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Contents

1 Introduction

This document summarises the outcome of the studies on Wobbe index aspects resulting in a proposal for including ranges for the Wobbe index in the standard for H-gas H-gas made in CEN SFGas WG 'Pre-normative studies of H-gas quality parameters'. (Short SFGas GQS)

This report documents and identifies those aspects for which consensus is given and those for which no full consensus could be achieved with the respective reasoning.

This report is drafted according to SFGas GQS TF1/CAG Conclusion 28/2019 made on 2019-12-18, at the moment, when TF1/CAG has considered that further studies would not facilitate or lead to major further developments in the subject.

This report is the final report of the current process. It is addressed to:

— CEN/TC 234 Gas infrastructure as basis of revision of EN 16726, according to M 400

— EC DG Energy as documentation of the further development of the standardisation request under M/400 and as information for any further European legal/regulatory framework

— Further interested parties

The aim of this report is to document the Wobbe index related matters as unambiguously as possible to avoid different interpretations and the repetition of discussions in CEN/TC 234 and/or elsewhere.

NOTE It is noted that almost all CEN/TC 234 WG 11 members have been directly involved in the SFGas GQS process.

2 Context of the CEN SFGas GQS study

Different H-gas quality specifications are given in the EU Member States, in form of national legislation and/or standards or national codes of practices. These could create barriers to trade gas on the internal EU market and could limit the development of renewable and decarbonised gases. At the same time, gas quality and gas quality variations can affect end-use applications in terms of safety, performance and emissions.

Several initiatives have been carried out, like:

— the EASEE-gas Common Business Practice on H-gas Quality at cross-border points of 2005 (CBP 2005-001/02);

— the mandate M/400 of 2007 asking CEN to elaborate a standard on H-gas quality specifications based on a pre-normative study (cf. Gasqual study) on the impact of gas quality on safety, performance and fitness for purpose of residential gas appliances;

— the European network code on Interoperability and Data Exchange (EU regulation 2015/703);

— the European standard EN 16726:2015 (ref. M/400).

— ENTSOG Impact analysis of a reference to the EN16726:2015 in the network code on Interoperability and Data Exchange

EN 16726 was published in 2015 without specifications for Wobbe index as no consensus could be found while the M/400 mandate clearly identified the Wobbe Index as one of the parameters to be specified.

The Madrid Forum during its meeting of October 2016 encouraged CEN "to carry on the work on finding an agreement on a band for the Wobbe Index, elaborating on the possibility of regional bands, to be included in an updated CEN standard [EN 16726] while ensuring its integrity.

As a result of a CEN/TC 234 workshop concerning further harmonization of gas quality, a WG was formed as joint WG of CEN Sector Fora Gas Infrastructure and Utilization (SFGas GQS) to study – as a pre-normative task - the impact of identified values of H-gas quality parameters not yet or insufficiently established in EN 16726:2015 on the whole gas chain and on the basis of technical and fact based findings with the purpose of supplying information and recommendations on the parameters in question to CEN/TC 234 for the future revision of EN 16726:2015.

The SFGas WG consists of the representative sector organizations of the different stakeholders along the whole gas chain including end-use and the national mirror committees (see list in Annex C).

The SFGas GQS started its work on the 24th of May 2016. At first, the work was limited to the Wobbe Index. It has been extended to the analysis of the impact of renewable and decarbonised gases on the Wobbe index and calorific value, complying with the Madrid Forum Conclusion of the 31st MF (October 2018)

In 2018 a dedicated task force Oxygen (TF 3) was formed reviewing the oxygen content specifications due to biomethane injection.

NOTE For several end-use applications (e.g. some industrial firing systems, gas engines or feedstock processes) other gas quality parameters are of similar relevance, e.g. calorific value (CV), methane number (already part of the EN 16726), gas composition.

As far as Wobbe index is concerned the group decided end of 2019 to document the WI recommendations in this report.

Finding an unanimous consensus turned out to be not possible, but the recommendations made in this report are supported by the majority of the represented sector organizations.

Ultimately, this work is the outcome of a lot of preceding work, efforts and meetings. All members are thanked for their efforts and valuable contributions. Furthermore, a special word of thanks to the EC's Joint Research Centre too for the provision of data and analysis and their helpful advises.

3 Definitions

The definitions hereafter have, as only purpose, to allow common understanding of the content of this report.

3.1
Reference conditions

Note to entry: Reference conditions: Unless stated otherwise all volumes are given for the real dry gas at ISO standard reference conditions of 15 °C (288,15 K) and 1013,25 mbar (101,325 kPa). Unless otherwise stated all pressures are absolute pressures. Whenever data on the volume, gross calorific value (GCV), energy and Wobbe Index are communicated, it shall be specified under which reference conditions these values were calculated.

3.1.1
combustion reference conditions
specified temperature T and pressure p at which a fuel is notionally burned

3.1.2
metering reference conditions
specified temperature T and pressure p at which an amount of fuel to be burned is notionally determined.

Note 1 to entry: There is no a priori reason for the metering reference conditions to be the same as the combustion reference conditions

[Source: EN ISO 14532, 2.6.1]

Note 2 to entry: The use of these reference condition 15/15 has been approved by SFGas WG GQ Conclusion 19/2016.

3.2

application

equipment that utilizes the transported and distributed gas

Note 1 to entry: Some examples of gas applications are: gas appliances (domestic or commercial), processes (chemical or industrial), power plants, vehicles, greenhouses etc.

[EN 16726:2015, 3.5]

3.3

appliances (GAR EC REG 2016/426)

‘appliances’ means appliances burning gaseous fuels used for cooking, refrigeration, air-conditioning, space heating, hot water production, lighting or washing, and also forced draught burners and heating bodies to be equipped with such burners;

[GAR EC REG 2016/426, Art. 2, (1)]

3.2

Renewable and decarbonised gases

No common definition is given. Terminology is subject to manifold initiatives at the moment.

The term 'renewable and low-carbon gases' is used in the MF conclusion (2019) which addresses the inclusion of the matter in CEN standardisation. In the sense of this document the term low-carbon and decarbonised are considered interchangeable.

3.3
Wobbe Index
WI
ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions; the Wobbe index is said to be gross or net according to whether the calorific value used is the gross or net calorific value

[Source: EN 437:2018]

Note to entry: Two fuel gases with the same Wobbe Index will release the same amount of heat in combustion system, as long as the nozzle pressure and the nozzle diameter remain constant. The gas temperature is assumed to remain constant in this context. The Wobbe Index is the primary gas interchangeability criterion for residential and commercial appliances as well as for some large-scale combustion equipment in industry and power generation.

3.4
Entry point
point - except interconnection points – at which gas enters a gas transmission or distribution system).

(Source: EN 16726:2015, 3.2]

Note to entry: SFGas GQS TF1 Conclusion 21/2019 = use definition as given in EN 16726

3.5
Exit point
point at which gas leaves the gas transmission or distribution system for end-use (source: EN 16726:2015).

[Source: EN 16726:2015, 3.?]

Note to entry: A number of connected exit points with the same class in the same topological and geographic region are considered to be an WI exit area.

3.6
Interconnection point
physical point connecting adjacent gas transmission and distribution systems and/or storage systems

[Source: EN 16726:2015, 3.3 modified taken from Regulation (EU) No 984/2013 and modified for purpose)

3.7
Deterministic approach
the WI of the gases supplied to the concerned point never exceeds the lower or the higher limit of the defined WI range.

3.8
Probabilistic approach
the WI of the distributed gas can exceed the lower or upper WI value by an amount (to be well defined and in any case strictly within the EU WI entry range) with a given frequency during the period of time the class is allocated to that specific exit point.

4 CEN SFGas GQS proposal of Wobbe index approach – Context and explanations -

The WI range of natural gas produced by one source is quite limited. By consequence, the WI range at an entry point supplied with gas from a single source is in general quite limited too. Gas entering the gas grid from gas fields can have a wide range because of several gas fields feeding in on the same pipeline.

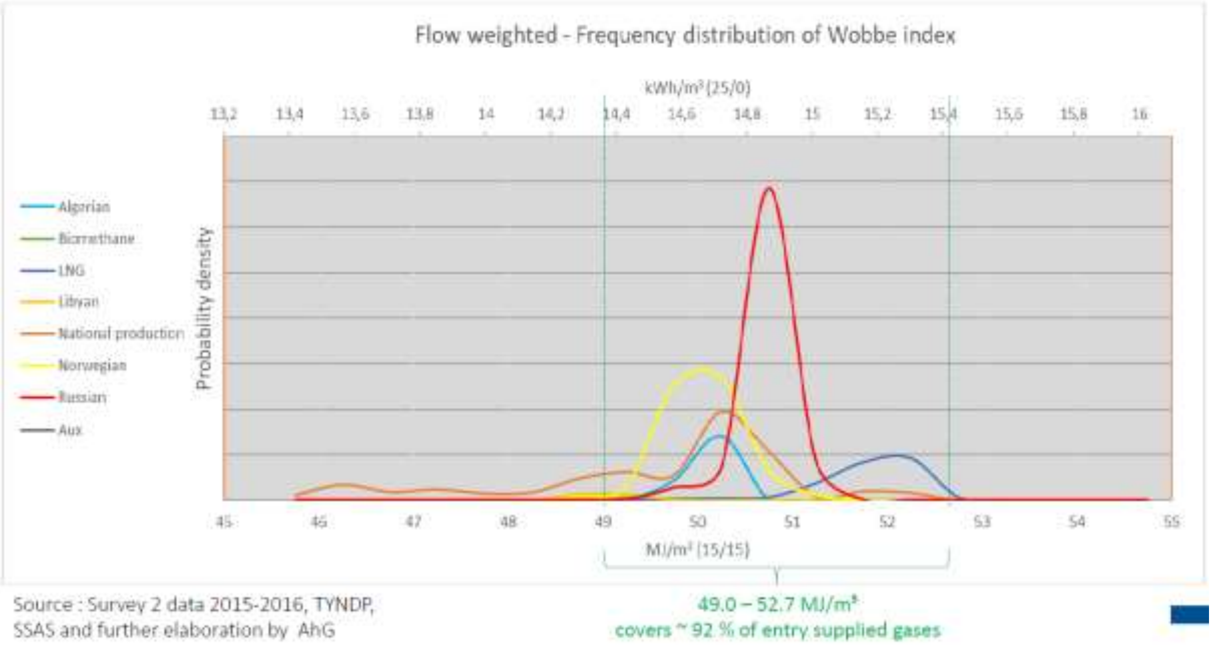


Figure 1 — Flow-weighted WI frequency distribution of different sources of natural gas

The WI range experienced at an entry point depends on the sources it is supplied from (physically connected to). If it is connected to more than one source the WI at a certain moment will be determined by the mix of gases of the different sources it is supplied from.

Sources can be e.g.: offshore/onshore fields, gas pipelines, LNG terminals, biomethane and hydrogen facilities, underground storage, etc. Underground storage can also experience a wide range in WI depending on the sources delivering gas to the storage.

If several fields/sources feed into the same pipeline the gas transported can experience a range in WI. Sources with e.g. high WI can be mixed with lower WI gases to reduce the WI and blending might even enable delivery of gas that originally are outside the specifications. Delivery and production is planned/agreed (months) in advance to maintain a steady gas quality.

Flow at the entry points is, apart from emergency situations, operated by system operators and driven by availability and other market principles.

NOTE System operators from LNG, storage, gas producers parties and network users (shippers, suppliers etc).

If gas quality from one gas source is off-spec, in some cases, it can be mixed with other sources to be compliant with the specifications. Off-spec gases are not allowed to enter the gas grid.

Survey 2 examined the WI of gases supplied to exit points over the years 2015-2016. The results show that:

— the WI bandwidth experienced at exit points is most often significantly smaller than the bandwidth between the legal min. and max. value for Wobbe Index;

— the WI bandwidth and range is different for different exit points depending on the upstream grid configuration, gas supply sources and demand.

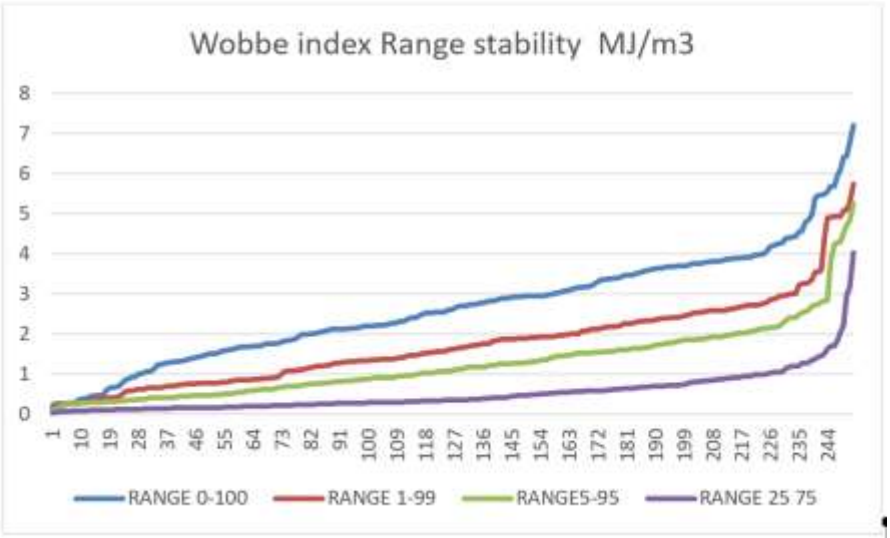


Figure 2 — Wobbe Index bandwidth for different percentiles at the 253 exit points over 2015-2016 from survey 2, analysed by JRC

This situation of smaller bandwidths at exit points has been existing for decades but might be widened due to diversification of sources and the increasing interconnection driven by

— security of supply and competiveness and

— renewable and decarbonised gases injected in the system driven by decarbonisation.

Also in case of declining production of indigenous gases in Europe the WI bandwidth at exit point can be impacted.

Natural gas as a "natural product" has some innate variation of composition; also gases from different sources will differ in their compositions. At the same time, end users generally prepare or even require stable composition and gas quality for optimum performance.

Wider bandwidths at the exit points can affect the proper functioning of end-use applications.

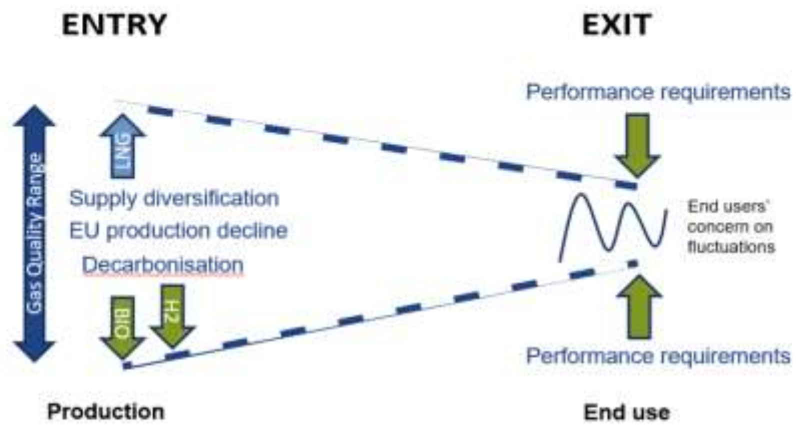


Figure 3 — Illustration of forces on the Wobbe index range of the gas entering and exiting the system

The WI range at an exit point can vary from the lowest WI to the highest WI of the gases of entry points the exit point is connected to if no gas treatment is carried out. The frequency distribution over this WI range can obviously be very different from one exit point to the other.

For better understanding of this effect one needs to have a view on how and what gas is used for. At the end of the supply chain gas is used

a) as fuel to burn it and to convert it to thermal or mechanical energy with the purpose of producing heat, moving an object or producing electricity;

b) as raw material/feedstock

   1) to process it with the purpose to produce a product/consumable (e.g. production of hydrogen, methanol, ammonia…).

   2) to convert it to chemical energy with the purpose of producing electricity by fuel cells;

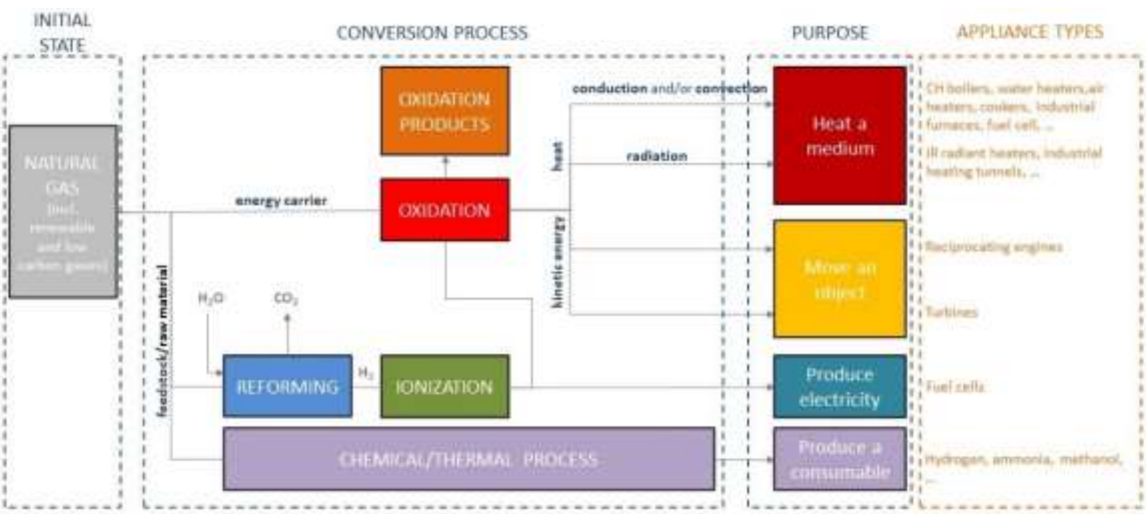


Figure 4 — Schematic view of different types of gas end-use

End-use applications have to be:

— safe;

— fit for purpose;

— efficient;

— reliable and robust;

— satisfying the end-use emission requirements, if applicable.

to answer all those requirements, the end uses processes have been designed and optimized.

