BIOMETHANE FICHE – Spain (2021)

BIOMETHANE PRODUCTION, POTENTIALS AND PATHWAYS

Biomethane is upgraded (purified) biogas to the quality of natural gas (methane). Currently, biogas is dominantly used for the production of electricity and heat in CHP plants.

Biogas/biomethane is 100% of domestic origin and has cross-sectoral effects.

Upgrading of biogas in the EU started in 2011. In 2021, total biomethane production in the EU27 was 3.5 bcm. REPowerEU has biomethane as one of the short and medium-time measures to reduce natural gas imports by boosting biomethane production to 35 bcm by 2030.

BIOGAS / BIOMETHANE IN SPAIN (DATA FROM 2021)

- Energy balances (Eurostat) record production of 0.36 bcm of biogases, without distinguishing the type.
- Biogases make 1.1% of natural gas supply.
- 0.36 bcm of biogases are mainly used to produce electricity (68%), whereas Final energy consumption (32%) had commercial & public services (17%) and industry (13%) as main consumers.
- European Biogas Association (EBA) reports[1] 0.79 bcm of biogas produced in 2021 (97% in 250 biogas plants and 3% in 4 biomethane plants). The 5th biomethane plant was to start in 2022 with 0.5 bcm. About 30 new biomethane plants are under construction, with operation planned to start before 2025.
- Biomethane use in transport is emerging (< 1%), given the limited CNG (compressed natural gas) vehicle fleet.
- Natural & bio Gas Vehicle Association (NGVA Europe) reports 100% supply of biomethane for transport at 71 CNG stations for Spain in 2020[2].

[1] EBA Statistical Report 2022 | European Biogas Association

[2] https://www.ngva.eu/medias/2510-biocng-in-2020-new-data-proves-rapid-growth-of-biomethane-in-transport/

Figure 1 Comparison of current natural gas supply, biomethane production and potential in Spain (2021) (sources: Eurostat: Energy Balances, 2022; Guidehouse: Gas for Climate Report 2022**)*

Biomethane has two production pathways:

- **Anaerobic digestion (AD)** produces biogas and digestate (fermented organic matter, similar to slurry) as a local source of nutrients and GHG emission mitigation option for land management.
  - Macro and micro nutrient composition of digestate depends on the feedstock used for AD[3]
  - Digestate contains phosphorus (0.2-1.5 kg/t) that is on the list of critical raw materials for the EU[4]**.**
- **Gasification** produces biogas and biochar (carbonized organic matter, similar to charcoal) as a land-based carbon removal option (IPCC, 2019) and soil amendment.

To maximize the multisectoral value of biomethane, byproducts must be recognized and valorized.

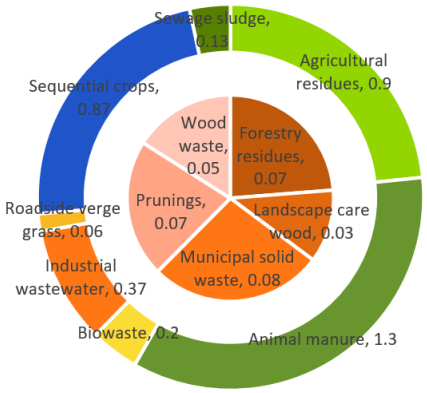

Figure 2 Biogas/biomethane potential in bcm, by feedstock for Spain (inner pie gasification and outer circle AD) (source: Guidehouse: Gas for Climate Report, 2022)

Industry estimates Spain's potential as 4.1 bcm (3.8 bcm from AD and 0.3 from gasification) by 2030 (Figure 2).

Spain is among the top 5 EU27 by sustainable biomethane potential.

Spain consumes 1.059 kt and 212 kt of nitrogen and phosphorus fertiliser[5] that could be partially replaced by digestate.

Manufacturing and Agriculture, forestry & fisheries are the 2 main GHG emission sources by economic activity with 47% (126 $MtCO_{2eq}$)[6] in Spain, which can be tackled both by manure management in AD, application of digestate on soil (land management) and use of biomethane and biogenic CO_2 in industry (ETS sector).

