STINKY BUSINESS: ARE THE DIFFERENCES IN THE ODORIZATION OF NATURAL GAS ACROSS EUROPEAN COUNTRIES HAMPERING THE PROGRESS TOWARDS EU-WIDE GAS MARKET?  

Keywords: natural gas, odorization

1 GAS ODORIZATION BACKGROUND

The first gas used in Europe for the purposes of lighting- so-called ‘town gas’ or ‘manufactured gas’ produced by gasifying coal- contained a wide range of sulphur components, which ensured the distinct smell of such gas and allowed its detection in case of leakages. The discoveries of large natural gas fields in the Netherlands, UK and Norway in the mid-20th century catalysed its wide adoption in Europe, and manufactured gas was quickly replaced by natural gas. The natural gas is a colorless and odourless substance, which means that it is not easily detectable by a lay person (or a professional for that matter) in the ambient air in case of a leak, potentially leading to significant health and property damage risks. Hence, the wide-scale gasification raised the issue of natural gas odorization- adding an odorant substance, which renders an easily recognizable and characteristic smell. Replicating the typical smell of manufactured gas, already associated in the minds of most people with ‘gas smell’, was assumed to be the most efficient odorization practice, and it quickly

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2 The current paper is partially based upon the insights gained by the author while employed by DNV GL Energy Advisory as Consultant Gas Markets, Policy and Strategy, and contributing to the project ‘The use of new energy resources: the role of law and the impact on networks’ (http://www.edgar-program.com/projects/c7), financed by a grant of the Energy Delta Gas Research (EDGaR) program. EDGaR is co-financed by the Northern Netherlands Provinces, the European Fund for Regional Development, the Ministry of Economic Affairs and the Province of Groningen.

3 The author would like to thank Daria Shapovalova, currently a doctoral student at the University of Aberdeen, for her contribution to this research in her role as DNV KEMA intern, and François Cagnon, Expert and Senior Engineer at GDF Suez, for his clarifying remarks. The author would also like to thank Johan Holstein, Consultant Green Gases, and Maurice Vos, Consultant Asset Risk Management, both of DNV GL Oil & Gas, for their input and review of this paper.

4 Tempelman and Butenko (2013), Tenkrat et al. (2010)
5 Tempelman and Butenko (2013), Roggenkamp and Tempelman (2012)
6 Butenko (2014), Tempelman and Butenko (2013)
7 Cagnon (2011), Tenkrat et al. (2010), Cagnon et al. (2004)
became common—first by adding cheap refinery and coke industry by-products, and later by adding more stable odorants.

The gas industries in the EU Member States were often developing along the lines of national industry needs and taking into account the traditional gas flows from supply sources to consumption. Historically and operationally there was no need to harmonize the process of natural gas odorization among European states. This led to the fact that, whereas the natural gas delivered to the European end consumers is always odorized, the means to do so differ across the Member States both in terms of odorant selection and in terms of odorization practice.

Two basic groups of odorizing substances are mainly used in Europe: sulphur-based, and sulphur-free. For example, in the Netherlands Tetrahydrothiophene (THT)- the most-widely used in EU sulphur-based odorant- is applied. In contrast, in the neighboring Germany sulphur-free odorants are used. The concentration of the odorant, also referred to as ‘stentching agent’, should be adequate: too much odorant could cause health problems, as well as equipment damage, and many ‘false alarms’ of leaking gas. Too little odorant in the natural gas would not be be sufficient for the end consumers to smell the gas leak in the ambient air. Generally, the odorant concentration should allow the regular household consumer to ‘smell’ gas as soon as its concentration is around 1% of the ambient air—these standards are fairly similar across EU Member States.

Natural gas odorization occurs within the gas grid, however the specific network level where the gas is odorized varies between European countries. In countries such as France and Ireland all the gas in the grid is odorized: this is performed by the respective Transmission System Operator (TSO) as soon as the gas crosses the national border and enters the high pressure network. In other countries, such as the Netherlands and Denmark, natural gas is odorized by the respective TSOs at the network points connecting the high pressure pipelines to the medium pressure (also called ‘regional’) transmission pipelines (both grid segments operated by the TSOs). The last technical possibility to odorize natural gas is the ‘city gate odorization’, adopted in Germany and Italy. City gate odorization occurs at the interconnection points between medium pressure transmission pipelines, operated by the TSOs, and low pressure distribution pipelines, operated by the Distribution System Operators (DSOs).

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8 Tenkrat et al. (2010)
9 Cagnon (2004)
10 Tenkrat et al. (2010), Cagnon et al. (2011), Cagnon (2011)
11 Tempelman and Butenko (2013)
12 Graf (2008), Cagnon (2004)
16 Ibid.
17 Ibid.
18 Ibid.
Interoperability generally refers to the degree of homogeneity between the technical rules and standards related to the transport of natural gas (e.g. metering, billing), as well as related to the physical properties of transported gas (e.g. gas quality and odorization, temperature, pressure). In other words, the national natural gas networks of two European Member States are interoperable when the rules and standards and the gas’ physical properties in both systems are similar to the extent as to allow for problem-free transport of gas from one country and network to the other.

