Regulation (EU) 2022/996 on rules to verify sustainability and greenhouse gas emissions saving criteria, bioLNG and bioCH4 are part of the same product group.

[8] The default value presented in ISCC EU 205 Greenhouse Gas Emissions (p. 50) is also reflected in JRC's JEC WTT report v5 Annexes, Chapter 8.3, p. 60-66 (tables) referring to the liquid biomethane pathway.

most recent value published by JRC. More regular (e.g. annual) updates by JRC would also help avoid confusion on which CI should be applied[9].

- If the Commission chooses to establish a unique default value for mass balance liquefaction GHG accounting under Annex VI, **this should be properly justified and should not artificially allocate emissions in a process where these emissions do not actually occur**. Such value would be expected not to diverge substantially from the carbon intensity computation currently set by ISCC.

Contact

Stefano Grandi
Manager – Gas Committee
s.grandi@energytraderseurope.org

[9] To date, it is unclear whether the CI to consider will be published by the JRC, or provided under recast IR 2022/996 (Annex IX), or under the LCF Delegated Act (Table 5).

Annex

Background notes on technical elements of physical liquefaction

Disclaimer: the information below reflects the reality of one of our Member companies, which could be considered as a proxy for European biomethane physical liquefaction.

1. An average small liquefaction unit at the scale of 4 kilo tonnes (kt) per year of BioLNG has an electrical consumption of about 1,1 MWhe per tonne of bioLNG, which correspond to 2,6 MWhth (CHP electrical efficiency of 42%) per 15,25 MWhth of bioLNG, equal to **17% of gross energy**. This is to be compared to **10%** of energy used for liquefaction as a share of the total gross energy content of the final output for **medium scale facility** (50 kt per year), and **7% for large scale liquefaction facilities** currently used in fossil LNG export countries (in the range of millions of tonnes per year) – which are thus 2.5 times more efficient than small-scale facilities.
2. The **total capex of a liquefaction unit of 4 kt per year** (civil and electromechanical items), including the cost of upgrading the unit to reach the very high standard of biomethane for liquefaction (50 ppm CO_2 residual content) and the cost of the power generator, **is in the range of EUR 6 million, or EUR 1.5 million per kt of annual capacity**; a medium scale facility would still have high costs, around EUR 1.0 million per kt per year.