DATA SHEET FOR GAS QUALITY DURING TYRA RECOMISSIONING

ENERGINET

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The gas composition, and thus the gas quality, in Denmark depends on the origin, i.e., the supply source, and the corresponding quantity of gas which is fed into the transmission grid at any given time. Here follows an overview of the gas quality of the current primary supply sources along with a prognosis on the coming gas quality in the Danish grid.

Current status of gas supply

Historically, the Danish gas supply have primarily been of national origin from the Danish North Sea. However, Danish production of natural gas have been at a minimum the previous year. Currently, the status of gas supply in the Danish gas transmission grid is dominated by large amounts of Norwegian gas from Baltic Pipe, Danish production of biomethane and the recommissioning of the Tyra-complex, where the latter is expected to reintroduce large amounts of Danish produced natural gas into the Danish transmission grid.

During the redevelopment of the Tyra-complex – a period spanning 4½ years starting September 2019 – the supply of gas from the Danish North Sea was significantly reduced. Consequently, the Danish and Swedish gas market was supplied from other sources in the redevelopment period compared to previously. Recommissioning of Tyra is currently ongoing, expectedly spanning from end of March 2024 and a total of four months, during which the capacity will slowly be ramped up from 0 to full capacity[1]. The gas quality from the Danish North Sea could in this period show larger variations than prior to redevelopment due to technical conditions related to the commissioning process during relaunch. Variations in gas quality will be mitigated by Energinet in collaboration with Ørsted such that the end user will not experience gas qualities outside the Danish gas quality specifications and regulations, see **table 1.** However, variations within the specifications might be larger than usually. The gas quality from the Danish North Sea is expected to stabilize once Tyra is fully recommissioned and back at full capacity.

The Baltic Pipe connection was commissioned in the fall of 2022 and now connects Europipe II[2] to Poland through Denmark. Thus, a significant amount of Norwegian gas has been fed into the Danish grid which is now – to a larger extent than prior – to be considered as a transit grid in addition of simply supplying Danish and Swedish consumers. In practice, this means that both Danish and Swedish consumers have and will be experiencing a gas supply dominated by the larger quantities of Norwegian gas under typical supply conditions. Additionally, the gas will be a mixture from the supply sources which have thus far supplied the Danish and Swedish markets, i.e., gas from the Danish North Sea, imported gas from Germany and biomethane. Thus, variations in gas quality will be more or less apparent whenever the supply conditions and sources vary.

[1] REMIT 22.01.2024: https://www.gashub.at/remit/details.xhtml?id=48894-4-2024

[2] Pipeline from Norway to Germany operated by Gassco.

During the period of Tyra-recommissioning, the gas introduced into the Danish grid originates from five different supply sources:

1. Norwegian gas from Baltic Pipe
2. Danish North Sea gas from South Arne and increasingly from Tyra
3. Imported gas from Germany
4. Biomethane
5. Gas from Danish gas storage facilities (Lille Torup and Stenlille)

The primary source of gas is expected to be Norwegian gas from Baltic Pipe as well as imports from Germany via Ellund, where the latter is expected to decrease with increasing amounts from the Danish North Sea, i.e. Tyra. In the long term, gas from the Danish North Sea will thus primarily originate from the Tyra-complex with a small contribution from the South Arne gas field. The gas quality from the Danish North Sea is expected to be stable following full recommissioning of Tyra.

The Norwegian gas is produced in Norway from gas fields in the Norwegian Sea and then transported from the process facility in Kårstø through Europipe II onto which the Danish gas grid is connected via Baltic Pipe. Due to the consistent processing method in Norway the gas quality is expected to be very stable.

The imported German gas consist of a mix of locally produced gas, imported LNG and other H-gas which is presumed to be of Dutch or Norwegian origin. Thus, the quality of the mixed gas from Germany will show greater variations due to the variations in underlying supply sources.

Biogas produced in Denmark is fed into the grid in an upgraded form as biomethane. Biomethane is expected to contribute to an improved supply situation in the Danish and Swedish gas market. Currently, biomethane in the gas grid represents around 40% of the Danish gas consumption and the share is expected to increase in the future. The combustion of biomethane is technically similar to that of natural gas.

The Danish gas storage facilities have a capacity equal to approximately one third of the yearly consumption of the Danish and Swedish gas market. As gas is primarily stored during the summer, the gas supply from the gas storage facilities during the winter of 2023-2024 will thus mainly consist of Norwegian gas.