Different gas odorization practices could represent a significant barrier for interoperability: Namely, gas from the country A where it is odorized at the high pressure level (e.g. Ireland, France) cannot be transported through the high pressure networks of the country B where it is odorized at a lower transmission or at distribution level (e.g. UK, Belgium) due to technical and safety considerations. Such considerations are mainly connected to the fact that the existing infrastructure (pipelines, gas storages) and industries in the country B are geared towards not odorized gas, and receiving gas which is odorized would mean changes to their operations (e.g. removing the sulphur from gas prior to using it in industrial processes). Moreover, injecting odorized gas from country A into the high pressure pipelines of the country B where gas is only odorized at distribution would mean that the gas already containing an odorant would be odorized again - in such conditions ensuring a proper concentration of odorant is a challenge, as the odorization systems of country B would be geared towards non-odorized gas.

Interoperability becomes increasingly important in the context of two recent developments on the European energy market - security of supply concerns and drive towards internal market creation. The implications of these developments for odorization of natural gas in European Member States will be examined below:

2.1 Security of Supply

Due to the increasing energy demand in Europe on one hand, and to the prolonged production of the gas fields on the other hand, the domestic reserves are declining. This exacerbates the already-significant dependence on the gas imports from non-EU countries, and quite expectedly, such situation in the EU creates public and political concerns for the security of natural gas supplies.

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20 Tempelman and Butenko (2013), Roggenkamp and Tempelman (2012)
21 Ibid.
These concerns led to the adoption of the Security of Supply Regulation in 2010.22 This regulation pays attention to the issue of interconnectedness between the Member States, and more specifically to the issue of bi-directional flows. The latter allow for a greater degree of security of supply (as well as more market liquidity), as the gas from one country could be easily rerouted to another one should the need arise. Besides physical modifications to the network (e.g. adding a compressor station to allow the gas to flow in another direction than historically was the case), interoperability between the natural gas systems is a pre-requisite for bi-directional flows.

2.2 Internal market drive

Historically, the European gas market was a patchwork of national markets with their own specific characteristics.23 These markets were scarcely integrated, and their regulatory regimes displayed a high degree of discrepancy.24 The so-called European Energy Packages, including three up-to-date (and arguably more to come), represented important milestones towards the creation of European energy market.25

A comparative analysis of the Energy Packages points out that an increasing drive toward the creation of an integrated internal market and harmonization of technical rules is occurring: from acknowledging the importance of common technical rules, however leaving their elaboration and implementation to the Member States in the First Package,26 to EU-wide, centrally elaborated, however non-binding rules in the Second Package,27 and finally to binding Guidelines and Network Codes introduced by the Third Package.28 Up-to-date, two network codes have been adopted by the Commission: Network Code on Capacity Allocation Mechanism (CAM) in 2013,29 and Network Code on Balancing in 2014.30 The work towards two more network codes- that on Tariffs and that on Interoperability- is in progress.31

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23 Haase (2008), as in Tempelman and Butenko (2013)
24 Ibid.
25 Butenko (2014)
The latter (Framework Guidelines on Interoperability) is important in relation to the process of odorization, as it states that ‘adjacent transmission system operators shall reinforce transparency as well as cooperation between themselves where differences in gas quality and odorization practices either side of an interconnection point might create a barrier to gas market integration’. The Network Code proposes bi-lateral agreements between the relevant TSOs as the leading approach to overcoming the differences in the odorization practices between the Member States. Where the TSOs cannot reach an agreement a number of options are available to them, and namely:

- conversion towards non-odorized gas in the odorized transmission network or part thereof;
- physical flow of odorized gas into the non-odorized transmission network or part thereof; or
- acceptable level of odourant for the interconnected transmission networks.

These options are investigated below.