When gas properties change over a wider range, negative effects can impact the optimised operation. To avoid this, end-use applications need to be equipped with an appropriate auto-adaptive combustion control Only a limited number of end-use applications is equipped with such controls today.

NOTE 1 Some current application have physical limitation that cannot be covered by combustion control system.

For feedstock applications, engines and some other end-use equipment the actual gas composition is the dominant factor.

Due to environmental concerns, legal requirements and efficiency, wide differences of local gas qualities pose a challenge to fulfil the operational requirements of a gas application, which is why end users require a limited gas quality range on a local level. (see also Figure 1).

Given the wide diversity of end-use technologies across all sectors, the operational requirements of these technologies to gas as a fuel or feedstock are very different. At the same time, there often are no harmonized EU regulations for application performance, emissions or safety, even for comparable technologies (some harmonisation is given for emissions).

NOTE 2 There are some requirements for putting appliances on the market but not for appliances in use, e.g. Eco-design directive, commercial gas use.

The (legal) gas specification limits are applicable on country level, and – as described earlier – values of the gases distributed locally fulfil the legal requirements, however the actual local bandwidth is today generally narrower than the legally allowed range. Adjusting and/or adapting of end-use application (residential, commercial and industrial) to this local situation is a widespread practice (see DVGW-Hauptstudie, French study), mainly for optimizing performance. By consequence, applications, that are adjusted and/or adapted to the local situation, can require an intervention by a service provider if the local gas quality changes significantly. Technological solutions do exist to make many end-use applications more resilient to gas quality changes, but they can be expensive and often have to be tailored to a specific application.

Currently, this adjustment and/or adaptation is done without knowing the real-time measurement value of the WI (or other gas quality criteria) in most cases, meaning that the new settings are appropriate for the current WI value, but not necessarily for the local WI range. Inappropriate adjustment can lead to issues (see Annex B). In the future with the setting up of smart grids and the installation of sensors and other measurement equipment and tracking system through the DSO more data will be available to the market.

All the above has led to an approach (Figure 1) recommending for differentiation at

— entry points: a single WI range;

— exit points:

  — a higher level of information on the WI range to be expected, at exit point;

  — a WI bandwidth threshold requiring an assessment and, in case of identification of connected sensitive end-use application, appropriate measures (to be defined by a regulatory framework).

The Rate of Change of Wobbe index is also identified as significant, but is not part of the current proposal. For the explanation see …and Annex A.(5.1.8 of this document)

The further document focuses specifically on Wobbe index aspects, even if many statements also apply, in broader terms, for other gas properties.

Note: Finally, it is important to keep in mind that for several end-use applications gas quality impact is not only a matter of WI, but also of calorific value (GCV), methane number (minimum value already defined in the EN 16726) , gas composition, etc.

The findings are based on broad preparatory work carried out by SFGas GQS TF2 'National situations' convened by EC JRC:

— SFGas Survey 1a: National situations regarding the regulatory framework on Wobbe index

— SFGas Survey 1b: National situations regarding the regulatory framework on environmental in-use requirements for gas application and maintenance practices

— SFGas Survey Survey 2: Wobbe index data on entry and exit points of distributed gases in 2015-2016SFGas Survey Survey 3: Simple scenario assessment (SSAS)

— SFGas Survey Survey 3: Annex: Impact of renewable and decarbonised gases on Wobbe index (WI) and Gross Calorific Value (GCV) in blends with natural gas

For a description of these studies see Clause 8.

5 Wobbe index recommendations

5.1 Entry point WI recommendation

CEN SFGas WG GQS considers the following aspects:

a) the EC's M/400 mandate asking for 'gas quality parameters that are the broadest possible within reasonable costs';

b) the existing CE certification framework since the implementation of the non-industrial gas appliances directive 90/396/EEC (currently the EU regulation 2016/426) and more specifically the appliance categories I2H and I2E(+) as defined in the harmonized EN 437 standard;

c) the outcome of CEN SFGas GQS surveys 1A and B;

d) a broad range of supply sources allowing a reasonable diversity of gas sources (e.g. natural gas, LNG, renewable and decarbonized gases) injected at TSO and DSO level.

e) taking note of the broad acceptance of CEN SFGas GQS TF1/CAG (Conclusion 27/2019) of the differentiated approach for a wide entry and a narrower WI bandwidth at exit is given including a classification system (see Figure 2).

f) the replies to the SFGas GQS TF1/CAG consultation addressed to the European sector organisations and national mirror committees in November 2019 (see Annex C)

g) Enabling a cost efficient decarbonisation of the TSO and DSO gas systems.

Based on these considerations, CEN SFGas WG GQS proposes for the Wobbe index of H-gas at entry points a lower WI limit of 46,44 MJ/m³ (15,15) and an upper limit of 54,0 MJ/m³ (15,15).

Table 1 — Proposed SFGas GQS Wobbe index entry range

minimum WI **[MJ/m³]** [a] [1]	**maximum WI** **[MJ/m³]** [a, b] [1, 2]
46.44	54.00
[a] *at 15/15°C and 1.013,25 mbar* [b] *the proposed max. value is questioned by a number of end-use sector organizations (see annex B with replies on Consultation 11/2019).*	

These upper and the lower limits of the WI entry range are fixed values.

NOTE This proposal corresponds to the WI range of the EASEE-gas Common Business Practice on Harmonization of Natural Gas Quality (CBP 2005-001/02).

Notes:

a) Standards (e.g. CEN-Standards) give the commonly recognised codes of practice.

They are not legally binding as long as they are not cited in legislation. However, they are an acknowledged part (or integral part) of the technical framework of the sector.

b) SFGas WG GQS could not agree on a binding identical WI range for all Member States due to different national legal situations (considering any national production and the currently installed base of appliances being different)) .

c) Euromot is formally objecting to this proposal, considering it too wide and putting forward a WI entry range from 49,0 up to 52,7 MJ/m³ based on the WI of currently distributed gases (Survey 2, 2015-2016), the WI bandwidth of 3,7 MJ/m³ is acceptable for all represented end-use application sectors and the advantage for proper adjustment of end-use application settings.

d) Although 54,0 MJ/m³ as upper limit for the entry range was concluded on during the TF1/CAG meeting of 18/12/2019, it was contested at the meeting and after the meeting, by a number of manufacturers and end-use representatives that 54,0 MJ/m3 is not acceptable at the exit level.

   1) for reasons of safety, emissions, performance (see 'clause classification);

   2) possible interlinkage with other gas quality parameter;

3) as hardly any of the gases at entry points currently reach 54,0 MJ/m3.

e) It would be required for appliances/applications to stay safe over the whole entry range under all possible ‘normal use’ circumstances.

5.2 Exit point WI recommendation

5.2.1 Establishment of a classification system for WI exit points

CEN SFGas WG GQS considers the following aspects:

a) the broad acceptance of CEN SFGas GQS TF1/CAG (Conclusion 27/2019) of the differentiated approach for a wide entry and a narrower WI bandwidth including a classification system (see Figure 2);

b) future injections of renewable and decarbonised gases getting closer to the exit points and therefore experience the possibility of more variations than in the past

c) the discrepancy between WI values of today’s locally distributed gases (at exit points) and the legal WI limits (see Survey 1A and fig sy above);

d) the fact that for most gas end use applications the absolute values of the local WI matter less than the bandwidth (relative values).

e) at the same time, the position of this relative GQ range within the entry range to be maintained for a reasonable amount of time.

f) the added value (or even need) of adjustment of end-use application settings to the local WI range to optimize performance and minimise emissions;

g) a WI bandwidth of 3,7 MJ/m^3 acceptable for all represented end-use application sector organisations

h) experience from several European countries showing that sharing data about delivered gas qualities and prognosis of future gas qualities has value for the end users.

Based on these considerations, CEN SFGas WG GQS proposes a classification system for WI of H-gas at exit points based on the local WI bandwidth consisting of two classes: a so called ‘specified’ and an ‘extended’ class. The ‘specified’ class has a maximum bandwidth of 3,7 MJ/m3 (15,15) within the entry range. The ‘extended’ class has a bandwidth above 3,7 MJ/m3 (15,15) within the entry range. In both cases the upper and lower WI values need to be indicated as also given in Table 2.

Table 2 — Proposal for WI exit classification

Class	**Indicated WI range** [MJ/m^3, 15/15]	**Bandwidth of WI of distributed gases at the exit point** [MJ/m^3, 15/15]	**Percentiles**[a] [%]
Class **specified**	Lower and upper limit values defined per exit point with an interval of 3,7 MJ/m3. Based on the distributed gas, within the WI entry range.	≤ 3,7	1 and 99 the lower and the upper WI limit respectively, i.e. 1% is cut at the upper and 1% at the lower level
Class **extended**	Lower and upper limit values defined per exit point. Based on the distributed gas, within the WI entry range. Note: This class requires an assessment (due diligence principle) of the presence of sensitive users downstream of the concerned exit point and, if any, the implementation of appropriate mitigating measures.	> 3,7	1 and 99 the lower and the upper WI limit respectively.

[a] The term 'Percentiles' is understood in different ways by the different stakeholders. The notion of the term as defined in survey 2, is not sufficient for the classification approach as it is not giving evidence about the intensity and frequency of the exceeding the WI limits

CONSIDERATION NEED IN SFGAS GQS TF1/CAG:

Further consideration by SFGas GQS TF1 or during the establishment of a classification methodology is needed.

With respect to the 1 and 99 percentiles, it is not clear how this has to be understood. It might mean that in 2% of the time in a year, i.e. 175 hours, the specific 3,7 MJ/m3 range in Wobbe index value that a customer receives can be exceeded towards the ultimate limits of the proposed WI entry range. In might also mean that 2% of the total gas supply in a year is allowed to exceed the 3,7 MJ/m3 boundaries in Wobbe index towards the ultimate limits of the proposed WI entry range. In that case, the exceeding of the 3,7. MJ/m3 range can even last over a much longer time than 175 hours in e.g. the summer time when the gas consumption is low. Both situations are unacceptable for the gas applications such as power plants nd for a large proportion of the industrial gas users.

A probabilistic approach is used for both classes (specified and extended).

5.2.2 Definition of classes

5.2.2.1 General criteria for a class

A class describes an exit point with a defined WI range:

a) In the classification scheme, a class is assigned to an exit point, based on a forecast of local Wobbe Indices at this point for a period of time (to be determined). For the communication associated to the classes see 5.2.2.1 and 5.2.2.2, whereof the minimum and the maximum of the range are defined and valid for a certain time period (= validity duration) on basis of the gases that are reasonably foreseeable to be supplied to the concerned exit point within that time period;

b) the minimum and the maximum of the range are within the limits of the WI entry range;

c) the bandwidth determines whether an assessment is required or not for the presence of sensitive users downstream of the concerned exit point and, if any, for the implementation of appropriate mitigating measures;

d) The class has to be maintained for a reasonable duration of time (to be determined, see 'clause framework').

Add revised graph (eg graph made by EHI)

Figure 5 — Example of assignment of classes to some exit points

Procedures are needed to specify classes (incl. at least switch to other class, time scales, liabilities and responsibilities) and to enable an implementation of the classification system. Considerations during the SFGas GQS work are documented in Clauses 6 and 7.

These procedures shall be subject to another (parallel) process on legal framework with European and national authorities.

The proposal to allow classification of exit points over the whole WI entry range as defined in Table 1) causes a conflict within the whole gas chain. For example - to enable exit class limits up to the proposed upper WI entry value of 54 MJ/m3 (see table 1 and table 2) - causes safety risks with view to the approach of a safety margin selected in the gas technology regulations from the gas appliance-specific product standards - e.g. EN 15502 and EN 437 is far too low. This applies to all existing gas applications within the scope of the current EN 437. It is essential that there is a sufficient safety margin between the network gases fed in in the maximum upper EU-WI entry range and the limit gases to be tested. The safety margin protects against external influences. An adaptation of the existing standards and regulations would not be a solution to the current and very large inventory of the appliances in Europe.

In case the upper limit of 54,0 MJ/M3 is kept, EN 437 and the related certification schemes need revision.

On-site adjustment at the time being is generally done without knowing the local gas quality at the time of adjustment at the moment. In order to find an appropriate set point for an appliance within the proposed class system, information on both the current local gas quality and an appropriate gas quality for the appliance to be adjusted for is necessary.

5.2.2.2 Class ‘specified’

Class specified is allocated to exit points of distributed gases for which the bandwidth of the WI range is smaller than or equal to 3,7 MJ/m^3. The lower and upper limit values need to be defined per exit point with an interval of 3,7 MJ/m3 within the WI entry range.The WI exit limits are probabilistic respecting percentiles (see table 1, footnote a); in case the WI index of the gas supplied to the concerned exit point exceeds these WI limits it needs to respect the limits of the WI entry range on a deterministic basis;

This class does not require further steps by the network operator (or another designated party) besides the allocation of the class to the exit point; it follows the approach that the initiative for indication of action need is up to the user, if sensitive.

NOTE It should be noted that even with a limited local WI range of 3.7 MJ/m3, not all types of end-use equipment will be able to fulfil all safety, operational and legal requirements without significant technical measures.

EXAMPLE Example for class specified:

Potential situation of the network operator:

— The actual distributed gases in exit point A have a WI range of 2,5 MJ/m3.

— The gas quality data over a certain period of time (to be determined) obtained for exit point A shows WI values comprised between 49,2MJ/m3 and 51,7MJ/m3 (2,5 MJ/m3 WI Range).

— Class specified has a defined range of 3,7 MJ/m3, whereas the actual distributed gases in an exit point in a class specified might have a WI range below or equal to 3,7MJ/m3. This to ensure that the data given for this exit point stays true for as long as technically possible (same class, same lower and upper IW values)

→ According to the classification system, exit point A is in a Class Specified. The end-users connected to exit point A will receive the following information (communicating party to be determined, see Clause 6):

  — Classification: The customers' gas application receives gas from an exit point in a Class Specified.

  — Indication of the foreseen lower WI value of 48 MJ/m3, the foreseen upper WI of 51,7 MJ/m3, i.e. a WI bandwidth of 3,7 MJ/m3.

  — Indication of the period of time (to be determined) during which the range and the lower and upper WI values is staying the same.

  NOTE 1 The indicated range (48 MJ/m3 and 51,7 MJ/m3) depends on the individual forecast for the distributed gases. Therefore, the range can be defined differently for another defined time.

  NOTE 2 The described example presumes that a procedure for classification and communication is set in the European framework, reflections occurring during the SFGas GQS process on this are given in Clause 6.

5.2.2.3 Class ‘extended’

Class extended is allocated to exit points of distributed gases for which the bandwidth of the WI range exceeds 3,7 MJ/m^3. The lower and upper limit values need to be defined per exit point within the WI entry range.

These WI exit limits are probabilistic, respecting percentiles (see Table 2, footnote a); in case the WI of the gas supplied to the concerned exit point exceeds these WI limits it needs to respect the fixed limits of the WI entry range on a deterministic basis.

This class requires an assessment (due diligence principle) of the presence of sensitive users downstream of the concerned exit point and, if any, the implementation of appropriate mitigating measures in cooperation of all parties involved (see Clause 7).

End-users (application includes residential and commercial) are not able to accept the whole proposed range of the entry (46,44 to 54) as the range of up to 7,56 MJ/m3 is too wide for the majority of applications if a variation of the WI over the whole range occurs. Furthermore, it is not compatible with on-site adjustment of end-use settings to the local gas quality (see Clause 8).

EXAMPLE Example for class extended

Potential situation of the network operator:

— the actual distributed gases in exit point B have a WI range of 4,5 MJ/m3;

— the gas quality data over a certain period of time (to be determined) obtained for exit point B shows WI values comprised between 48 and 52,5 MJ/m3 (4,5 MJ/m3 IW range);

→ in the classification system exit point B is in a class Extended.

Potential information to the end-users connected to exit point B (communicating party to be determined, see Clause 7):

- indication of the classification: The customers' gas application receives gas from an exit point in a Class extended;
- indication of the foreseen lower WI limit value of 48 and the foreseen upper limit value of 52,5 MJ/m^3, ie a WI range of 4,5 MJ/m^3;
- indication of the period of time (to be determined) during which the range and the lower and upper WI values is staying the same,
- indication of warning remark that, if the end-use application is sensitive to WI aspects:
  - i) the wider range might have an impact,
  - ii) an impact analysis in cooperation with the TSO/DSO will be carried out to identify which mitigation measures are the most reasonable, if needed. Inclusion of the equipment manufacturer in the process might be needed.

