Technical Association of the European Gas Industry

A screenshot on Oxygen management in Biomethane in Europe

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ENTSOG Gas Quality Workshop

Background

Background

- **Quality of biomethane required in European countries for injecting into natural gas grid- update – February 2024**

	FR	NL[4]	ES	SE	DE	CH	AT	IT	DK	GB[2]	BE[17]	CZ	PL	IE
O_2 (% Mol)	0.01 (exemption: up to 0.7% in the transmission grid / up to 0,75% in the distribution grid/ exemption up to 0,4% in the distribution grid for new projects > 2023)	≤0.0005 (High pressure L - HTL) ≤0.5 (Regional L – RTL) ≤0.5 (Distribution L – RNB)	<0,3 in transmission grid < 1 in distribution grid[1]	≤ 1	< 0.001 (MOP > 16bar) < 3 (MOP <16 bar)	< 0.5	< 0.02	≤ 0.6	< 0.5	< 0.2 < 1 for MOP< 38 bar	When the gas can reach an Interconnection Point: 0.001, 0.01, 0.1 depending on location When the gas cannot reach an Interconnection Point: 0.5	≤ 0.02 Transmission ≤ 0.5 distribution	< 0.5	<0.2 on transmission grid < 1.0 on distribution grid[12]

Background

EN 16726:2025 “Gas infrastructure- Quality of gas- Group H”

Parameter	Maximum limit
Oxygen	1% or below 1% to 0,01% or below 0,01% to 0,001% according to assessment process

In the gas infrastructure the concentration of oxygen shall be no more than 1 %.
However, if it can be demonstrated by an **assessment process** that a gas with oxygen content can flow to installations with proven sensitivity to oxygen at the level:
— of below 1 % to 0,01 %, the maximum limit shall be lowered to the maximum acceptable limit, expressed as a moving 24-hour-average.
— of below 0,01 %, the maximum limit shall be limited to 0,001 % at the lowest, expressed as a moving 24-hour average. Solutions for protecting these specific installations shall be defined in co-operation of the parties concerned, as part of the assessment.
NOTE 1 Most applications can accept a level of 0,01 % of oxygen or higher; certain types of underground storages are sensitive to oxygen contents higher than 0,001 %.
On a case-by-case basis, it can be required to identify the techno-economical optimal solution enabling the level of O2 acceptable for the part of the gas grid affected, e.g. from biomethane producers to installations sensitive to O2.
The assessment process for identification of installations sensitive to O2, and evaluation of the applicable threshold and responsibilities need to be stipulated to facilitate the application of the standard requirement on O2 content.
NOTE 2 Considering the expected development of biomethane production, the lower maximum limit of 0,01% will probably have to be reassessed upwards in the coming years.
NOTE 3 1% is equal to 10000 ppm and 0,001% is equal to 10 ppm.

More information on oxygen origin, challenges, mitigation measures and measurements are given in Annex I.

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Questionnaire on O2 management by G5 “Gas quality and metering” of MARCOGAZ

Presentation of the questionnaire: content

Questions related to the network structure (Picture of Mid-2025)	Questions related to the network structure (In 2030)	Questions related to EN 16726 (Gas infrastructure - Quality of gas - Group H)	Questions related to the monitoring	Questions related to side effects of O2:	Questions related to mitigation of O2:
Biomethane injection points : number and size	Biomethane injection points : number and size	Country position regarding the implementation of EN16726	How O2 is measured: kind of analyzers, which point of the grid, simulation tools, …	Incidents related to the increase of O2 in the network	Sensitive end-users: experience to share?
Reverse flow stations: number + quantity of biomethane injected	Reverse flow stations: number + quantity of biomethane injected	Level of implementation as TSO or DSO			EN16726: strategies to respect the limits of EN16726
Sensitive end-users: number, kind and level of sensitivity	Sensitive end-users: number, kind and level of sensitivity	Assessment processes: are there established processes + experience to share			Solutions to prevent problems related to the side effects of O2
Annual average amount of flow of injected biomethane compared to the total flow of gas + level of O2 in the biomethane and in the grid	Annual average amount of flow of injected biomethane compared to the total flow of gas + level of O2 in the biomethane and in the grid				Technologies to treat O2 before injection
					Current and future research projects
					MARCOGAZ TF dedicated to issues related to O2