About 4% (~15.8 bcm) of the total natural gas supply in EU was used for non-energy purposes, dominantly for synthesizing nitrogen-based fertilizers, in addition to the energy input needed to support the production process. Combining biomethane production with a strong support of using digestate as a local source of nutrients would have multiple benefits for the reduction of natural gas imports.

[3] As a rule of thumb, 1 ton of digestate contains 2.3-4.2 kg of N; 0.2-1.5 kg of P and 1.3-5.2 kg of K.
[4] EUR-Lex - 52023PC0160 - EN - EUR-Lex (europa.eu)
[5] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_mineral_fertiliser_consumption#Analysis_at_country_level
[6] File:Greenhouse gas emissions by economic activity, 2021 (thousand tonnes of CO2 equivalents).png - Statistics Explained (europa.eu)

NATURAL GAS (NG) SUPPLY AND CONSUMPTION OF SPAIN (2021)

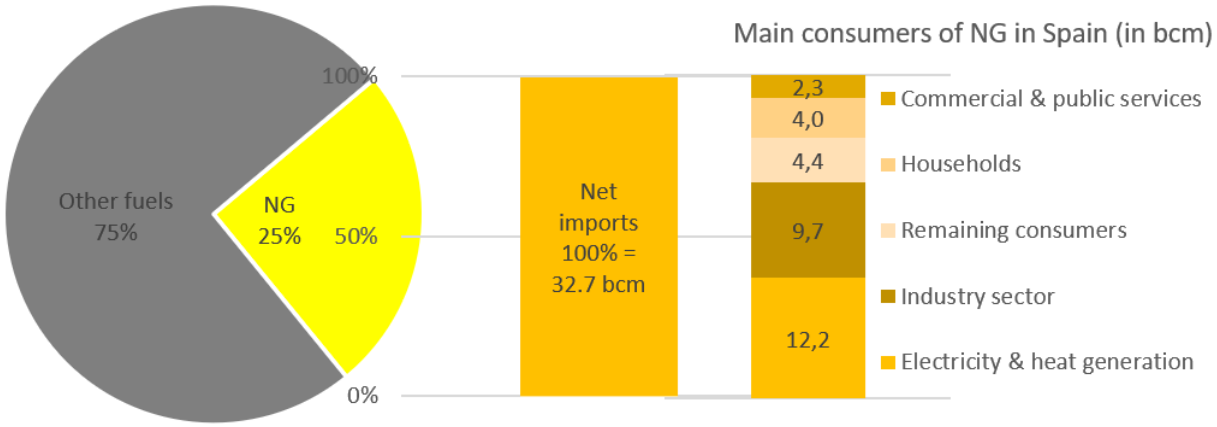

Figure 3 Natural gas share in total energy supply, origin and main consumers for Spain (2021) (source: Eurostat: Energy Balances, 2022)

- NG makes 25% of the total energy supply (TES) of Spain, out of which 100% (32.7 bcm) is imported.
- Roughly, NG is used 99% for energy purposes and 1% for non-energy purposes (synthetic fertilizers).
- The main NG consumption sectors in Spain are in Final energy consumption (51%): industry (30%) and households (12%) as the main consumers. 37% of NG is used for electricity production, either in electricity only or CHP plants.

Key messages for biomethane in Spain:

- Spain has ability to replace about 13% of current NG consumption with biomethane.
- Current biogas/biomethane production can grow 10fold to reach sustainable biomethane potential.
- To have full effect of biomethane production on the green transition, biomethane production support is to be linked with the agri-food industry to avoid transportation costs and feedstock loss, with local digestate application, renewable CO_2 and biomethane use in industry (ETS sector) or heavy-duty vehicles (transport sector).
- Where is possible, integrate biogas electricity in ancillary services of power grid balancing.
- A programme to repower biogas CHP plants, without grid balancing function, to biomethane, either as a single upgrading point or a cluster with a centralised upgrading unit close to the NG grid injection or end-use.
- Transition from food & feed feedstock to sequential cropping and digestate use (like the Italian BiogasDoneRight concept) would increase the impact on GHG emission savings and green transition of already operational biogas and (newly established) biomethane plants.
- 71 CNG fillings stations seem not sufficient to support larger uptake of biomethane in transport, a good start would be to combine biomethane from wastewater treatment or landfills with urban transport as a part of a larger urban area decarbonisation strategy.