5.2.3 Rate of change

Besides the WI range and bandwidth, a high rate of change of the WI is also identified as being detrimental for proper functioning of a number of end-use applications such as feedstock, gas engines, gas turbines. Its relevance is increasing with larger WI bandwidths at exit level. Based on the diverse origin of gas quality changes and the distributed responsibility along the gas value chain no common threshold value could be determined in the SFGas GQS process. As measurements are not possible at the time being in the required granularity and as research is needed to define the critical rate of change for the sensitive technologies. For more information see Annex A.

6 Recommendation for framework as pre-condition for implementation

With view to the regulation of the gas market, the process-related aspects are not in the competency of CEN but they are a major pre-condition for the finalisation and implementation of the described recommendations for WI entry and exit (5.1 and 5.2) and the approval of any related technical CEN standard. The clarification and stipulation of process-related aspects such as classification procedures, responsibilities and liabilities shall be subject to a process on the legal/regulatory framework with European and national authorities (EC, ACER, NRA, Ministries, etc) involving all stakeholders groups.

NOTE SFGas GQS TF1/CAG participants emphasize that an agreement on the involvement of all stakeholder groups would be requested, in case the Network Code process is used for this purpose.

Although the competency of CEN is clearly technical in this matter, SFGas GQS collected the framework/process-related issues raised during the discussions in order to document and forward them to EC together with the result of the SFGas GQS process results (EN SFGas GQS TF 1 Conclusion 20/2019).

CEN SFGas GQS recommends to launch the required process as soon as possible and to take the following aspects into account:

a) Transparent methodology rules and procedures for a reliable implementation of the proposed classification system at least:

    1) assignation of classes

    2) validity duration of classification including potential re-evaluation due to unforeseen circumstances

    3) procedures of switching classes from

        i) class specified to another class specified

        ii) class specified to class extended

        iii) class extended to another class extended

        iv) class extended to class specified.

    4) a procedure for reassessing the classification range for an exit area taking into account the future dynamics of the changes in supply sources driven by the energy transition

    5) the assessment of the presence of sensitive users downstream of the exit point;

6) the identification and implementation of appropriate mitigating measures and the related responsibilities and liabilities

7) Information flows before and after the assignment of classes between the grid operators, the injectors and the end users

b) The concept of classification needs a clear definition of responsibilities in the European framework. The classification described in 5.2.1 is based on the idea that:

1) for specified classes initiative for indication of action need is up to the user, if sensitive.

2) for extended class, the initiative is up to the network operator.

In cases a and b, here below, the solution identification and the analysis of potential mitigation measures (cost benefit analysis) are carried out in cooperation between users, small-scale gas producers and grid operators, involving NRAs, where applicable.

c) A legal framework for enforcing the implementation of the classification proposal and more specifically roles and responsibilities is to be elaborated by the European and national authorities (ministries & regulators) in close collaboration with all stakeholders.

d) European alignment of safety and environmental requirements for comparable end-use applications for the residential and commercial sector, as the existing situation leads to different acceptable WI bandwidths in different Member States or even different regions in one Member State, wherease:

— safety requirements: CO concentration from combustion processes);

— environmental requirements, like NOx emissions and/or efficiency).

e) The current EU Regulation 2016/426 on gas appliances requires residential appliances to satisfy the essential requirements for the gases distributed on the territory in the country of destination. To prepare a future common stock of installed gas appliances it is recommended to study the possibility of replacing the current national WI specifications published in the OJEU by harmonized WI specifications based on the classification system.

f) A common EU WI entry range promotes the common European market for residential gas appliances.

Additionally, the following findings related to the rules, procedures and a legal framework have been identified during the study work:

g) In case of presence of sensitive users, a range of mitigating measures shall be considered locally and on a case by case basis (reference to item b above) :

— end-use adaptation and mitigation;

— gas quality measurements (DSO, TSO)

— grid management measures;

— gas treatment;

— optimised communication of network operators to end-users

— ...

h) The existing network code on Interoperability and Data Exchange (EU regulation 2015/703) contains instructions in its article(s)

— 15 on managing cross-border trade restrictions due to gas quality differences;

— 16 and 17 on short-term gas quality variation monitoring, data publication and further information provision.

This existing regulatory implementation tool should be evaluated for:

i) the feasibility of using it for future implementation of the recommendations for entry and/or exit points

ii) communication between the different grid levels (Producer, TSO, DSO, end-user etc) and between gas network operators and end-users

iii) default situations

iv) ...

i) The regulatory framework probably needs to foresee a step-by-step implementation to allow for solving different national issues (due to current legislation, stock of existing installed applications not coping with wider WI bandwidths, etc.).

7 Impact of renewable and decarbonised gases on the Wobbe-index (WI) and Gross Calorific Value (GCV) in blends with natural gas

7.1 General

The impact of renewable and low carbon gases on the Wobbe-index (WI) and Gross Calorific Value (GCV) in blends with natural gas was studied. The renewable and low carbon gases taken into account are biomethane, biogas, synthetic methane and hydrogen. This study focusses on the effect of blending of renewable and decarbonized gases with respect to the WI proposal of CEN SFGas GQS (see Clause 5). In addition to WI and GCV, the injection of renewable and decarbonized gases also has an impact on other gas quality criteria, such as the relative density or the Methane Number, which have to be considered.

Since this study was carried out simultaneously to the main task of CEN SFGas GQS, a part of the investigation refer to the ideas of that moment within the CEN SFGas GQS (simple scenario approach, multiple class system with fixed class limit values for certain classes – class A approach). The class with fixed WI limit values of 49,00 – 52,7 MJ/m3 (15,15) was used in various analyses in this study and is used in this summary as an example for the ‘specified’ class with a maximum bandwidth of 3,7 MJ/m3 (15,15).

The blending of biomethane, biogas or hydrogen into a natural gas stream results generally in a decrease of the WI and GCV. As a consequence for the proposed classification, the WI of the resulting blends will decrease or even pass the lower classification limit, whereas passing the lower limit of the WI entry range is not allowed.

NOTE This does not reflect any national exemptions for indigenous gases.

The full report is available at with SFGas GQS Report 3.

7.2 Synthetic methane

In terms of WI and GCV, synthetic methane is considered fully interchangeable with the proposed entry specification and has characteristics comparable to the H-gas distributed in Europe. Determination of the impact of trace components is in detailed examination at the time being.

7.3 Biomethane

Biomethane (WI: ranging from 46,65 MJ/m3 (15,15) to 50,37 MJ/m3 (15,15) and GCV: ranging from 36.03 MJ/m3 (15,15) to 37.90 MJ/m3 (15,15)) is fully interchangeable with the proposed entry specification.

NOTE 1 Data for biomethane was calculated based on the informationof Table 1 of the RES document information delivered by the members of the AhG RES.

The spread in the WI- and GCV-values is mainly caused by the CO2 content in the biomethane. For biomethane, both the WI and the GCV, are at the low end of the spectrum compared to the H-gases. Injecting biomethane in a natural gas generally lowers both the WI and the GCV of the blend with a possibility to exceed the lower limit value of an exit classification based on the natural gas distributed.

For example for the exit classification range 49,00 - 52,7 MJ/m3 (15,15) 6,5% of the biomethane exceeds the lower class limit. This would result in the indication of a new specified class or – when exceeding the range of 3.7 MJ/m^3 - to an extended class.

NOTE 2 Most of the data series analysed in CEN SFGas GQS Survey 2 lay within the specified class chosen as example, although it is not the case for other set of data get for the group writing this Annex.

7.4 Low grade biomethane

Low grade biomethane (90 mol-% CH4 and 10 mol-% CO2) is not interchangeable with the proposed entry specification and not within the EN 16726 and EN 16723-1 standards. Depending on the initial composition of the H-gas a maximum fraction of 40% - 60% of low grade biomethane can be accommodated to fulfil the proposed entry range. Because the injection of low-grade biomethane in natural gas lowers both the WI and the GCV of the blend at a certain fraction the lower limit of an exit class will be exceeded. This would result in the indication of a new specified class or – when exceeding the range of 3.7 MJ/m^3 - to an extended class.

For example for the exit classification range 49,0 - 52,7 MJ/m3 (15,15) the fraction of low grade biomethane that can be injected within these limits varies between 5% - 35%.

NOTE 1 These fractions are based on the results presented for simple scenario 4 which has a lower limit value for the Wobbe index of 49,00 MJ/m3 (15,15)

NOTE 2 In this analyses only the effect of WI and GCV is taken into account. It is clear that the blend also needs to be checked against other limit values such as oxygen (EN 16726), CO2 (EN 16726), relative density (EN 16726) and siloxanes (EN 16723-1).

7.5 Biogas

Biogas (65 mol-% CH4 and 35 mol-% CO2) is not interchangeable with the proposed entry specification and not with the EN 16726 and EN 16723-1 standards. Depending on the original composition of the H-gas a maximum fraction of 10% - 20% of biogas can be accommodated to fulfil the proposed entry range. Since the injection of biogas in natural gas lowers both the WI and the GCV of the blend at a certain fraction the lower limit of an exit class will be exceeded. For example for the classification range 49,0 - 52,7 MJ/m3 (15,15) the fraction of biogas that can be injected within these limits varies between 1% - 12%4 of the normal volume flow. A higher fraction results in the indication of a new 'specified' class or when exceeding the range of 3.7 MJ/m^3 an 'extended' class.

7.6 Hydrogen

Hydrogen does not comply with the WI entry specification for the natural gas grid (45,88 MJ/m3 at 15/15). Therefore, it can only be accommodated in a blend with natural gas, biomethane or synthetic methane, unless the injected hydrogen quantity is negligible compared to the gas flow. Depending on the composition of the H-gas a maximum hydrogen fraction of 8 vol-% - 45 vol-% can be accommodated to fulfil the proposed WI entry range.

NOTE 1 For the injection of hydrogen in natural gas grids, requirements are needed to ensure the proper injection and mixing with the gas stream depending on the local situation.

NOTE 2 When injecting hydrogen, the impact of the other gas quality parameter (e.g. relative density, methane number) need to be taken into account. Their limits are likely to be exceeded before the limits of the Wobbe index.

As with biomethane and biogas, the injection of hydrogen lowers both the WI and the GCV of the blend. For example for a exit classification range 49,0 - 52,7 MJ/m3 (15,15) the fraction of hydrogen that can be injected within these limits varies between 2 vol-% - 27 vol-% (RES Doc, Figure 16). A higher fraction results in the indication of a new 'specified' class or – when exceeding the range of 3.7 MJ/m^3 - to an 'extended' class.

Based on a Monte Carlo simulation, using a normal distribution with the 1 percentile point at 49,0 MJ/m3 (15,15) and the 99 percentile point at 52,7 MJ/m3 (15,15), the effect of injecting hydrogen up to concentrations of 2 vol-%, 5 vol-%, 10 vol-%, 15 vol-% and 20 vol-% was studied. These simulations showed that with increasing hydrogen content the 1 percentile point value of the blend is decreasing as anticipated. However, the decrease is less than expected on the basis of a theoretical minimum analyses. Based on the average decreases in WI of 0,00 MJ/m3 (15,15) (2 vol-%), 0,06 MJ/m3 (15,15) (5 vol-%), 0,33 MJ/m3 (15,15) (10 vol-%), 0,67 MJ/m3 (15,15) (15 vol-%) and 1,09 MJ/m3 (15,15) (20 vol-%), it can be concluded that the possibility an exceeding of the lower classification limit for 2 vol-% and 5 vol-% occurs is not expected to be significant but for 10 vol-% and up it will be.

Hydrogen concentrations of 2% will not affect the class of an exit point.

For 5%, a reassessment of the class of the point needs to be done, leading to a possible migration from one 'specified' class to another.

For 10 or 20%, the variability of the hydrogen injection and the bandwidth of the base gas will determine if the exit point will remain within its previous class statement. It is unlikely that the point class remains at a specified class and will often go to an 'extended' class.

NOTE 3 These admissible fractions disregard the density and methane number criteria given in EN 16726:2015.

Admixing hydrogen in natural gas, biomethane or synthetic methane alters the gas properties much stronger than interchanging different (natural) gases. For some application, there is an effect of the hydrogen concentration even if the Wobbe index of the different hydrogen/gas blends does not vary.

Due to the difference of H2 properties compared to natural gas, the impact of h2 admixtures on specific applications depends on the actual technologies. At higher hydrogen concentrations, e.g. 10 to 20 %, industrial end-use equipment and power plants can be adjusted to a constant hydrogen concentrations but will have difficulties with a varying hydrogen concentration.

NOTE 4 Examples as condensing boilers conformant with the eco-design directive and cookers are explained in main part of this document. Furthermore, EU and national projects are in process to examine the specific impact on applications, e.g. THyGA.)

8 Open issues and considerations for CEN or elsewhere

For the following items, SFGas GQS has identified the need for further considerations in CEN and/or in other organisations:

a) Implementation of the Wobbe index proposal as part of the CEN standard EN 16726: The recommended WI range for entry points (chapter 5.1) is wider than the legal WI limits in many Member States which could currently lead to a significant number of A-deviations on a revised EN 16726 standard.

b) Gas appliances in the scope of GAR (mostly residential and commercial appliances) need to be provided with an appliance category marking. This marking is composed of different elements (cf. EN 437) of which one is the gas group the appliance is designed for. Two gas groups H and E cover the H-gas WI range as defined again by EN 437. According Dutch research, appliances developed for a group E generally can cope with a wider WI bandwidth than those of category H. Further confirmation and information of the abilities of these appliances would be useful for a stepwise implementation of the above recommendations for entry and exit points.

c) As far as auto-adaptive controls of gas application settings are concerned further work is needed

- to evaluate the ability of existing auto-adaptive controls;
- to evaluate the possibility of retrofitting existing gas applications with such controls; This is particularly relevant for larger systems.
- to improve auto-adaptive controls and more in particular sensors and feed-forward systems.

d) On-site adjustment:

Experience from several countries in EU show that on-site adjustment of residential appliances is a widespread practice. This adjustment is almost never based on knowledge of the actual gas quality on-site at the time of adjustment, but purely based on measurement of flue gas components (e.g. oxygen in flue gas). This practice can optimise the performance of the appliance in terms of efficiency and level of emissions if the gas quality at the time of adjustment is typical and the supplied gas quality over a long period is stable, but this may increase the risk of malfunctioning or poor combustion if the gas quality changes. Reference is made to Annex x.

An example is that in Denmark the practice of on-site adjustment was restricted in 2011 so the adjustment afterwards was always to a kind of pseudo-G20-point (pure methane) to mitigate the effect of gas quality changes. All appliance vendors did update their instructions for service and adjustment if necessary. A few appliance types have had their minimum load increased and some the max load reduced. For forced-draught burners the adjustment is in practice done by finding the change-over point of the CO curve and then adjust with a given O2 margin agreed in the Danish gas community and supported by the Danish gas appliance vendors. The benefit has been good operation of the appliances at increased variations of gas quality and no safety issues. Input from Danish experts have confirmed that the knowledge of the actual gas quality would increase the robustness for gas quality as the adjustment procedure could be more correct.

NOTE Some of the Danish end-users have received gas with a Wobbe index range from 48.1 to 52.8 MJ/m3 (15/15). This is a bandwidth of 4.7 MJ/m3 (15/15). (The gas quality range has been narrower the last few years). The variation within a day have been up to 3.8 MJ/Nm3.However this approach requires detailed information about on-site gas quality at the time of re-adjustment, e.g. for maintenance purposes. Therefore, better knowledge about the gas quality due to the proposed classification system will optimise on-site adjustment. This will support safety and robustness of the residential applications.

For large-scale end users in industry and power generation, on-site adjustment is usually necessary to meet the application's requirement in terms of fitness of purpose, efficiency, safety and/or pollutant emissions, both during the design and commission phase, but also after maintenance or repairs.

Industrial furnaces in thermal processing industries, feedstock processes in the chemical industry or power generation equipment are technologically very different, and will require tailor-made solutions to handle gas quality/composition variations. Examples could be customised advanced measurement and control technologies or on-site fuel gas conditioning. However, there are physical limits to what some of these end-use applications can accept in terms of gas quality.

Detailed data about local gas qualities at the site of the installation as well as forecast information as part of the exit-point classification approach are an added benefit in this regard, as additional information can help find optimal solutions for specific applications. With the future implementation of smart grids and the availability of better and cheaper sensors, measurement and tracking systems more and faster information will be available in the future also at the DSO level.