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33 See Art. 19 ibid.
3. ODORIZATION IN THE CONDITIONS OF INTERNAL MARKET AND SECURITY OF SUPPLY-ENHANCING MEASURES

As noted earlier, diverging odorization practices in neighboring countries could represent an obstacle in bi-directional flows between these countries, and therefore hamper the creation of European internal gas market. In the period prior to internal market- and security of supply-driven interoperability requirements these differences across the Member States did not pose significant problems, as the nature of gas flows in Europe traditionally followed the supply route from gas producing (or transit countries) to gas consuming countries (e.g. from UK to Ireland). The odorization practices in the Member States developed simultaneously with these flows, and therefore were not an obstacle to the ‘traditional’ flows dynamics. As the flows are increasingly cross-border, both as the result of internal market drive and security of supply concerns, odorization practices come under pressure. The options available, according to the Network Code, to the TSOs of the countries with diverging odorization practices are illustrated below:

3.1 Conversion towards non-odorized gas

Such conversion could be achieved in two ways, either by changing the national odorization practice from odorization on high pressure level to odorization on medium or low pressure levels, or by the means of installing a deodorization plant removing the odorant from the gas to be transported across the border. Each of these options are briefly discussed below:

- Changing the national odorization practice:

Prior to 1998 all of the natural gas in the national grid in UK was odorized: the odorization was performed by 5 stations in the high pressure transmission pipelines, as soon as gas entered the UK. Each of these stations served an average of 4 million customers. 34 This odorization system design was replaced by a different one, and namely by the natural gas odorization at low pressure level, performed by approximately 120 stations, serving on average 127 thousand customers each. 35 This radical overhaul of the odorization system was deemed necessary as to allow for the transport of non-odorized gas to the continent through the newly built Interconnector pipeline. 36 It is estimated that a similar change in France- where the gas is odorized at the high pressure transmission level, comparable to the situation in UK prior to 1998- would increase the total number of odorization stations from 6 to around 530. 37

34 Cagnon (2004)
35 Ibid.
37 Cagnon (2004)
• Installing a deodorization plant:

Another option is to install a deodorization plant which would remove the odorant from the gas to be transported across the border. This option has not been implemented on an industrial scale in Europe to date: it only exists as a pilot plant. Moreover, such an option would inevitably add a cost to the deodorized gas.

3.2 Odorized gas into the non-odorized transmission network

As noted earlier, when the TSOs of the countries experiencing obstacles in interoperability because of the divergence in the odorization practices fail to reach mutually acceptable bi-lateral agreements, they could recourse to the physical flow of odorized gas into the non-odorized transmission network or agree on an acceptable level of odourant for the interconnected transmission networks (besides the above-described conversion towards non-odorized gas). These two options are very similar in operational terms, as both presume that odorized gas from country A where it is odorized at high pressure transmission level is injected into the high pressure network of country B, where the gas is normally odorized at lower levels (regional or distribution). Therefore it is not entirely clear why the Network Code makes a distinction between the two.

As described in section 2, injecting odorized natural gas from country A into the network of country B which is geared towards non-odorized gas could create a number of operational and (mostly) financial problems. These problems would have to be addressed by the country B- by the industry and/ or by the respective TSO. A technical option to alleviate such problems could be a rather simple process of mixing the odorized gas with non-odorized one as to achieve sufficient dilution of the odorant to the level when it does not present technical problems (mainly concerning over-odorization). In fact, such practices are business-as-usual in Switzerland, which receives odorized gas from France and not odorized gas from Germany.

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38 DNV KEMA (2013)
39 It is estimated that an industrial scale odorization plant suitable to deodorize 300,000 m3/h (or approximately 80 GWh/day) would require an investment of about 51M€ (CAPEX). Furthermore, it is estimated that the plant’s operating costs would be between €2.7 and €10.2 per 1,000 m3 of deodorized gas, i.e. €0.2 to €0.9 per MWh (OPEX). See DNV KEMA (2013)
41 Email interview with François Cagnon, Expert Senior Engineer GDF Suez, May 6, 2014
CONCLUDING REMARKS

The current article claims that the recent changes taking place in the EU gas market, and namely internal market drive and security of supply concerns, have a significant impact upon the process of natural gas odorization. The latter did not represent significant problems in previously heterogenous and scarcely interconnected national gas markets of the EU Member States, in which the gas flows were traditionally uni-directional from gas supply/transit to gas consuming countries. However, in the changing conditions of the currently developing EU gas market, discrepancies in odorization practices found between neighboring countries effectively hamper interoperability and represent an obstacle for bi-lateral flows, therefore negatively impacting the security of supply-ensuring measures, and the creation of an integrated and liquid internal market.

These developments, most vividly obvious in the soon-to-be-adopted Network Code on Interoperability, effectively shift the focus on odorization from the traditional national level to the European one by stating that the existing differences in gas quality and odorization practices might create a barrier to gas market integration. The Network Code proposes the bi-lateral agreements between the relevant TSOs as the leading approach to solving the problems connected to the differences in the odorization practices between the Member States. Where the TSOs fail to reach such a bi-lateral agreement, two main options are available to them: either changing their national odorization practice from odorization of all the gas in the grid to the odorization on lower pressure levels, or accepting odorized gas into the non-odorized transmission network. Whereas it is outside of the scope of the current article to provide an opinion regarding the benefits and drawbacks of these options, it is clear that the status quo in terms of different odorization practices will inevitably change in European Member States in the near future.
REFERENCES


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