Gas quality in the Danish transmission grid

The legal basis for gas consumption in Denmark is stipulated in requirements for the gas quality made by ”Bekendtgørelse om Gaskvalitet” (i.e. executive order on gas quality). Additionally, Energinet’s ”Terms and conditions for Gas Transport” defines specifications for transportation of gas. Gas transported in the transmission grid of Energinet will always comply with the legal limits. The respective technical combustion requirements are listed in table 1.

	Lower limit	Upper limit
Wobbe index [kWh/Nm^3][3]	14.1	15.5
Wobbe index [MJ/Nm^3]	50.76	55.8
Relative density [-]	0.555	0.700

Table 1: Legal requirements for gas quality

The expected variations of upper calorific value and Wobbe index for the five main gas supply sources are listed in table 2.

	Upper calorific value		Wobbe index	
	[kWh/Nm^3]	[MJ/Nm^3]	[kWh/Nm^3]	[MJ/Nm^3]
Imported gas from Germany	11.1-11.6	40.0-41.8	14.4-15.0	51.8-54.0
Biomethane	10.8-11.3	38.9-40.7	14.4-14.9	51.8-53.6
Gas from Danish gas storages	11.2-12.4	40.3-44.6	14.8-15.3	53.3-55.1
North Sea gas	11.8-12.7	42.5-45.7	14.3-15.3	51.5-55.1
Norwegian gas	11.2-11.4	40.3-41.0	14.4-14.6	51.8-52.6

Table 2: Expected upper calorific value and Wobbe index for different supply sources.

The variations in gas quality as it appears in table 2 is due to the variety of the gas composition across the different supply sources. Table 3 shows examples of gas composition and corresponding gas quality of gas from specific supply sources.

		Example of expected gas quality of German gas at import	Example of expected gas quality for North Sea*	Example of biomethane quality in transmission	Example of Norwegian gas
Methane	mole - %	89.85	85.67	98.30	90.1
Ethane	mole - %	5.01	7.87	0	6.4
Propane	mole - %	1.01	3.61	0	0.4
I-butane	mole - %	0.10	0.26	0	0.028
N-butane	mole - %	0.12	0.73	0	0.035
I-pentane	mole - %	0.021	0.087	0	0.003
N-pentane	mole - %	0.017	0.0976	0	0.002
Hexane+	mole - %	0.016	0.0370	0	0.001
Nitrogen	mole - %	2.53	0.3909	0.33	0.79
Oxygen	mole - %	0	0	0.21	0
Carbon dioxide	mole - %	1.33	1.30	0.33	2.2
Gross calorific value	kWh/Nm^3	11.30	11.98	10.87	11.36
Gross calorific value	MJ/Nm^3	40.67	44.86	39.15	40.88
Wobbe index	kWh/Nm^3	14.38	15.31	14.52	14.47
Wobbe index	MJ/Nm^3	51.78	55.13	52.29	52.09
Relative density	-	0.617	0.662	0.556	0.6157
Normal density	kg/Nm^3	0.798	0.856	0.718	0.7961

* Expected gas quality of Danish North Sea gas are based on historical data for South Arne, a smaller Danish gas field. Thus, the resulting gas quality from the Danish North Sea could potentially change significantly with the recommissioning of Tyra as the capacity from here is a lot greater. However, currently, the gas quality of the recommissioned Tyra is unknown.

Table 3: Expected gas compositions and qualities for imported gas from Germany and Norway, North Sea gas and biomethane.

[3] A special preparedness plan for Ellund Border has been approved by the Danish Safety Technology Authority allowing gas with Wobbe index between 50.04 MJ/Nm^3 to 50.76 MJ/Nm^3 (13.9-14.1 kWh/Nm^3) to be imported

As the gas composition in the Danish transmission grid varies over time due to changing fractions of supply sources, thus are changes in gas quality in the Danish gas grid expected to occur. Historical data for gas qualities in the Danish gas grid are available at Energinet's online dataplatform Energi Data Service.

References

Terms and Conditions for Gas Transport (BfG) https://en.energinet.dk/Gas/Rules/
Bekendtgørelse om gaskvalitet (BEK 230 af 21/03/2018) https://www.retsinformation.dk/eli/lta/2018/230
Energi data service website for historical data for the Danish gas grid https://www.energidataservice.dk/

Further questions can be directed at: gaskvalitet@energinet.dk