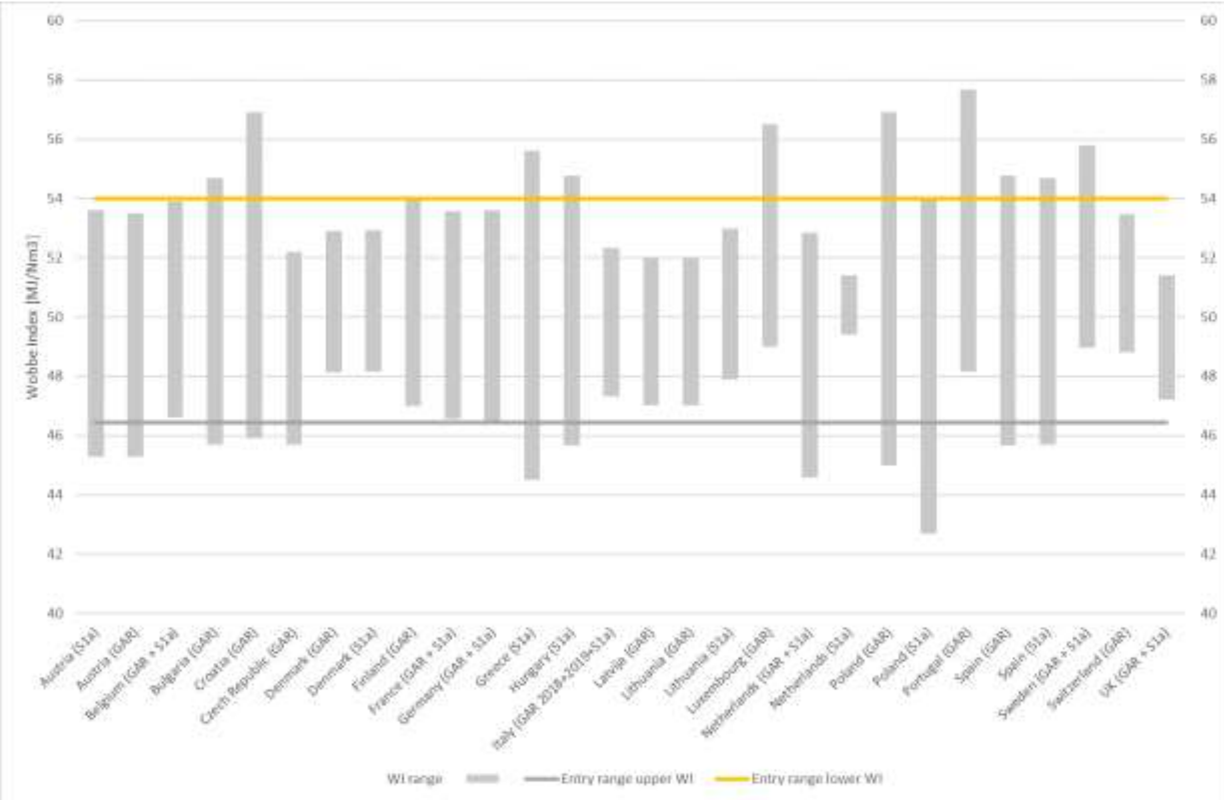
9 Preparatory work

9.1 Survey 1A – National situations regarding the regulatory framework on WI

The goal of Survey 1 - Part A: Legal and technical framework of gas quality was to probe the jurisdictive national frameworks on gas quality in order to provide an overview of the different legislative and technical national frameworks, encompassing actors, legislative instruments employed and binding technical parameters. The survey ran from 25/05/2017 until 15/07/2017, it was addressed to the heads of national delegations within the CEN SFGas study and identified relevant representative for EU and Energy Community members not yet involved in this study. In total, 14 countries submitted answers[1]. The outcome of the survey revealed significant differences in national regulatory frameworks from country to country. Some countries have very strict and specific limits, while others leave more space to technical specifications from TSO. A report has been made available to the working group on the outcome of Survey 1A. This supported the CEN SFGas WG in being aware of specific national legislative structures and possible bottlenecks or conflicts. This knowledge was meant to help in furthering the discussions of the CEN SFGas WG and in identifying further action needs, enabling gas

[1] Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Poland, Spain, Sweden, United Kingdom

quality harmonisation. The Survey 1A also made differences clear between reported legal limits and those found in Annex II of the GAR.



NOTE The lines show the upper and lower WI of the entry range proposed by the WG.

Figure 6 — WI range (MJ/Nm^3 - 15°C/15°C/101.325 kPa) as reported in the Tables of Survey 1A[2] and in the GAR.

The Netherlands use H gas only for industrial users and there are specific regional limits.

9.2 Survey 1B – national situations regarding the regulatory framework on environmental in-use requirements for gas application and maintenance practices

Performance parameters: Legal framework and current practice in end-use application of natural gas aimed at providing an overview of relevant legislation for Emission, Efficiency, Safety and Maintenance of different applications using natural gas in different European regions or member states. Within the EU there are different approaches for the specification of performance parameters associated directly or indirectly with natural gas quality requirements. As only five member states submitted answers to the survey, which moreover were difficult to analyse as the complex questions were interpreted differently, no further analysis took place. The answers were circulated with the Chair Advisory Group of the SFGas WG.

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[2] https://livelink.din.de/livelink/livelink?func=ll&objid=191745&objAction=browse&sort=name&viewType=1

9.3 Survey 2 – WI data on entry and exit points

9.3.1 Aim, content and outcome of Survey 2

CEN SFGas GQS launched a survey in 2017 in order to map the status quo on relevant gas quality parameters within European countries, as a basis for developing technical scenarios. A survey was to provide the necessary data to map and analyse national and sectorial situations and experiences in the European Union. This survey aimed at collecting gas quality information from a variety of representative end use points, in different European regions. The overall aim of the data collection was:

— to produce maps at national and regional level to summarise and describe main statistical properties of aggregated and anonymised data for the Superior Wobbe Index and Superior Calorific Value;

— to further elaborate the data to provide aggregated and anonymised descriptive statistical values covering the average behaviour and the rate of change by category of end-user.

The data was collected through two parallel exercises – ENTSOG collected data from its Transmission System Operator members, whereas JRC conducted a survey directed at Distribution System Operators and end user level. The participants contributed data sets corresponding to different types of points (distribution, residential, industrial, ...) and time granularities. The time period covered is from 01/01/2015 until 31/12/2016. The data requested for the time series were Superior Wobbe Index (WI) and Superior Calorific Values (GCV).

Survey 2 collected 121 time series for different types of end user off-take points. From the ENTSOG survey data set at the level of TSOs a total of 136 time series were used. Overall 257 time series were analysed, consisting of hourly and 15 minutes data. Results were made available to the WG through a report summarising the findings. The report contains a chapter for each Member State for which at least 3 data sets have been provided. A common set of tables and figures, as agreed with TF2 is presented for each member state. An overview of findings at European level are also provided.

Table 3 provides details on the number of series by type and group. The "end user" group accounts for 70% of the points, with 54% points labelled as "City Gate".

Seventeen Member States provided data (Table 4) which is complemented by data for the interconnection points between Ukraine and Poland, Slovakia, Hungary and Romania. Germany, Italy and Greece have the highest number of observations, while other Member States were under-represented – in particular for end user points – such as France and the United Kingdom (Table 4).

Table 3 — Summary of the number of time series used in the report by type of point and group

Type of point	Group	Acronym	Number of time series
City Gate	End user	C	140
Industry		I	12
Industry - combustion		Ic	11
Industry - non combustion		In	5
Power generation		Po	13

Type of point	Group	Acronym	Number of time series
Biomethane injection point	Other	B	9
Interconnection point		Ip	35
Domestic Production point		P	6
LNG terminal		L	6
Underground Storage Facility		U	3
Transit		T	10
EU import point		Im	7
		Total	257

Source: JRC on ENTSOG and survey data.

Table 4 — Summary of the number of time series used in the report by Member State and participating Country

Member State	Number of points
Austria	20
Belgium	9
Denmark	8
France	9
Germany	55
Greece	26
Hungary	14
Ireland	4
Italy	28
Lithuania	7
the Netherlands	15
Poland	22
Slovakia	4
Slovenia	3

Member State	Number of points
Spain	15
Sweden	5
United Kingdom	8
Other Countries	
Ukraine	5
Total	257

Source: JRC on ENTSOG and survey data

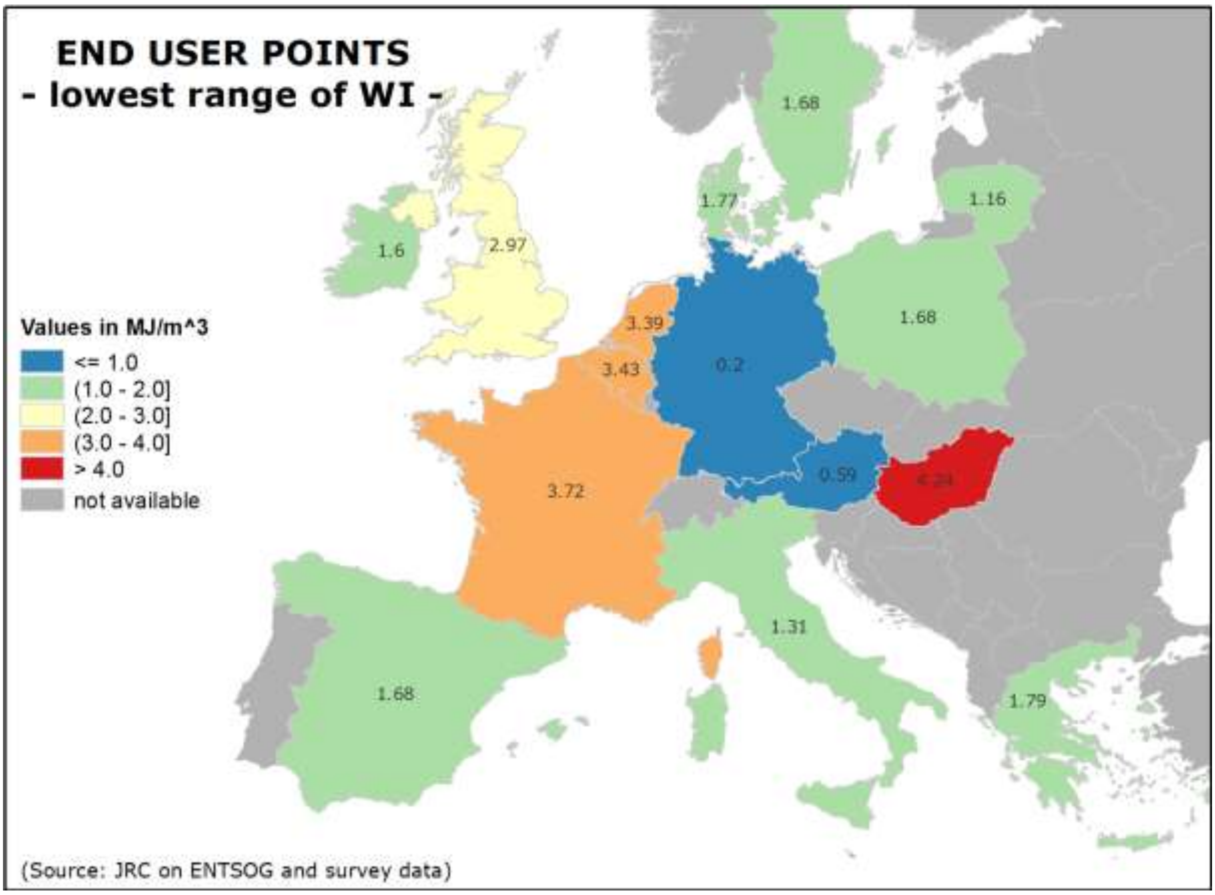
Considerable effort has been put into data processing and analysis. Due to concerns with data reliability and the identification of outliers, a methodology was agreed in SFGas GQS. This was deemed necessary as the results of the data analysis may be affected by errors and noise in the data sets. The aim of any data treatment was to remove any data points which may falsify or bias the analysis results. Data handling, management and processing has been carried out using R, an open source programming language and software environment for statistical computing and graphics. All data sets contributing to the survey were analysed with the same data analysis methodology, with the aim to provide a summary of the most relevant statistical parameters on WI and GCV in support of the study. The type of data analysis performed and the visualisation of the data has been discussed and agreed with SFGas GQS.

9.3.2 Key findings

The analysis of end user WI data at the regional level demonstrates the presence of potentially quite consistent ‘gas quality areas’ in Europe.

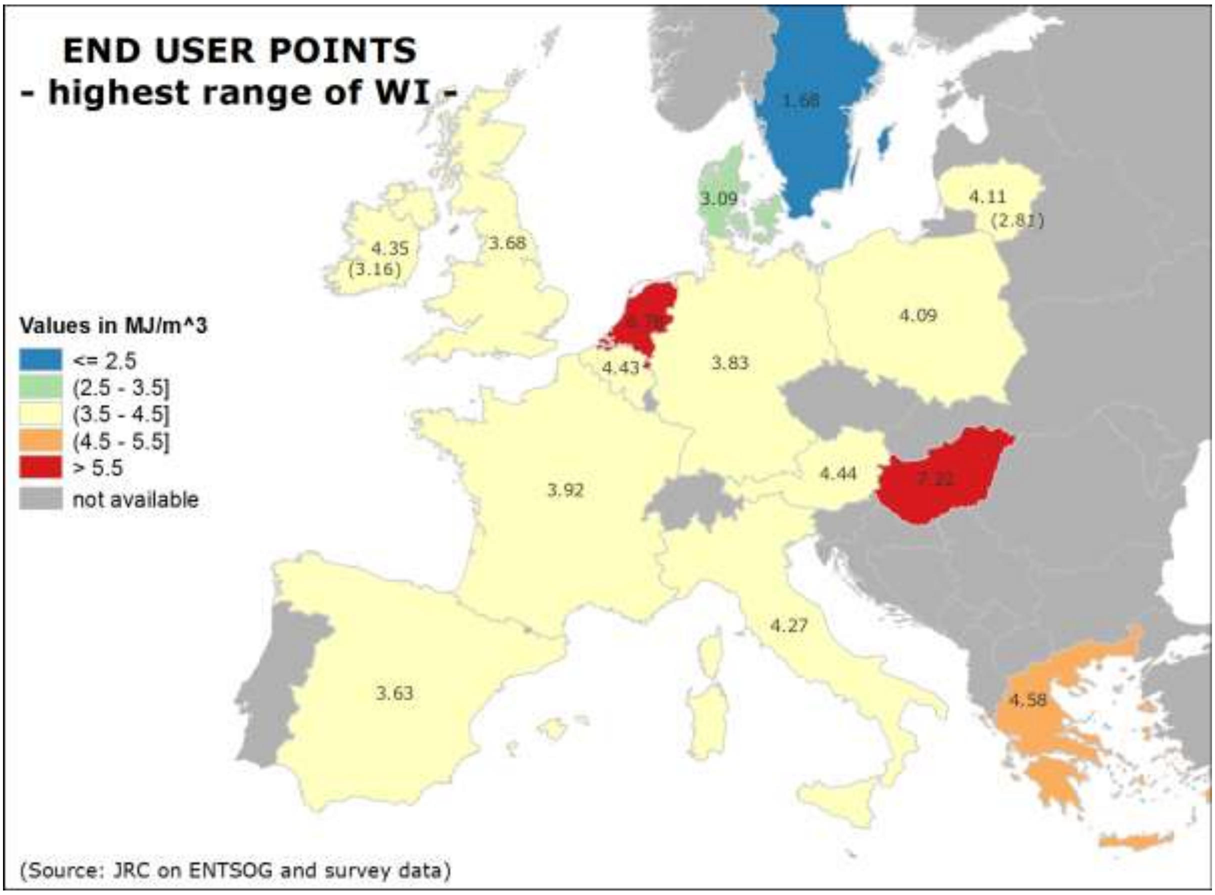
When looking at Europe as a region – as covered by the survey – the local highest range of WI varies between 3 and 7 MJ/m^3 and the local highest Rate of Change (RoC) between 1.7 and 4.6 MJ/(h m3). Seven out of seventeen MS have the local highest RoC above 2.5 MJ/(h m3). Regarding WI range, Figure 1 and Figure 2 represent the local lowest and highest range of WI observed in Member States for the group “end user” during the sampled period. Figure 1 shows the miminum observed ranges and Figure 2 the maximum ranges. For a given a MS, all time series labelled as „end use“ were screened and the range calculated for each, then from this list of calculated ranges the minimum and maximum were selected to qualitatively describe the variability (in the WI range) experienced by this group (end use) in each of the member states. Colours represent steps of 1 MJ/m^3 , these also help to roughly identify possible clusters or “regions” for the observed variable. Considering the minimum ranges observed, the Figure 1 show that overall the majority of MS experiencing ranges up to 2 MJ/m^2. Austria and Germany show a particularly narrow lower range. Hungary is on the contrary highly variable due to the characteristics of the national production. France, Belgium and the Netherlands share very similar values (around 3.5 MJ/m^3) potentially linked to the variety of supply corridors they use. The highest WI range values as shown in Figure 2 are quite similar across the EU (around 4 MJ/m^3 on average), with notable exception for those MS where national production plays still an important role. For in Greece the variability is linked to the difference between supply of the Russian gas and LNG gas.In broad terms the local range of WI, Western Europe (i.e., United Kingdom, France, Spain, Italy and Belgium) shares more similarities than the rest of the surveyed MS, with values between 2.6 and 3.8 MJ/m3. WI ranges in Germany and Austria are commonly around an average value between 1.6 and 1.8 MJ/m3. In contrast, the Netherlands and Hungary share more extreme patterns due – most likely – to the variety of supply sources and routes (with ranges from 4.4 to 5.7 MJ/m3). For the local average of the RoC of WI, Germany and Austria are similar with values between 0.8 and 0.9 MJ/(h m3). Italy, Spain, Belgium and Greece share values between 1.5 and 1.6 MJ/(h m3). Average values higher than 2.5 MJ/(h m3) are observed in Hungary, the Netherlands and United Kingdom, while France is around 2.3 MJ/(h m3).