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Participation

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Participation

Country	Gas Operator	TSO/DSO/SSO		
Spain	Enagas	TSO		
	Sedigas (Spanish Gas Association)	TSO	DSO	
Denmark	Energinet	TSO		
The Netherlands	Gasunie	TSO		SSO
Ireland	Gas Networks Ireland GNI	TSO	DSO	
France	GRDF		DSO	
	NaTran	TSO		
	Storengy			SSO
Italy	Italgas		DSO	
	Snam	TSO		SSO
Latvia	JSC GASO		DSO	
United Kingdom	National gas	TSO		
Austria	Netz Niederösterreich GmbH, (NNOe)		DSO	
	Netz OÖ		DSO	
Sweden	Nordion	TSO	DSO	
Germany	OGE	TSO		
Poland	Polska Spółka Gazownictwa (PSG)		DSO	
Belgium	Fluvius		DSO	
	ORES		DSO	
	Fluxys	TSO		

20 participating gas operators

13 different countries

- ➔ 10 TSOs
- ➔ 11 DSOs
- ➔ 1 SSO (since Snam and Gasunie participated as TSOs)

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Analysis of collected data

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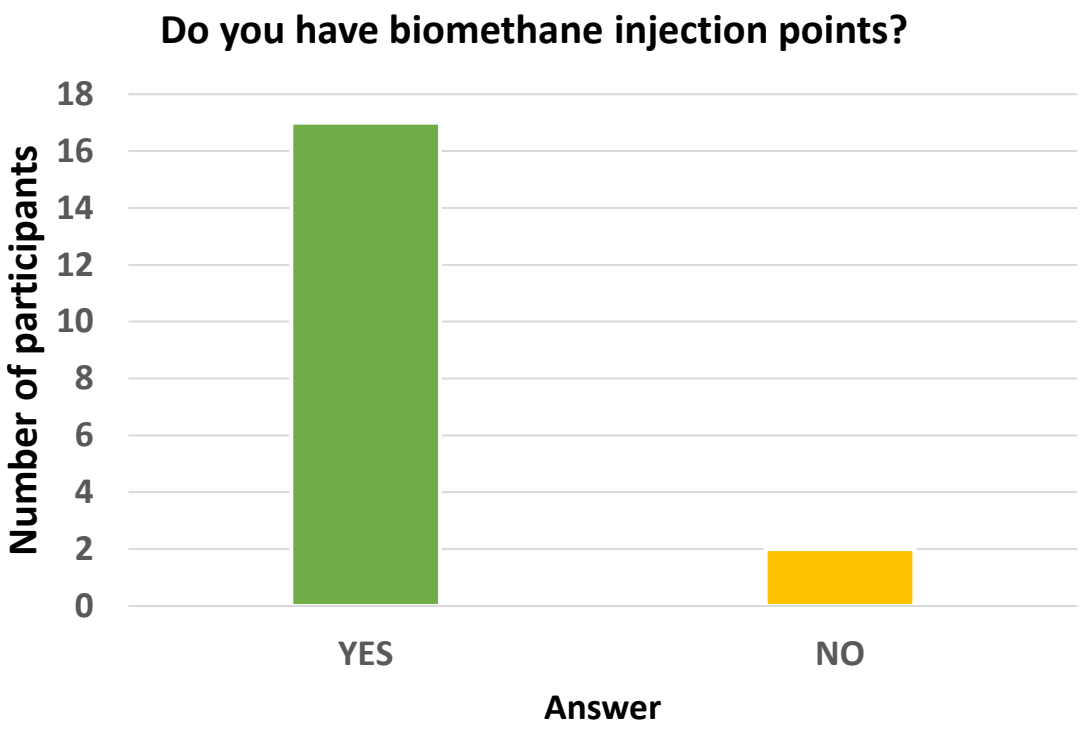
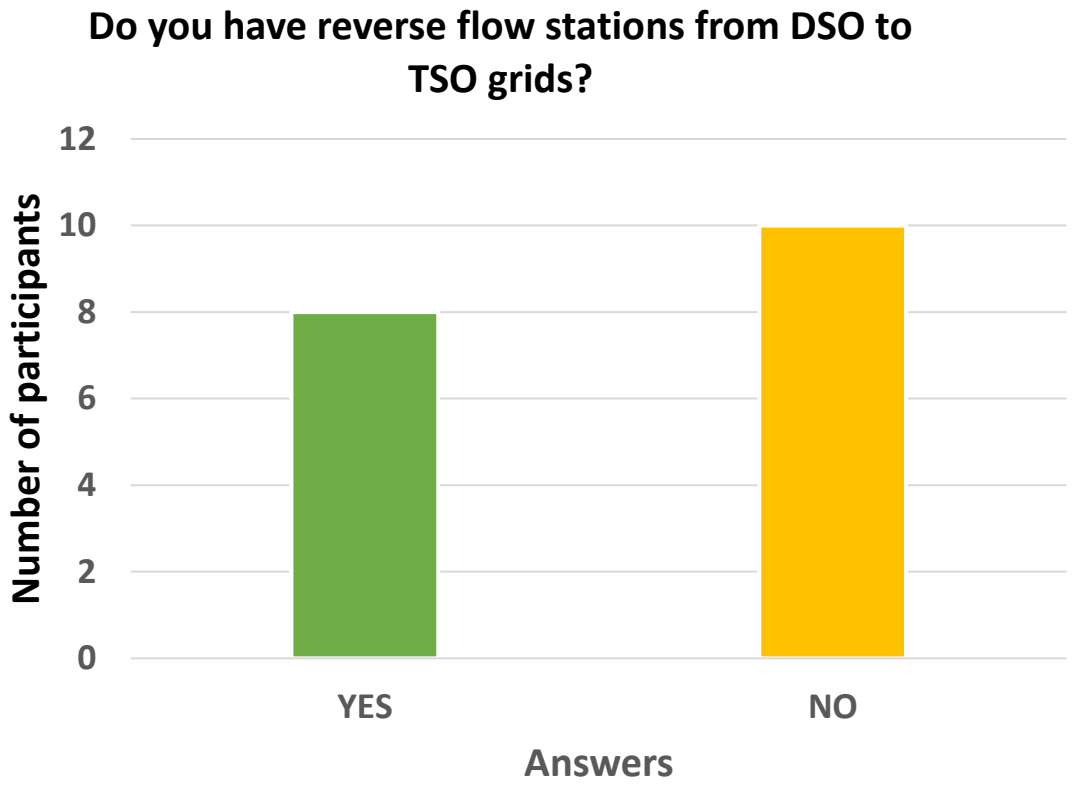
Questions related to the network structure (Picture of Mid-2025):
Do you have biomethane injection points and reverse flow stations?