It should be noted that flow rate information was not available and no weighting of the data has been performed. The time series collected do not allow for an extrapolation or forecasting of future gas quality developments. The number of biomethane injections is not representative for the future.



NOTE Values in brackets indicate the index after removal of potential outliers.

Figure 7 — Local lowest range of WI by Member States for the group "end user"



NOTE Values in brackets indicate the index after removal of potential outliers.

Figure 8 — Local highest range of WI by Member States for the group "end user"

9.4 Survey 3 – simple scenarios assessment

Introduce a short description and the main outcome of the survey.

Annex A
(informative)

Rate of change of Wobbe index

A.1 Definitions related to rate of change

A.1.1
Rate of change (RoC) = speed of change
Change of the value of a gas quality property over a period of time; the period of time is to be specified.

A.1.2
plug flow and effects
Because different gas qualities are subsequently transported in a gas pipeline and there is no mixing in the flow direction, gas users experience as instantaneous change in gas quality.

This is what is called a plug flow.

A.2 What causes plug flow?

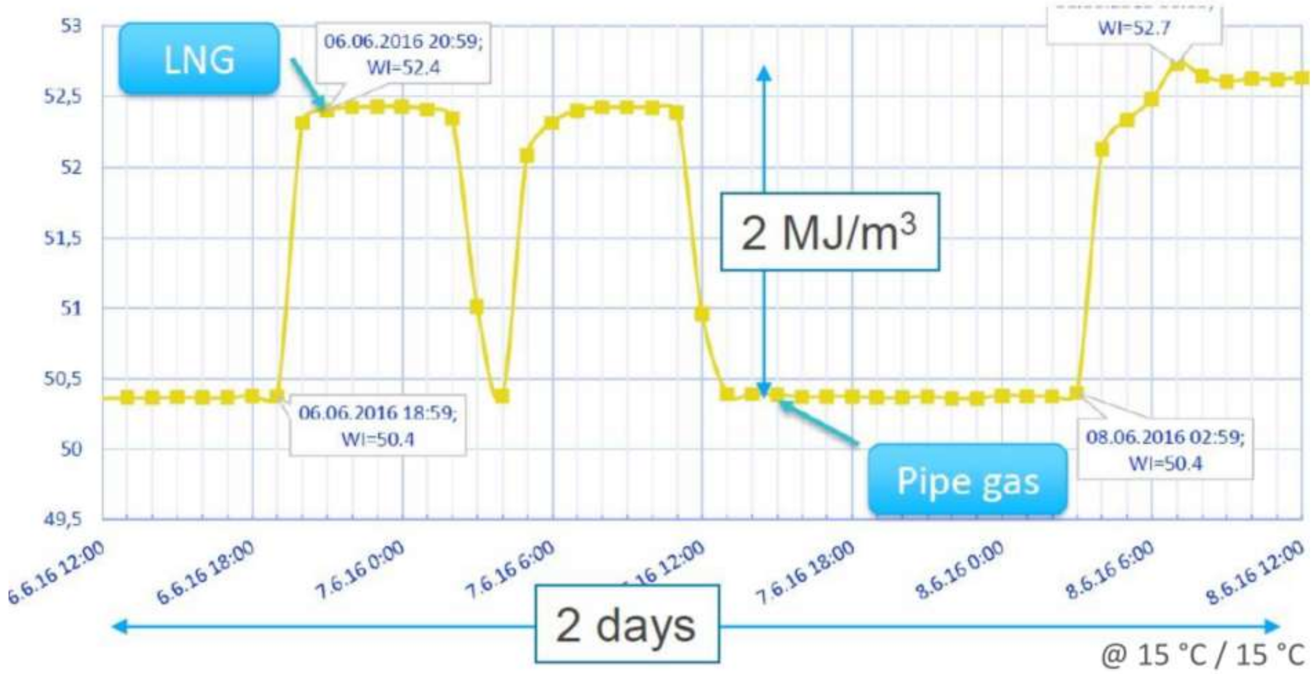
Plug flow is a (close to) stepwise change in gas quality criteria, e.g. the Wobbe index. The Wobbe index is an important gas property, as a direct indicator for the energy supply for many combustion systems and as an indirect indicator for the gas composition for feedstock in the chemical sector.

Gas grids have several entry points from gas producers like gas from local fields, off-shore, import from Norway, Russia and also LNG from a lot of different sources. For instance, in the Netherlands there are almost 40 different entries of different gas qualities in the H-gas grid. In the near future more biomethane will be injected and possible also Hydrogen which has a much lower density compared to methane. All these gases will mostly enter at different places into the gas grid. Mostly depending on the local situation, the end-user receives the gas from the gas grid with a different impact on gas quality.

Three possible situations are described.

a) Figure A.1 shows the situation with the entry of two or more gas sources at one side of the gas grid. If one of the gas sources changes in gas quality (gas fields have mostly different gas wells and therefore different gas qualities) or in case of emergency stops producing gas, the entry gas quality is also going to change.

   If gas from two sources is subsequently fed into one entry there is hardly any mixing in the gas pipeline. The maximum gas quality change occurs when there is a switch from one source to another (see Figure A.1).



Quelle: Ourliac, M., „Deal with gas quality variations and melt glass with syngas from gasification", IFRF/GWI TOTeM 44 "Gaseous Fuels in Industry and Power Generation: Challenges and Opportunities", Essen, 2017

Figure A.1 — Example in a transmission grid

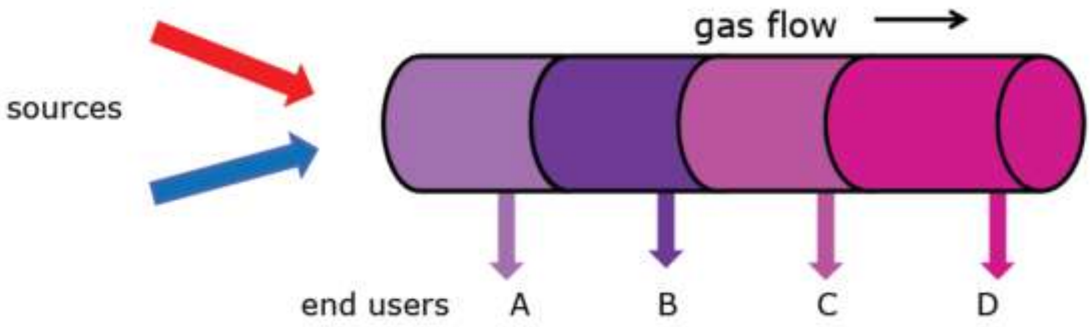


Figure A.2 — Example on single direction section

Variations as shown in figure A.2 can also occur if a supply point or compressor in the system is operated intermittently.

b) Figure A.3 shows the situation where gas enters from two or more different gas sources on both sides of different end-users and the gas flow also comes from both sides. In this situation you have a so called "zero flow point" where you have a rather quick transition between the two different gas qualities. In figure A.3 the "zero flow point" is located at end-user "B". The "zero flow point" will move to the left or right depending on which source changed or because of changes in entry or exit flow. This is typical due to change the off-take from the grid that varies with consumption.

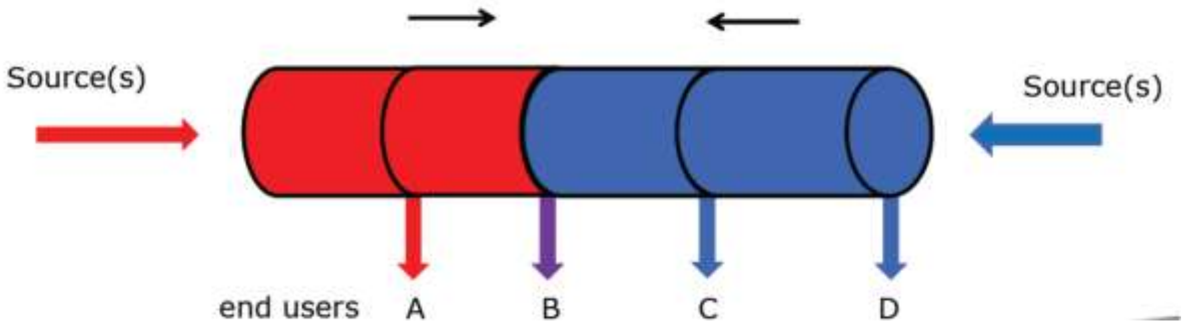


Figure A.3 — Example of frontal flow

One can conclude that changes in quality will differ per location of the user and the impact of quality changes will be different for different end-users in the same region.

c) A third case of change in gas quality at the end-user is where the end-user has not used any gas for a period of time and then starts the gas application, while the gas quality in the grid have changed in between and is therefore different from the one in the dedicated supply line for the end-user. Then the gas quality shift is seen in start-up process of the gas application (see Table A.4).

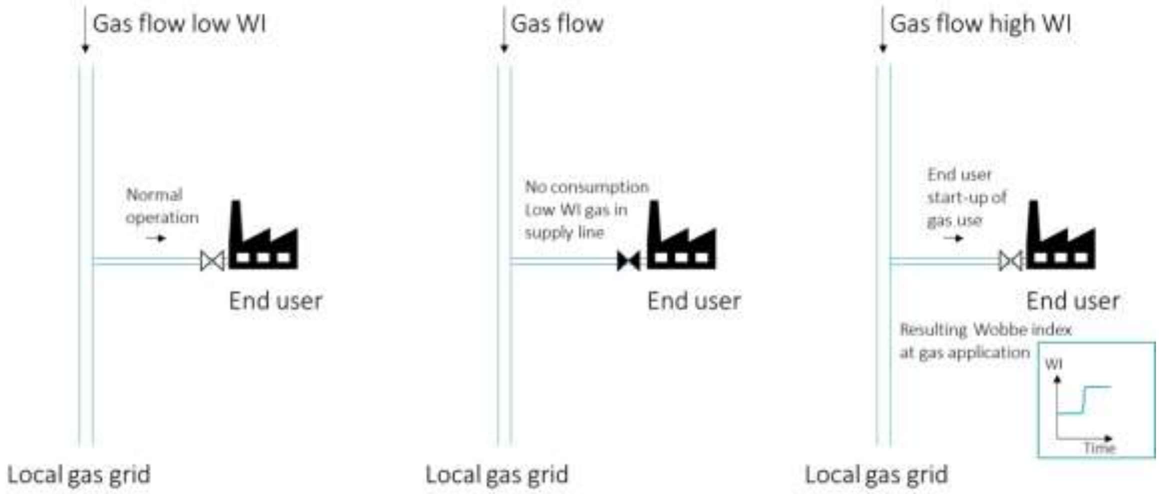


Figure A.4 — Example of gas quality change due to end-use start-up

A.3 Impact on sensitive customers

In many combustion systems, for burners for heating purposes, for gas turbines and for gas engines, the energy flow is linearly proportional with the Wobbe Index value. At the same time, changes in Wobbe Index (or gas composition in general) can also affect the air excess ratio of a combustion process, with consequences for flame temperatures and shapes, efficiency and pollutant emissions.

For natural gas as a feedstock, the relationship between the Wobbe Index and the composition of the gas is of consequence. Therefore, changes in Wobbe Index value can affect the energy output of systems as well as the process efficiency, the emissions, the product quality and safety.

The Wobbe Index range of the EASEE-gas common business practice (between 46,44 and 54,0 MJ/m^3 (15/15°C)) is in general too wide for control systems and for combustion systems of most industrial combustion processes and power plants to accept as the range for considering an acceptable rate of change (see SFGas GQS Survey 3).

Most domestic heating appliances are not sensitive to moderate Wobbe Index value changes. A restriction is always the extent of the change. However, many commercial and industrial applications can only handle disturbances in a limited range where the change is gradual in time. A too rapid and too large stepwise change (plug flow) of the Wobbe Index (or the gas quality in general), will negatively affect the product quality and the safety. For turbines and reciprocating gas engines, a rapid change in Wobbe Index will result in undesirable power output fluctuations. The air-to-fuel ratio can be affected in such a way that flash-back of the flame occurs or even flame out with consequently a detrimental trip, i.e. a sudden shut-down. At the same time change of gas quality can affect start up procedures for large-scale equipment. Also, the product quality in e.g. the industrial sector and in many thermal processing industries will suffer from rapid wide deviation in Wobbe Index value.

For many industrial applications and for power plants, the maximum acceptable 'instantaneous' change in Wobbe Index value is +/- 0,5 MJ/m^3 (based on an internal survey of power sector). For a gradual change in Wobbe Index value, within a maximum bandwidth of 3,7 MJ/m^3, the maximum ramp rate is 0,5 %/min (even with control systems), roughly equals 0,25 MJ/m^3 per minute.

In general, the plug flow issue is more relevant if there is a larger permissible range at the exit level.

For natural gases, there is often a tendency that high WI imply low MN.

The acceptable downward swing in MN depends however on the initial value of the methane number (figure A.5).

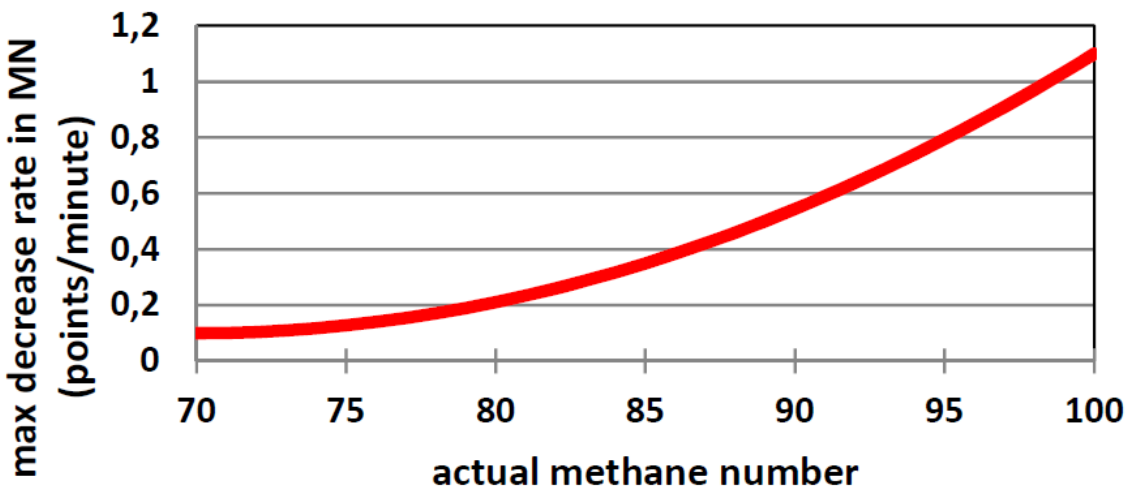


Figure A.5 — Maximum acceptable downward rate of change in the Methane Number

A.4 Measures to mitigate plug flow and a high rate of change

Possible measures of mitigation:

Gas treatment (e.g gas component stripper) and gas blending before and at the entry level into the gas system

— Use of gas blending and mixing facilities (Figure A.3) in the network

— Flow controls in the grid at DSO level

— Gas component, WI, GCV measurement (e.g. by sensors) and data communication at higher frequency to relevant and interested party

— Optimisation of the process of appliances and applications adapting to gas quality information

— Feed forward process control and local gas quality measurement at the end user

— Fuel gas conditioning on site of the end-user (Figure A.3)

The identification of most efficient mitigation measures needs to be carried out in cooperation between all stakeholders (see Clause 6).

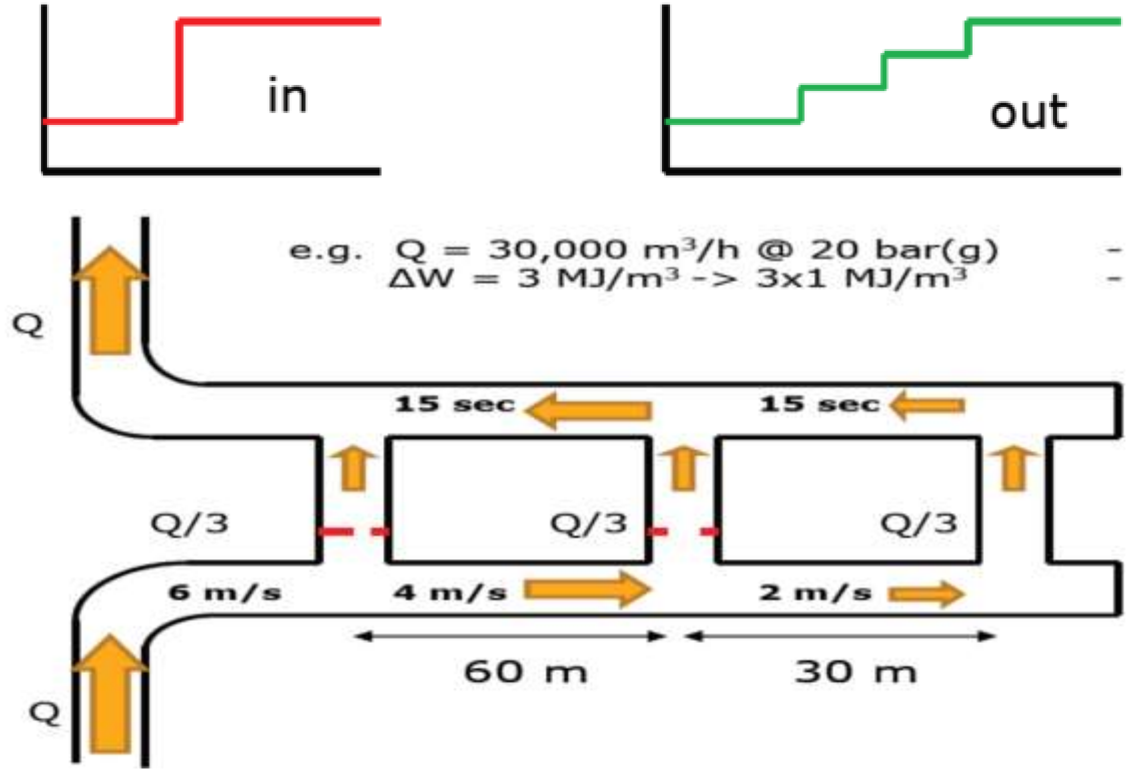


Figure A.6 — Example of a mixing facility - A so-called mixing organ that smooths a sudden change in gas quality

Annex B
(informative)

On-site adjustment of the end-use applications related to the WI exit proposal (5.2)

Complementary to chapter 7 point 4 on on-site adjustment, this annex is meant to bring some further insight in the need for more precise information on the WI of the gas supplied to applications, even if it concerns an exit point supplied with gas in a specified class.

The combustion related settings of an application are adjusted for a specific WI or NCV/GCV point. The WI, GCV or NCV may vary to a limited extent both, upwards and downwards, to guarantee proper functioning of the application (i.e. fulfilling the requirements on fitness for purpose, proper functioning and performance (i.e. efficiency and emissions). Even in a specified class with a bandwidth of 3,7 MJ/m^3, in which most of the household gas appliance can be operated it is required to have a reference point to which the applications is to be adjusted; see example in Figure B.1 index A to E.

The difference between A to E is:

- A: the set point is in the middle of the WI-bandwidth and the given 3,7 MJ/m^3 range (+ 1 MJ/m^3 and – 2,7 MJ/m^3) for safe operation of the appliance will be within the possible distributed gas range.
- B: ditto to A but the 3.7 MJ/m^3-range will touch the upper gas range limit as the set point is near the upper limit.
- C: Ditto to B but in this case the 3.7 MJ/m^3-range will touch the lower gas range limit as the set point is near the lower limit.
- D and E: same as B and C but the set point is near the upper limit or near the lower limit. In both cases the possible operation range of the appliance is limited to only to the lower end of the class range (C) resp. to the upper end of the class range. Reason: the upper or lower end of the operational range is outside of the gas bandwidth. In D the value is leading to thermal overload and increased CO and NOx emissions when supplied with gases with a WI exceeding the point the appliance is adjusted to with more than 1 MJ/m^3 while still in the limits of the concerned specified class. In the case E the appliance is adjusted to the upper limit value leading to fame lift and increased CO emissions when supplied with gases with a WI exceeding the point the appliance is adjusted to with more than 2,7 MJ/m^3 while still in the limits of the concerned specified class.

In any case the applications do not support a WI bandwidth of possibly +3,7 MJ/m^3 or -3,7 MJ/m^3; see examples on the right end of Figure B.1.

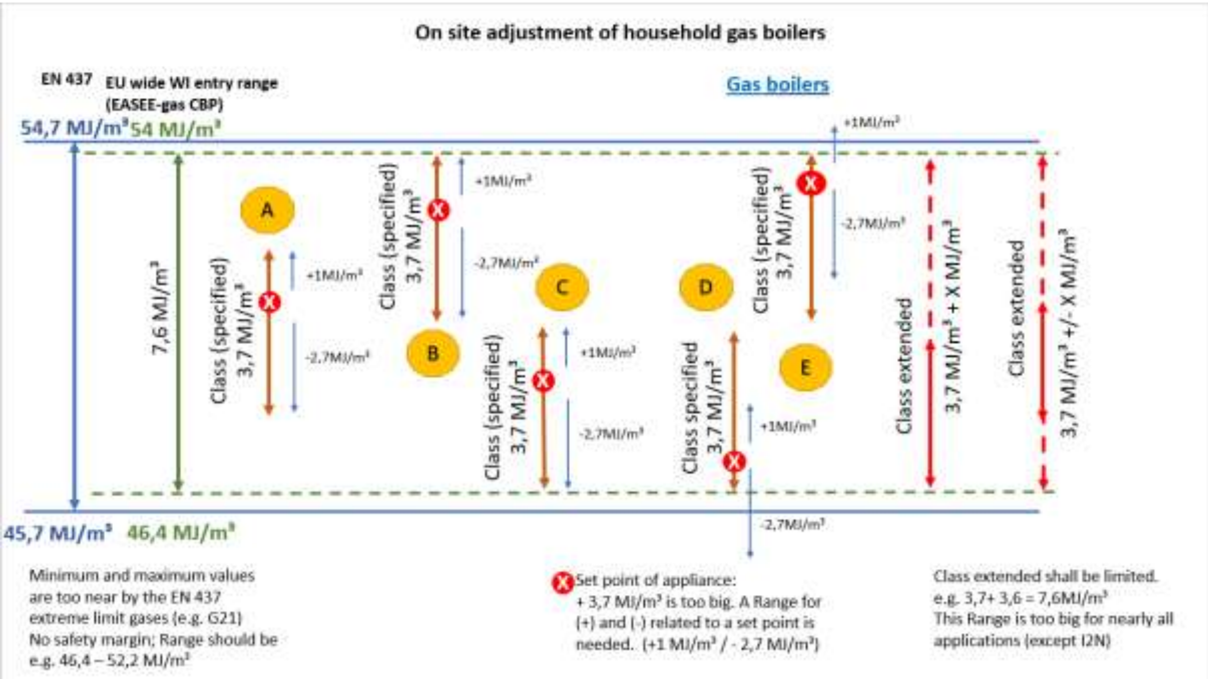


Figure B.1 — Example of on-site adjustment of household gas boilers in relation to the proposed WI exit classification

NOTE The values are common for residential applications (German Hauptstudie).

All appliances/applications, factory pre-set and/or adjusted on-site, obviously need to be re-adjusted in case the class allocated to a certain exit point changes significantly from one class specified to another or from a class specified to a class extended (see figure B.2).

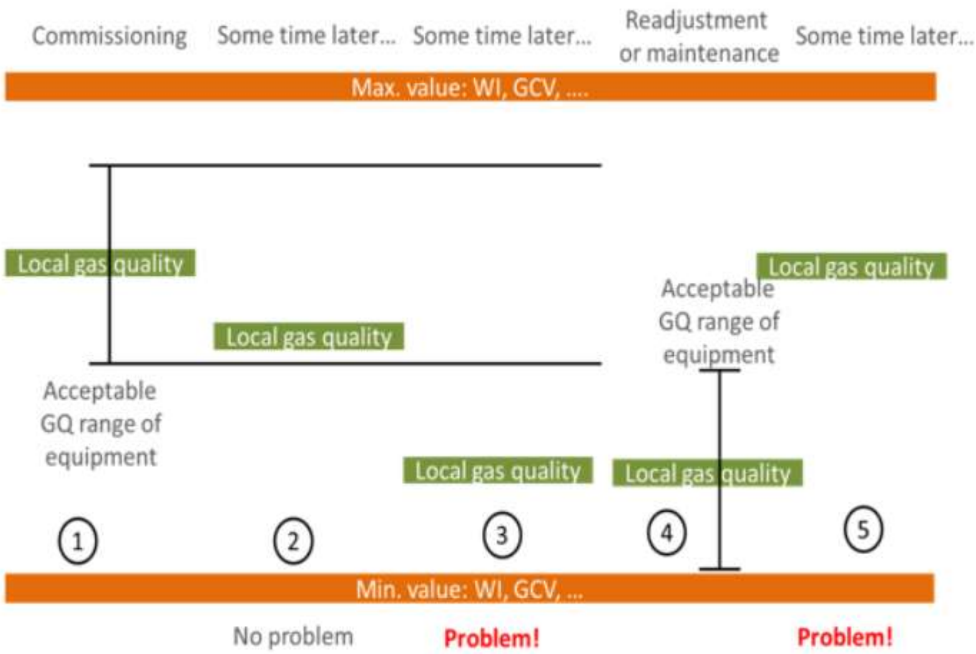


Figure B.2 — Impact of local gas quality changes on combustion equipment that was adjusted on-site.

As above mentioned, many gas applications are able to operate with a bandwidth of 3.7 MJ/m^3. But there are also gas applications – mainly in the **commercial and industrial area** - that can only operate within a WI-bandwidth of 2 %; see figure B.3. So, the possible upper or lower end of the bandwidth is much nearer to the set-point. These are application, which react more sensible on gas quality fluctuation but are more flexible for adjustments within the bandwidth. The problems, which will appear, are the same to those mentioned above for the household applications.

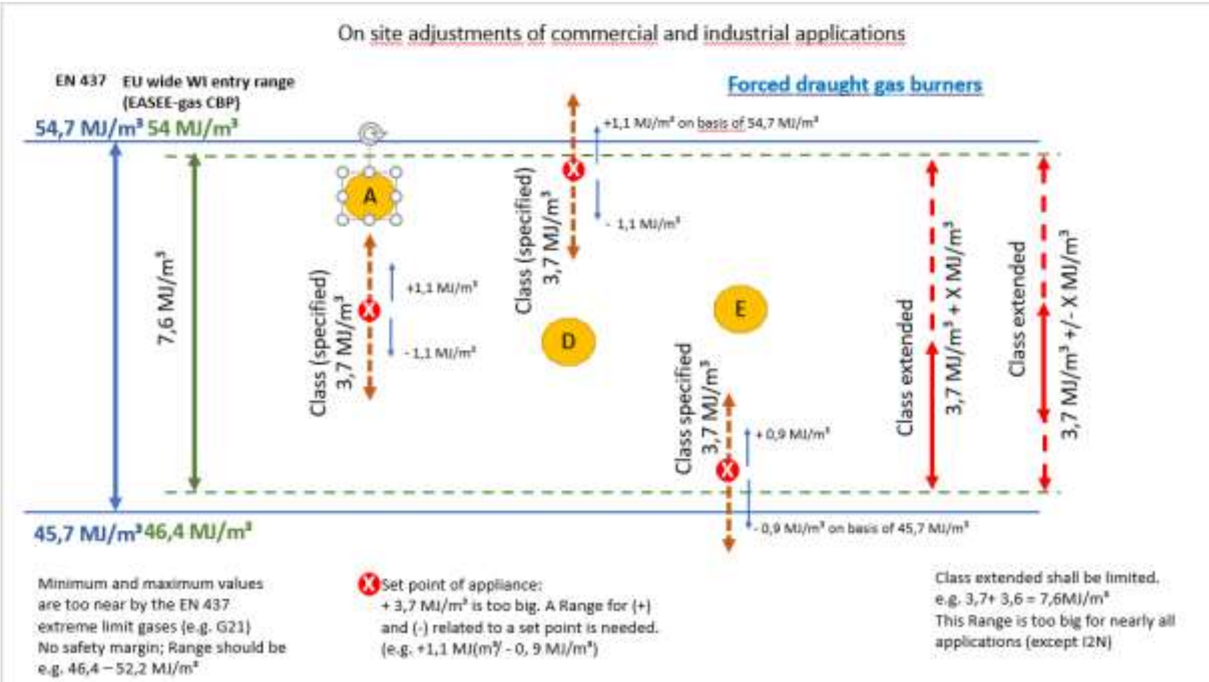


Figure B.3 — Example of on-site adjustment of commercial and industrial gas applications in relation to the proposed WI exit classification

Annex C
(informative)

Consultation on SFGas draft proposal in October/November 2019 – Basis for the present SFGas GQS proposal

C.1 Questions on Wobbe index proposal (2019-19-30) subject to SFGas GQS consultation

RESPONDENT
Name
Contact data (e-mail address and phone number)
Are you officially replying in the name of a sector organization? (Yes/No)
If 'yes', which one?
Are you officially replying in the name of a national mirror committee? (Yes/No)
If 'yes', which country?
If 'yes', which stakeholder groups are represented in this national mirror committee? (producers, TSO's, DSO's, suppliers, manufacturers, end users, ...) ***In case of manufacturers specify of which kind of gas applications – stationary engines, turbines, boilers, radiant heaters, water heaters, cookers, ...*** ***In case of end users specify what type of end users – industrial, power generation, residential, ...***
CONSULTATION
1. Does the sector organization/mirror committee agree with the proposed EU wide WI entry range of 46,44 up to 54,00 MJ/m³ (15/15°C)? (Yes/Yes if/No)
If 'yes if' then complete.
If 'no', why?
If 'no', do you have another proposal and if so, describe the proposal and the reasoning behind.
2. Does the sector organization/mirror committee agree with the proposed WI exit classification as described in decision 25/2019? (Yes/Yes if/No) *See table of conclusion 25/2019 illustrated with an example in annex B.*
If 'yes if' then complete

If 'no', why?
If 'no', do you have another proposal and if so, describe the proposal and the reasoning behind it.

C.2 Wobbe index classification proposal (2019-10-30) illustrated with an expample

ANNEX B — WI exit classification proposal illustrated with an example

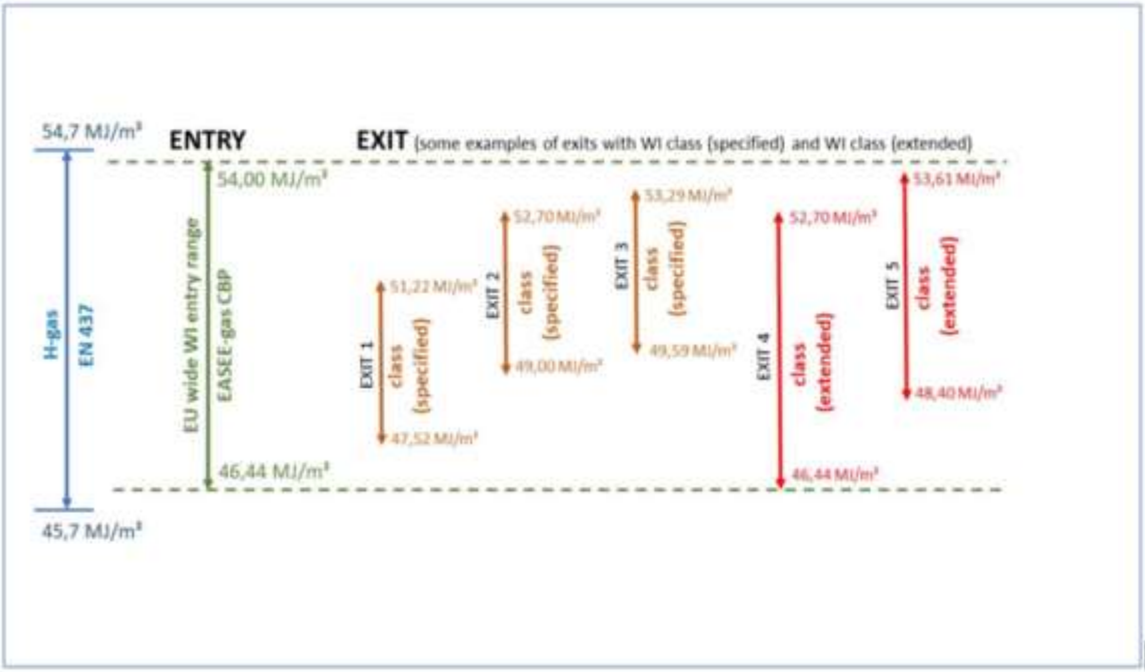
Classes	WI range	Bandwidth	Percentiles
Class (specified)	With indication of WI limits defined per exit point, based on the distributed gas, within WI entry.	Below or equal to 3,7 MJ/m³ with specifying the actual bandwidth.	1-99
Class (extended) If deviating bandwidth. Case by case assessment (rules to be specified in legal process).	With indication of WI limits defined per exit point, based on the distributed gas, within WI entry.	Above 3,7 MJ/m³ with specifying the actual bandwidth.	1-99

EXPLANATION:

If the WI range of gases supplied to the concerned exit point or exit area ≤ 3,7 MJ/m³ its class will be assigned by defining a lower WI limit and a higher WI limit but always covering a range of 3,7 MJ/m³.

If the WI range of gases supplied to the concerned exit point or exit area > 3,7 MJ/m³ its class will be assigned by defining a lower WI limit and a higher WI limit covering a range exceeding 3,7 MJ/m³.