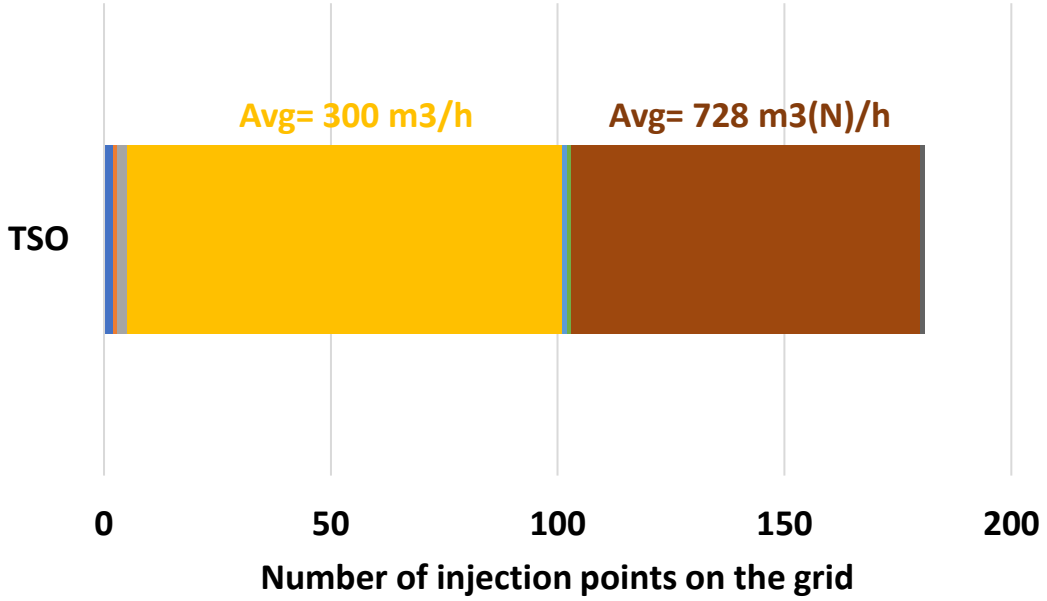


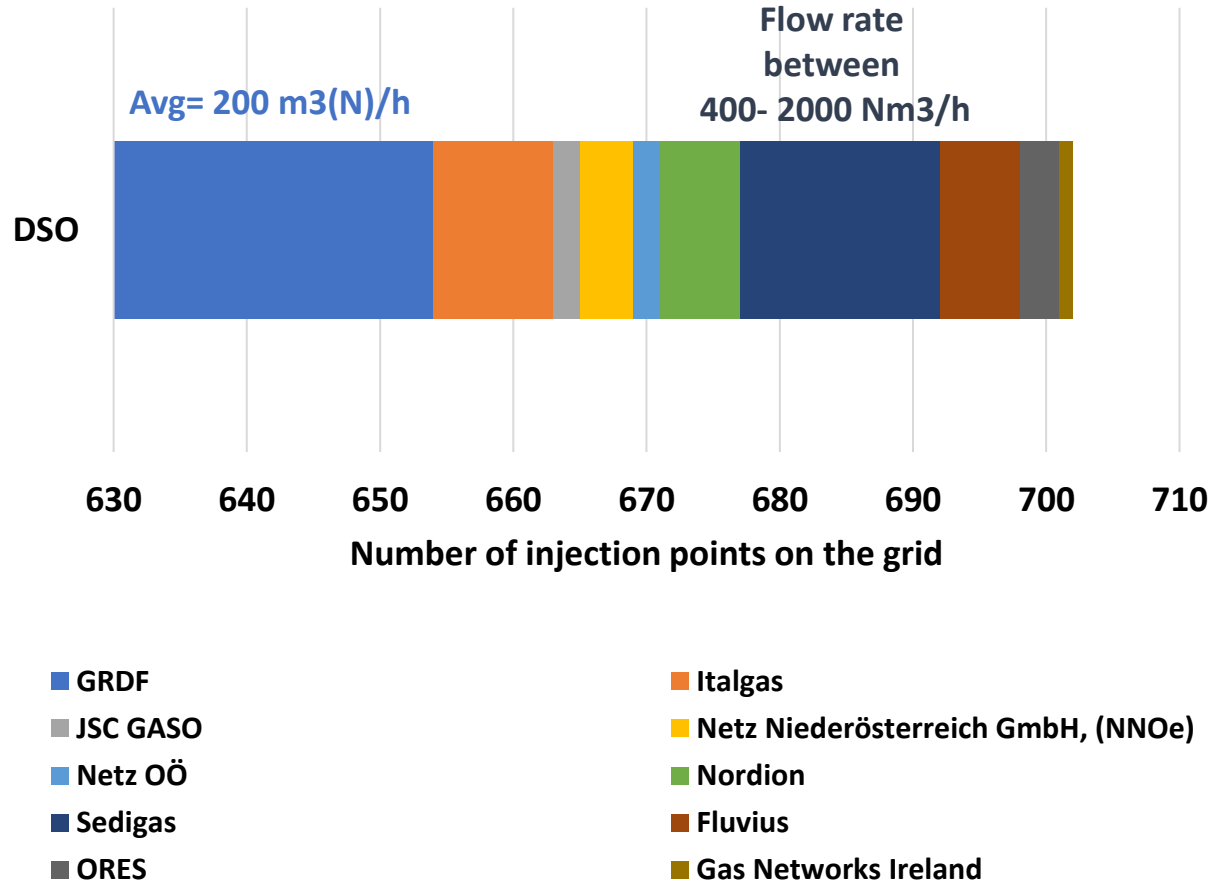


* No: One of the participants is a storage operator

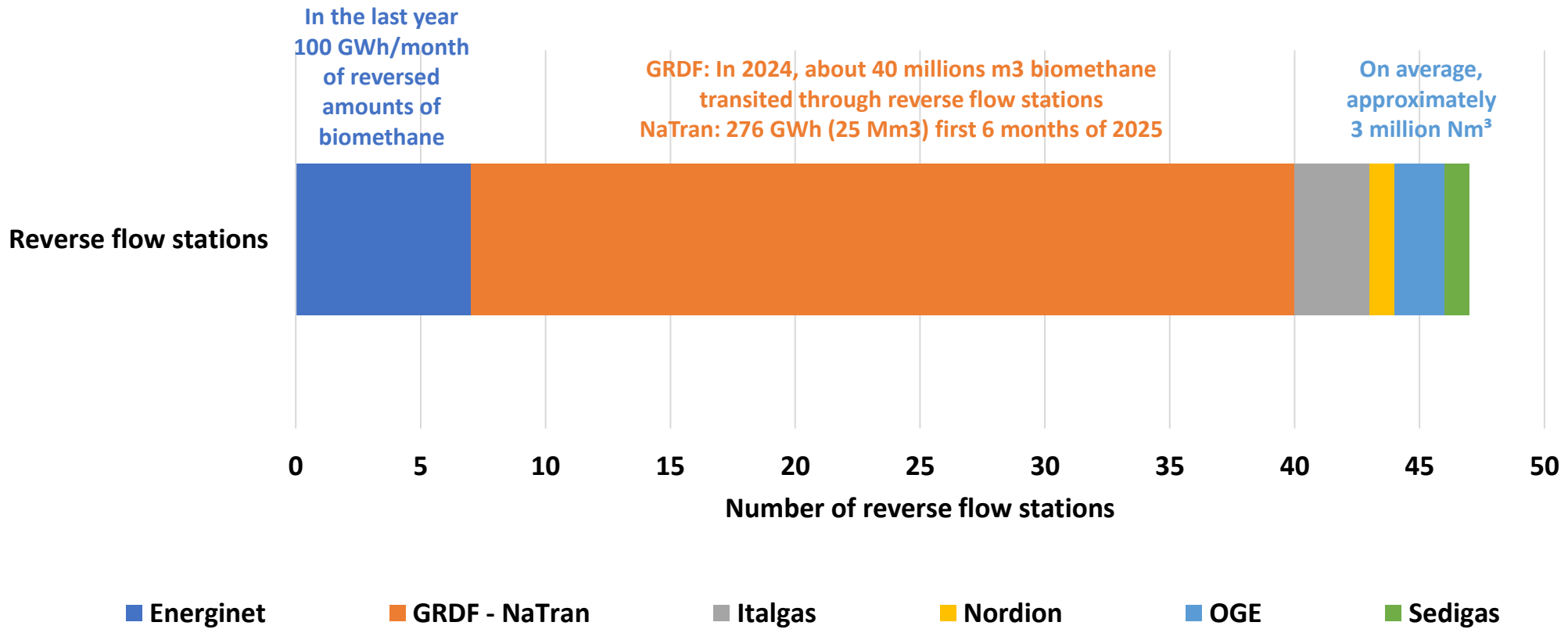
Questions related to the network structure (Picture of Mid-2025):

How many biomethane injection points and what size m3(N)/h?





Questions related to the network structure (Picture of Mid-2025):
How many reverse flow stations and what size?



Questions related to the network structure (Picture of Mid-2025):
What is the level of biomethane and O2 in the gas grid?

0,01- 7%

Annual average amount (in %) of flow of the injected biomethane compared to the total flow of gas in the grid

0- 1%

Level of O2 in biomethane (at biomethane injection points)

0- 1*%

Level of O2 in the gas grid (once biomethane is blended with natural gas)

*when no mixing with natural gas is occuring

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Questions related to the network structure (Picture of Mid-2025):
Are you dealing with sensitive end-users? What is the level of sensitivity?

Sensitive end-users	Level of sensitivity
Underground storages	• 0.001 % mol must be maintained (unless no technical necessity). • 10 to 200 ppm (daily value) • = or < 0,01 %mol • <=1 to 0,01 % mol/mol • 0.5% or 0.2% • < 0.5 %mol, although not more than 0,1 %mol on a yearly basis (365 consecutive Gas days)
Calibration facilities	• <=1 to 0,01 % mol/mol
Power generation sector	• 0,5% mol
Adjacent TSOs **Interconnector operators**	• 10 to 1000 ppm
Industrial customers using gas as a raw material	• 0,1 to 0,001 %mol • ≈ 1000 ppm (instantaneous value) • < 1 to 0,01% mol/mol is acceptable

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Questions related to EN 16726 (Gas infrastructure - Quality of gas - Group H)

Position/s in regard to implementing the standard EN 16726 for oxygen levels

Implementation

- **NNOe & Netz OÖ Austria**
- **Nordion Sweden**
  Acceptance of EN16726 on both DSO and TSO but the TSO gas specification have harder limits of the gas
- **Storengy France**
- **DVGW Germany**
  Codes of Practice of DVGW are perfectly aligned with national standards given by DIN. As EN 16726:2025 becomes DIN EN 16726:2026 Germany will strive for implementation.