ILLUSTRATION WITH EXAMPLES :



C.3 Compiled results of Wobbe index consultation as documented in SFGas GQS TF1 N 148

C.3.1 First question related to the agreement with the proposed entry range

Table C.1 — Replies relate to the proposed entry range

CEFACD	yes		yes	no further comment	
CEFIC	Yes		yes, if	exemptions can be made for domestic use on a country-by-country basis and the TSOs are able to provide the proper exit specification at industrial consumers. This would allow some member states the continuing injection of indigenous gas according to the H-GAS EN 437 standard. For the exemptions, the lower limit for entry points should be set at 45.66 MJ/m3 as defined in the EN437 standard (Test gases. Test pressures. Appliance categories.) and adaptions of the upper limit might be required as well. For cross-border points we agree with the proposed higher entry point. This means that national TSOs should be able to provide the proper exit specification. For the chemical industry continuous gas supply is essential. In principle, reducing the entry range is not desirable as it limits the availability/supply and the security of supply for natural gas. Going beyond the principle, current example demonstrates that in the CEE region due to geopolitical issues and the conditions of the gas	

				supply system there is considerable risk that without indigenous gas supply operators will be exposed to gas supply disruption risks.	
CEN/TC 131			No	In the enclosed slides a description is enclosed that the proposed range of the distributed gases at the upper or lower end at the exit points are out of spec and have no safety margins in respect to the EN 437. Further the proposed range of 3,7 MJ/m^3 is in the opinion of CEN/TC 131 too wide as the EN 676 describes a maximum tolerance of ± 2 %. Based on the upper value 54,7 MJ/m^3 are that e.g. ± 1,1 MJ/m^3. As a forced draught burner have no fixed setpoint but will be adjusted based on the distributed gas the information of this quality and possible fluctuation at the exit point is needed.	
DIN NAGas	yes	Producers, TSO, DSO, suppliers, manufacturers of residential, commercial and industrial appliances, industrial end users	yes, if	• Biomethane injection into a gas net is covered. • Feed in/back from distribution net to high pressure transport grid is covered • The mirror committee agrees with the principle. However, the exact range should be discussed: There is not sufficient distance between a possible distributed high Wobbe gas (54MJ/m^3) and the current extreme limit gases as specified in EN 437. In this regard, a slightly lower upper limit appears advisable, still covering almost all gas qualities present in European grids. • It must be clear that the discrepancy between a wide entry specification and a much narrower exit point specification puts some strain on TSO's and DSO's. Thereof, TSO's are, as proposed, directly connected to an entry point and in some cases have facilities to adjust the CV or Wobbe value of a given gas, e. g. by conditioning or storage, to buffer variations. However, DSO's normally have no such technical possibility, and will have some entry points in particular for renewable gases, which could make stable delivery conditions to a given exit point specification a major challenge.	
DK (DS)	yes	Authorities, biogas association, boiler supplier, gas distribution, gas competence centre, gas engine suppliers, gas producers, gas storage, gas	Yes, if	Yes if it is confirmed that, upon the inclusion of the WI range, the standard will remain as voluntary adoption, with Member States retaining the competence for establishing the Wobbe Index range. The Danish mirror group see the competence at the Member States as key tool to ensure the safe use of gas at end-user level. The suggested entry range is evaluated by the Danish mirror as a balanced approach that keep safety margins between the extremes and the test gasses according EN 437, that gives room for both high Wobbe index gas as the Danish gas production in the North Sea and the green gasses that is crucial for the decarbonization of the gas system.	

		turbine service company, industrial burner supplier, industrial burner service company, gas transmission.		Together this covers both the security of supply for the Danish marked and the necessary green transition.	
EASEE-gas	yes		yes, if	it is confirmed that, upon the inclusion of the WI range in the EN 16726, the standard will not be binding but will remain as voluntary adoption, with Member States retaining the competence for establishing the Wobbe Index range. The approval of the technical standard should be guided with clear definitions of the regulatory framework and related procedures, responsibilities and liabilities.	
EBA	yes		yes	Yes. A minimum value of 46,44 MJ/m^3 for the EU wide WI entry range is acceptable for the European Biogas Association. When a higher WI would be required, either the efforts of upgrading in terms of cost and energy rises significantly or propane must be added.	
EHI	yes		no	No because: (see also statement in annex) In the enclosed slides a description is enclosed that the proposed range of the distributed gases at the upper or lower end at the exit points are out of spec and have no safety margins in respect to the EN 437. For gas boilers the range should be defined as 46,4 – 52,2 MJ/m^3 and set points should be described. Further for gas forced draught burners the proposed range of 3,7 MJ/m^3 is too wide as the EN 676 describes a maximum tolerance of ± 2 %. Based on the upper value 54,7 MJ/m^3 are that e.g. ± 1,1 MJ/m^3. As a forced draught burner have no fixed set-point but will be adjusted based on the distributed gas the information of this quality and possible fluctuation at the exit point is needed.	
ETN	yes		yes, if	We would agree with the proposed EU-wide WI entry range provided: a. This is an absolute limit and is NOT subject to a statistical range such that 1st to 99th percentiles of readings lie within this limit. Any such statistical relaxation of the overall limit could in principle allow ANY gas to enter the system for short periods and could result in significant safety, integrity and operational issues.	

				b. This should be an overall limit EU-wide limit. More restrictive limits, within this overall range, could be defined at specific entry points irrespective of whether these entry points are entry points to the EU-wide system or entry points between sub-systems within the EU-wide system. c. More restrictive requirements are set at transfer and exit points within the system, in line with our responses to Question 2. d. For countries with gas resources (e.g. local gas production, biogas etc.) that lie outside this EU-wide entry range limit, wider limits may be set. This should only be allowed under exceptional circumstances with appropriate due diligence and appropriate means to ensure gas outside the EU-wide entry range limit could not enter the rest of the EU-wide system. Areas where limits are outside the EU-wide entry range should be considered to be outside of the EU-wide system but connected to it.	
ENTSOG	yes		yes, if	Yes if it is confirmed that, upon the inclusion of the WI range, the standard will remain as voluntary adoption, with Member States retaining the competence for establishing the Wobbe Index range. This would be in line with the conclusion of the European Commission following the examination of the implementation issues associated with EN 16726:2015 that was led by ENTSOG in 2016. This is without prejudice to the classification system for exit points being enforced in the relevant regulatory framework. The approval of the technical standard should only proceed when the regulatory framework and related procedures, responsibilities and liabilities have been clearly defined	
EUROMOT	yes		yes, if	EUROMOT would agree with the proposed EU wide WI entry range provided: a. There is a technical and legal certainty that TSOs will ensure that the exit points for the users and DSOs will not exceed the preferred WI exit range (see answer to question n. 2 below), although we know that this would be extremely difficult to ensure with such a wide entry range. b. The EUROMOT proposal for a preferred WI range at exit points is	

				accepted by the group (see answer to question n. 2). This preferred range should be the guide value for import contracts and for renewable gases to be injected in natural gas. c. Countries with indigenous gas resources can deviate from the preferred range, although the local TSOs should investigate the technical and economical possibilities for converging to the preferred WI range.	
EUTurbines	yes		yes		
ES	Yes	Groups represented in the national committee are TSO's, DSO's, test houses, national and regional authorities, installers, manufacturers of appliances and components for gas appliances (CEN/TC 58) and gas installations, biogas producers and engineering companies. Appliance manufacturers are of those products covered by CEN/TCs 48	Yes	Yes, if it is ensured that the implementation of the proposed solution is on a voluntary basis. Exit ranges should remain as a merely probabilistic approach. We would like to highlight that a clear regulatory framework linked to the proposal has not been defined yet. This should not introduce unnecessary additional obligations, complexity or costs to the gas infrastructure operators, especially in countries where gas quality has never been an issue. National/local solutions should remain being the priority tool at national level to solve local issues. Gas operators can neither provide a firm guarantee on exit bandwidth(s) nor have any liabilities if off-class gas arrives to the exit point. Gas grids are operated according to the gas demand in each moment, and never based on gas quality. Finally, it is paramount to ensure that any costs related to the implementation of this proposal are recovered by the gas operators.	

		(water heaters), 49 (domestic cooking), 109 (boilers), 180 (air heaters and radiant heaters). CEN/TC 106's (catering appliances) interest in our case is covered by a test house, no any manufacturer.			
FR	yes	TSO, DSO, LNG Operator, Storage Operator, Suppliers, GAR French Notified Body, Gas appliances manufacturers (boilers, overhead radiant heaters), Testing laboratory. (All stakeholders listed in the group receive the documents but do not regularly attend the meetings nor answer the consultations)	yes	no further comment	

GIE	yes		yes, if	Yes if it is ensured that the implementation of this range will not be binding. GIE proposal is in line with the conclusion of the European Commission following the examination of the implementation issues associated with EN 16726:2015 that was led by ENTSOG in 2016. In addition, GIE would like to highlight that the definition of the Wobbe Index range should be discussed at national level together with clear regulatory rules, procedures, responsibilities and liabilities. Cooperation at cross-border points is key to avoid any issue related to gas quality and WI range accordingly.	
HU	yes	Hungarian Horizon Energy Ltd., MOL Hungarian Oil c Gas Plc., O&GD Central Ltd., Riverside Ltd., Tét-3 Gázkút Ltd., Vermilion Energy Hungary Ltd. The above companies cover all HC production in Hungary.	no	We propose to the change the lower value to 45.66 MJ/m3. The upper value may remain the same but may be reduced by 0.78 MJ/m3 to compensate for the proposed lower value. Unfortunately, the introduction of the above range will result in the decrease in natural gas production in Hungary, as it will limit the marketability of certain gas reserves. A reduction in production would have the following undesirable effects: - The Hungarian state would lose tax and royalty revenue. - Security of gas supply of the country would be jeopardized. - Instead of cheap domestic gas, Hungarian consumers would have to buy more expensive imports, which would have an effect on gas prices. We request the development of a WI range that does not curtail the current production. In Hungary, the lower end of the range of Wobbe Index value of indigenous gas production that can enter the interconnected TSO network is at 45.66 MJ/m3. So, the values of 46.44 MJ/m3 or higher are not suitable as a lower end would constitute a limit for Hungarian producers. Thus, the currently used low threshold of Wobbe value of 45.66 MJ / m3 is appropriate for the Hungarian production.	
IFIEC	yes		yes	The current H-gas quality specifications of supply and demand are different in Europe, varying between the EASEE-gas CBP of 2005. Reducing the entry ranges are not desirable as long as the TSOs are able to provide the proper exit specifications taken into account the interests of end-consumers.	
IOGP			yes, if	IOGP supports the ongoing work by CEN on developing a Wobbe Index proposal to be included in the standard EN 16726. We also support the EASEE-gas range for WI which is used in the current proposal. The reason why we have answered this question with	

				‘Yes if’ is to express the following concerns: ▪ IOGP holds the view that the standard EN 16726 should not be a legally binding specification that results in rejecting natural gas which is outside this standard but can be accepted without impacting the quality at exit points. For indigenous production in some Member States the lower Wobbe Index is set below 46. 44 MJ/m3 proposed by CEN (such as 45.66 MJ/m3 in Hungary) and this gas should not be restricted by the standard EN 16726. The same would apply to injecting hydrogen into the natural gas system: hydrogen is outside the standard but can be accepted in limited quantities and should not be restricted by EN 16726. ▪ The standard EN 16726 should not require changes to national systems which have a Wobbe Index entry specification which is more narrow than the current proposal, unless changes would be justified based on a full cost-benefit analysis.	
Marcogaz	yes	Authorities, regulators, producers/suppliers, TSO, DSO’s, heating appliance manufacturers, cogeneration manufacturers/ end users, technological industry, industrial gas consumers, notified body, test lab.	yes	no further comment	
NBN	Yes	Authorities, regulators, producers/supp	Yes, if	Yes if • at least the gas applications covered by the Gas Appliances Regulation 2016/426 satisfy the essential safety requirements over this whole WI	

		liers, TSO, DSO's, heating appliance manufacturers, cogeneration manufacturers/ end users, technological industry, industrial gas consumers, notified body, test lab.		entry range; • WI values not experienced so far (for BE : > 53,25 MJ/m^3) have proven not to compromise the safe use of the existing gas applications stock; and if so, the regulatory framework should allow Member States not to accept gases with these WI values until safe use would no longer be compromised.	
NEN	yes	TSO, DSO's, suppliers, testing and certification institute, manufacturers; stationary engines, turbines, boilers, radiant heaters, water heaters end users; industrial	yes		
PL	yes	Producers, DSOs, TSOs	yes, if	Yes if it is confirmed that, upon the inclusion of the WI range, the standard will remain voluntary, with Member States retaining the competence for establishing the Wobbe Index range in theirs grids. This would allow for individual Member States to assess the technical and safety aspects of the gas infrastructure, as well as national production potential. In Poland the higher limit of WI is acceptable , however the lower WI limit can create a problem because of national production. This is due to the fact that Polish gas production, which accounts for around 20% of natural gas demand, is characterized by lower WI that this specified above. Gas of lower WI range is injected into the grid and handled safely.	

UK BSI Shadow Groups GSE/33 and GSE/-/05: Gas Infrastructure	yes	UK Oil and Gas Producers, a Gas Terminal owner/operator, Large Gas Generation Users and various Industrial, Commercial and Domestic users and appliance manufacturing interests, all as specified below. Yes, all the above stakeholder groups are represented in this UK response. Also, below, the UK stakeholder groups commenting here represent the manufacturing categories itemised below:- Manufacturers: boilers, radiant heaters, water heaters, cookers, End-users: All these above	Please Note that the diverse interests along the gas supply chain require this Consultation to be answered in several parts, which are given in an extra table in this file		

		types, including Industrial, Commercial, Residential and Own-Use by the TSO's for their normal operational purposes and for standby/emergency power support. For example, these operations depend upon the reliable and efficient operation of gas-turbines and engines.			
UK Response No1: OGUK (Producers - Oil and Gas UK)	yes		yes	Overall OGUK members support the proposed range for entry capacity. This is wider than the range currently allowed by the UK current regulatory framework (GSMR). However, the wider range would allow more diverse gas supplies to be delivered to the EU market through a. indigenous gas production, especially in the central and southern North Sea, and richer gas fields on the Norwegian continental shelf such as Edvard Greig and LNG imports which currently have to be ballasted at some cost to users. A wider specification will also help facilitate the development of new gases such as biogases and Hydrogen and, as a result, help make progress to decarbonisation of gas that is required to contribute to the UK and European climate objectives. The IGEM process in the UK is currently reviewing the GSMR specification that was introduced in 1996 and has not been modified since that date. More diverse supplies and reduction of processing costs are both strongly in the interests of consumers. The evidence from safety analysis is that a wider range can be accommodated.	

UK Response 2: North Sea Midstream Partners Ltd, NSMP. As a gas terminal owner and operator: David O'Donnell	[NB: This response is included as part of the UK Response along the UK Gas Supply Chain and is made via BSI Stakeholder/mirror Committees BSI GSE/33 and BSI/GSE/-/05: Gas Infrastructure. Malcolm Howe Chairman GSE/33 and GSE/-/05: Gas Infrastructure]		yes		
UK Response 3: GB National Grid: Gas, which is the GB TSO and makes gas available for offtake at Moffat from the UK to Dublin (2), Isle of Man and Northern Ireland (1). National Grid Gas also operates the Bacton	This reply is by National Grid Gas, which is the GB TSO and Bacton Terminal Operator etc. NGG is		no	No, because at present, National Grid could not apply the proposed EU wide WI entry range because the parameters are outside the UK's national legislation contained in the Gas Safety (Management) Regulations 1996 which require the gas conveyed on UK networks to be between 47.20 MJ/m3 and 51.41 MJ/m3 under normal operational circumstances. Work is underway in GB with a view to expanding this range, but this has not yet produced a final proposal. However, our understanding is that upon the inclusion of the WI range, the status of the standard will remain as 'voluntary adoption', with Member States retaining the competence for establishing the national	

Terminal into which both the BBL and Interconnector UK pipelines are connected. National Grid Gas. Philip Hobbins	part of the GB Response to the Consultation via the GB BSI Stakeholder Groups BSI GSE 33 and GSE/-/05: Gas Infrastructure. Malcolm Howe Chairman BSI GSE/33 and GSE/-/05.			gas quality specification. This would be in line with the conclusion of the European Commission following the examination of the implementation issues associated with EN 16726:2015 that was led by ENTSOG in 2016.	
UK Response 4: Large Gas Generation Users (CCGTs), *Energy UK. Ms Julie Cox*	Replying as part of the BSI GSE/33 and BSI GSE/-/05 Gas Infrastructure Response		yes, if	We would agree with the proposed EU-wide WI entry range provided: a. This is an absolute limit and is NOT subject to a statistical range such that 1st to 99th percentiles of readings lie within this limit. Any such statistical relaxation of the overall limit could in principle allow ANY gas to enter the system for short periods and could result in significant safety, integrity and operational issues. b. This should be an overall limit EU-wide limit. More restrictive limits, within this overall range, could be defined at specific entry points irrespective of whether these entry points are entry points to the EU-wide system or entry points between sub-systems within the EU-wide system. c. More restrictive requirements are set at transfer and exit points within the system, in line with our responses to Question 2. d. For countries with gas resources (e.g. local gas production, biogas etc.) that lie outside this EU-wide entry range limit, wider limits may be set. This should only be allowed under exceptional circumstances with appropriate due diligence and appropriate means to ensure gas outside the EU-wide entry range limit could not enter the rest of the EU-wide system. Areas where limits are outside the EU-wide entry range should be considered to be outside of the EU-wide system but connected to it.	