Alignment with EN16726

- **Sedigas Spain**
- **Snam Italy**
  O2 concentration in the national specification is up to 0.6% ➔ biomethane plants are able to cope with this value without problem.
- **National gas United Kingdom**
  Up to 1mol% may be acceptable for transportation/such gas does not flow to UGS which cannot tolerate > 0.001mol%. The current legal limit for transmission is 0.2mol%
- **GNI Ireland**
  For gas on the Distribution system where the limit for O2 is ≤ 1.0 (mol)%
- **Fluxys Belgium**
  TSO will respect the rules as stated in the EN 16726, knowing that limitation to 0,001 % mol/mol is a significant limitation on biomethane evolution
- **Fluvius Belgium**
  DSO < 5000 ppm

No implementation

- **Energinet Denmark**
  The Gas quality is regulated by national law
- **GRDF France**
  Discussions between Frensh gas infrastructure operators
- **NaTran France**
  100 ppm or more to favor the development of biomethane with exemptions from biomethane injection points at up to 7.000 ppm historically (now 4.000 ppm).

A-deviation

- **GNI Ireland**
  On the basis that the current O2 limit for gas on the transmission system < 0.2 (mol)%.
- **Snam Italy**
  A deviation only for the upper maximum level of 1%.

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Questions related to EN 16726 (Gas infrastructure - Quality of gas - Group H)

Assessment processes, regarding sensitive users to O2 (how a user or an installation is determined as sensitive to O2 and how the level of sensitivity is determined)

Announcement of O2 increase to the market and questioning sensitive users on their precise reasons and limitations

Evaluation of the sensitive facilities + Determination of the maximum allowed percentage of O2 for sensitive end-users

Creation of an interoperator Workgroup between UGS, TSO and DSO specifically dedicated on how to manage oxygen issues

Gas market consultation + contractual limits

Discussions with industrial users to know the level of sensitivity of their processes
Discussions also with UGS and other TSO to get limit values to write in IO agreements

Performing a network study for each new Biomethane Network Entry Facility connected to the Transmission ➔ determination of the downstream gas composition + if sensitive end-users would be subjected to higher O2 gas

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Questions related to the monitoring

O2 Measurement and simulation

O2 measurement equipment/ technologies	At which points of the grid are the measurements done?
- Electrochemical sensor - Gas Chromatography - Galvanic fuel cell sensor - Chemiluminescence technology - Thermo-paramagnetic sensor - Laboratory analysis: GC-TCD, µGC-TCD, …	- Biomethane injection points - Reverse flow stations - Compression stations - Interconnection points - Underground storages/ salt caverns - LNG terminals in the future - Citygates - Entry and exit points of the network

Simulation tools	How simulation tools are used?
- Simulation tools are used or are under investigation ***Some operators do not have at this stage simulation tools, and others have simulation tools not adapted for O2.**	. Ensure that O2 content above the maximum allowed does not reach sensitive users. . Track the gas quality for points without gas quality measurements. . Determine the likely penetration of higher O2 gas from a prospective biomethane connection. . Follow the volume of O2 injected into underground by season (injection and withdrawal) + to estimate reaction in the underground with gas quality, flowmeters and pression of well

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Questions related to the monitoring

Current and upcoming research projects

France	**Optimization of the O2 content injected**
	Alternative desulfurization technologies which do not require the adjunction of O2
	Catalytic deoxygenation to remove oxygen once it is on the gas
UK	**Plans to conduct an innovation project to examine oxygen removal technologies**
Other countries	**No technologies implemented yet/ No experience**
	Biomethane producer is responsible to reach the gas quality at the injection point

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What do we learn?

What do we learn from the first analyzed results?

- **17/18** participating gas operators have biomethane injection points
- **8/18** participating operators have reverse flow stations
- **0,01-7%** Annual average amount (in %) of flow of the injected biomethane compared to the total flow of gas in the grid
- **0-1%** Level of O2 in biomethane and in the gas grid (Max 1% in the gas grid when no mixing with natural gas is occuring)

- **Sensitive end-users:** UGS, calibration facilities, industries, adjacents operators, power stations
- Several **analysis technologies** are implemented as well **simulation tools** are used to monitor O2 levels in the gas
- Several **assessment processes** are already being used to determine sensitive end-users and levels of sensitivity
- **Research projets** are being developed to limit the level of O2 in biomethane

The outcome of this questionnaire will be valuable for the work done in the Task Force O2 of CEN/TC 234/WG11 aiming to summarize the present knowledge of O2 and its impact on the gas system

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Thank you!

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