UK Response 5: Utilisation, which represents various Trade Associations, i.e. 5 Heating and Hot Water Industry Council, HHIC. Neil Macdonald	This Part 5 response from HHIC is part of the UK response along the UK Gas Supply Chain, via Gas Industry Stakeholders represented in BSI GSE/33 and GSE/-/05: Gas Infrastructure. Malcolm Howe, Chairman of these committees.		yes, if	It is HHIC's understanding that UK gas appliance manufacturers have no fundamental objection to standardising the gas quality in the distribution of gas between member states. As this gas enters the individual member states high pressure system from the European distribution network, then the gas must be mixed/treated to come within the individual member state gas quality. In the UK this is governed by The Gas Safety (Management) Regulations, specifically Schedule 3. We repeat, how gas is grouped into geographical areas for transport of gas around Europe, may not be a concern, as long as the gas entering the UK's high pressure national transmission system (NTS), and subsequent pressure tiers, maintains a gas quality which is safe and of an acceptable level to meet the requirements of at least the existing installed appliance pool.	
UK Response 6: The Industrial and Commercial Energy Association, ICOM, Ross Anderson, and the Energy and Utilities Alliance, EUA. Peter Day. (ICOM Energy Association represents the	Yes, via *BSI GSE/33 and GSE/-/05: Gas Infrastructure*: Chairman Malcolm Howe		yes, if	The proposed entry gas quality specification for inter-border transportation is not an issue for the manufacturers, as long as the member states control the specification at the entry to their specific network. For the UK, this needs to be in line with the gas specification detailed in schedule 3 of the Gas Safety Management Regulation (GSMR), having a WI range of 47.20 to 51.46 MJ/m3 .	

commercial/industrial heating equipment manufacturers.)					
UK Response 7: Cadent (DSO) Cadent falls in the UK Gas Supply Chain between the National Grid Gas, as the GB TSO, 3, then Cadent a DSO and the Large Scale Generators, at 4.	Yes, via *BSI GSE/33 and GSE/-/05: Gas Infrastructure*: Chairman Malcolm Howe		no	Although the aims of the Committee are recognised and there are benefits in establishing an acceptable Wobbe Index range, it is not the only parameter that needs to be considered with regard to ensuring that the end user receives gas of a quality that is suitable. This is detailed in EN 16726, where other factors are identified. In the UK, gas quality is controlled and managed at the main transmission system entry points to ensure compliance with appropriate legislation and network requirements. The concept of introducing a wide network entry point range but narrower exit point range does not match the overall network operation. In most instances, the exit point range is not controlled, and it relies on control of the entry specification to ensure compliance. This is also the case for smaller embedded biomethane entry connections. Interconnected gas networks with many entry points need to have a specified gas quality range but the quoted range from 46.44 to 54.00 MJ/m3 (15/15°C) is too wide. This was confirmed by the EU-funded GasQual study, and this conclusion has been endorsed by other studies. The upper and lower Wobbe Index values are close to the current EN 437 limit gas and do not provide sufficient safety headroom. As noted in part of the supporting information, there are concerns over appliances and combustion equipment that has been adjusted to be optimised for the prevailing gas quality. To ensure the future safety of end-users the entry point gas quality range should be narrowed to avoid possible increased emissions or impacts on safety. Within the definition quoted in Conclusion 24/2019, and exit point on a gas transmission network could be the same as an entry point on a gas distribution network. It seems in this instance that the entry point range is redundant, as it clearly must be equivalent to the exit point range.	
SE (SIS)	Yes	TSO's, DSO's, suppliers, end users (industrial, power	Yes		

		generation, renewable production)			
Individual replies:					
Assotermica Assotermica is the Italian association representing manufacturers of heating appliances and components. It associates more than 60 companies that are active in the residential and non-residential sector and it represents more than 90% of the domestic market. In Italy Assotermica is part of ANIMA - the Federation of the Italian Associations of Mechanical and Engineering Industries, one of the major Federations of Confindustria. In EU it is also a member of the Board of EHI, the European Heating Industry.	yes		Yes, if	The entry range would fit if an upper limit were set to the WI exit range. There is not sufficient distance between a possible distributed high Wobbe gas and the current extreme limit gases as specified in EN 437. See also enclosed slides summarizing the situation. We propose to set an additional upper limit to the exit point at 52,2 MJ/m3. The reasoning behind is that whatever the entry point is, a maximum exit point should be set to guarantee a safe use of the appliance in each condition.	
FNBgas	yes		yes, if	From the technical point of view the Wobbe Index range of 46,44 up to 54,00 MJ/m^3 (15/15°C) is in general technical feasible for a Transmission System Operator (TSO). Yes, if Entry and Exit points are defined more clearly and a ruleset for national and international Grid Connection Points is developed simultaneously. It must be made clear which rules apply for	

				connections between e.g. national or international TSOs and DSOs. From the operational point of view for the gas transmission a defined Wobbe Index range only on the UPSTREAM Entry (like 46,44 up to 54,00 MJ/m^3 (15/15°C)) and a differing Wobbe Index range on the DOWNSTREAM Exit (e.g. any specified class) is infeasible and not acceptable for a regulated TSO, who is embedded in a contractual and liability context to Up- and Downstream System operators (3rd energy package).	
Glendimplex (Faber)	no		yes		

C.3.2 Second question related to the agreement on the proposed Wobbe index exit classes and classification

Table C.2 — Replies on the proposed Wobbe index exit classes and classification

			See table of conclusion 25/2019 illustrated with an example in annex B.	

CEFACD	yes		no	WI exit range classification for EN 16726 is ok but as gas fireplace manufactures we are missing the max allowed PE value for the distributed gas. The max PE value is also missing in the EN 16726. A value over 10% PE will cause high soot deposit in gas fire places. For most gases PE= 0.5*(CH2H6)+1*(C3H8)+1.5*(C4H10) + 2*(C5H12) + 2.5*C6H14)
CEFIC	Yes		yes, if	the TSOs are able to provide the proper exit specification based on the CEN proposal, which comprises an agreement for specified regional Wobbe Index ranges of < 3,7 MJ/m3 (15:15) and a com- promise that an extended range should be possible, on the condition that its range should be properly substantiated including a consultation with "eligible" end-users on how they can safeguard their interests. This is backed by the conclusions of the 29 th Madrid Form on 16 October 2016, which acknowledged the interests of the end-users and requested to elaborate on the possibility of re- gional bands to be included in the updated standard while ensuring the integrity of the existing standard. As volatility and plug flow remain a difficult problem to manage for TSOs, we agree with a compromise of an explanatory annex to the standard which acknowledge that plug flow may be detrimental for specific end-use applications, including chemical feedstock.
CEN/TC 131			Yes, The Class (specified) with a Range of 3,7MJ/m³ would fit only if there would be a defined appliance set point for an appropriate setting and	

			the set point(s) is (are) within the overall range with safety margins.	
DIN NAGas	yes	Producers, TSO, DSO, suppliers, manufacturers of residential, commercial and industrial appliances, industrial end users	yes, if	• A clear, unmistakable different definition of “exit point” is required. The proposed definition “point at which gas leaves the distribution or gas transmission system for end use” contradicts existing agreements and real contracts (e.g.: exit points to gas storages). Use different expression as e.g. “end use point” • Clearly define not only entry and exit points, but also for those transfer of custody points in between. • Procedures for information of gas quality changes across the gas chain, by e.g.: TSO/DSO, have to be foreseen in CEN TC 234. Covers part of the rate of change aspects • Depending on their side of the market, there are proposals to widen the range up to 4,0 MJ/m³ or to narrow it well beyond 3,7 MJ/m³. Which range proofs to be practicable, and when and how the concept of "Extended ranges" applies or instead the gas is delivered as "unspecified", experience may show: The indicated range should cover more than 95% of deliveries in a given exit area. From an appliance manufacturer's view, it is important to define proper set points for the gas delivered to the appliances to allow smooth operation of the appliances in an exit area. • Still to be addressed are the question of fluctuation in case of the entry of renewable gases, "floating Wobbe zones" in case of alternating delivery to local areas with two different gases, etc.. Question: where? EN 16726 – probably not, since entry of renewables is yet the subject of EN 16723-1. EN ISO 15112 – needs to be more requiring, then. Network code – will it cover such eventualities? • If “class specified exit WI range” may change (as to be expected in a renewable world), who bears the costs for renovation/changes in end use appliances. • In this concept, the responsibilities and liabilities of the different actors/market partners need to be clearly identified.The standard EN 16726 cannot address such items, therefore a parallel, interactive development of the network code/legal framework is required. • Narrowing the Wobbe range between entry and exit point will require more control along the way. Whilst many TSO's have modernized their steering and control systems in the last decade, providing a seamless online control of the system including gas quality, for most

				DSO's such systems will require large investments.
DK (DS)	yes	Authorities, biogas association, boiler supplier, gas distribution, gas competence centre, gas engine suppliers, gas producers, gas storage, gas turbine service company, industrial burner supplier, industrial burner service company, gas transmission.	yes, if	Yes if the classes have a usable “lifetime” of several years at the end-users that gives real possibility to achieve any benefits of local optimisation. The administrative burden of quantification, management and communication of the classes may be significant for the relevant parties in the value chain. The Danish mirror group stress that the upsides of the classification systems must without doubt be bigger than this administrative task before final decision. The Danish mirror group is concerned whether the proposed classification system is the most economic and efficient one and suggest that a cost-benefit analysis is performed before any finalization of regulation that implements the classification system. The Rate of Change (RoC) of WI is a complex dynamic interplay of supply quality, off-take, end-user start-up/shut-down, grid operation and the pipeline geometry for which no single party of the value chain have the measures to control the RoC in the point where the gas is used. Therefore defining a RoC limit value in a gas quality standard makes no sense. The Danish mirror group recognises that a minority of the sensitive end-users have challenges due to rapid change in gas quality and acknowledge the need for development of technical solutions. In Denmark demonstrations project have shown good perspectives with the use of gas quality sensors that need further development. Sharing current gas quality data for the end-users either public or directly is evaluated as a simple but cost-effective tool to help the end-users and could be considered as a supplement to the classifications system.
EASEE-gas	yes		Yes, if	The approval of the technical standard is guided with clear definitions of the regulatory framework and related procedures, responsibilities and liabilities. This regulatory framework should be based on the in 25/2019 proposed probabilistic approach. Any costs related to the implementation of this proposal need to be recovered by the system operators. This proposal should therefore not introduce unnecessary additional obligations,

				complexity or costs to the gas infrastructure operators, especially in countries where gas quality has never been an issue, to avoid unnecessary additional costs for the network users.
EBA	yes		yes	Yes, the European Biogas Association agrees with the scenario presented at conclusion 25/2019. If the gas industry wants to survive in the future and accept injection of biomethane, hydrogen and synthetic gas, indeed a wide range of specifications is required. In this manner, Europe's gas industry will be helped to replace natural gas with 100% renewable gases by 2050. Gas industry needs to be reasonable and ambitious at the same time. The division of Europe's network in different classes will allow a wide range of specification at entry points and low WI band width for end-users at the same time.
EHI	yes		yes	Class (specified) with a Range of 3,7MJ/m³ would fit if there would be a set point for an appropriate setting. E.g. +1MJ/m³ and -2,7MJ/m³. Only a plus or minus in one direction does not fit.
ETN	yes		no	The proposed classes are not consistent with the previous definitions of classes A to C defined in CEN SFGas GQS TF1 N 120: Draft reflection paper for the further development of the Integrated Scenario/classification approach provided by AhG, 2019-07- 9 and presented at the Madrid Forum, June 2019. These definitions covered the possible situations well. The two proposed classes are not materially different as they both require that the WI be within the overall entry range and be specified. The only difference is whether the range is greater or less than 3.7 MJ/m3. Neither class allows for fuels outside the EU-wide entry range that may be required to accommodate local gas production. We do not believe that this provides a workable classification system.
ENTSOG	yes		yes, if	If 'yes if' then complete ENTSOG recognises that the proposed solution with a wide EU Entry WI range and a classification system at Exit is a compromise that tries to give an answer to the competing requirements of both sides of the gas value chain (the security, diversification and decarbonisation of the gas supply, at the same time as a safe and efficient end use with as low GHG emissions as possible).

				ENTSOG supports that compromise in principle, but there are a number of issues to address before it could be implemented. Forecasting the WI range at individual exit points is not a capability that TSOs have at present and it may be difficult to achieve a robust assessment, particularly for networks with a high level of supply diversity and variable demand patterns. The proposal may therefore not deliver the value that exit points, that are sensitive to WI variation, envisage, and TSOs must not be held liable for any commercial lost for End-users, if the WI deviates from the forecast. TSO cannot provide a firm guarantee of whether the WI will be within the 3.7 MJ/m3 range for Specified class sites. The resulting flows in the system are a product of the whole gas sector value chain's dynamics (e.g. nomination and allocation), and the TSOs have no measure to control the flow at all exit points. The definition of the classes must therefore have a probabilistic approach, and ENTSOG support the approach of using percentiles to define the classes. As a consequence, the gas applications must be able to react safely within the whole entry range defined by the relevant member state. Additionally, the impact of supply sources (e.g. injection of renewable gases) would need to be managed by legal requirement for access of third parties, which would alter flow patterns in that

				area of the network and could change the TSO's view of the gas quality that a particular offtake is likely to receive. A procedure for reassessing the classification range for an exit area must be developed taking into account the future dynamics of the changes in supply sources driven by the energy transition towards renewable energy. Regarding points of Extended class, the End-users might want advanced provision of information regarding the WI. New tools would need to be developed to do this, potentially requiring either additional chromatographs to be installed upstream of offtake points or the implementation of capability to track WI through the network. These investments must be recovered by the Operator (i.e. as part of the regulatory assets base (RAB)). Extended class related procedures need careful consideration taking into account the foreseeable increase of renewable gases (e.g. hydrogen). It's not given, that the proposed numerical solution is the most economic and efficient one. Opening too many Extended class procedures and too frequent changes of classification may lead to additional cost for the involved parties. Therefore, ENTSOG advises CEN stakeholders to further elaborate on reasoning of the chosen values of bandwidth (3.7 MJ/m3) and percentiles (1-99%). ENTSOG has also not seen any evidence, that the proposed classification solution is more economic than the exit points, that are sensitive to WI change, making changes at their sites to address the impacts, they experience due to variation in WI. ENTSOG therefore suggests,

				that a cost/benefit analysis should be completed to demonstrate whether this could generate an inappropriate cross-subsidy whereby all consumers would be funding the TSO investments to deliver this solution for the benefit of a section of large-scale industrial consumers that are sensitive to WI variation.
EUROMOT	yes		no	Such a proposal would be against the aim of Mandate M/400, which is, ultimately, a harmonisation to a preferred EU wide WI range. Moreover, such a proposal would result in: • Variable equipment performance (with regard to both efficiency and emissions) • Increased safety risks • Occasional and destabilising changes in equipment settings and tuning • Difficulties in guaranteeing performance by the manufacturers • A trip of an electricity generator caused by gas quality changes would have substantial financial consequences • Variable product qualities
EUTurbines	yes		yes	Gas turbines are able to cover qualities in the H-gas range EN437. In case of huge rates of WI changes, the GT can still be controlled via the average of the measured turbine exit temperatures (by means of thermocouples). Only in case of very transient operation, like load rejection or ignition or fuel transfer from oil to gas or synchronization with the grid, the gas turbine might be controlled in an “open loop control cycle” commanding a changing fuel mass flow based on a design gas composition. Then the control valve stroke is commanded with maybe a gradient in control valve stroke. The thermocouple signal would be delayed (too slow). These fast transient operation modes had led to the fact that Wobbe Index change rate requirements for gas turbines had been given in x% per second and not minutes, well knowing that a measurement device would not be fast enough to detect or measure this.

				This could happen if there is a sharp plug-flow change characteristics from one gas quality to another. These superposition of fast transient operation and huge WI gradients are considered very unlikely to happen.
ES	Yes	Groups represented in the national committee are TSO's, DSO's, test houses, national and regional authorities, installers, manufacturers of appliances and components for gas appliances (CEN/TC 58) and gas installations, biogas producers and engineering companies. Appliance manufacturers are of those products covered by CEN/TCs 48 (water heaters), 49 (domestic	Yes, if	Yes, if it is ensured that the implementation of the proposed solution is on a voluntary basis. Exit ranges should remain as a merely probabilistic approach. We would like to highlight that a clear regulatory framework linked to the proposal has not been defined yet. This should not introduce unnecessary additional obligations, complexity or costs to the gas infrastructure operators, especially in countries where gas quality has never been an issue. National/local solutions should remain being the priority tool at national level to solve local issues. Gas operators can neither provide a firm guarantee on exit bandwidth(s) nor have any liabilities if off-class gas arrives to the exit point. Gas grids are operated according to the gas demand in each moment, and never based on gas quality. Finally, it is paramount to ensure that any costs related to the implementation of this proposal are recovered by the gas operators.

		cooking), 109 (boilers), 180 (air heaters and radiant heaters). CEN/TC 106's (catering appliances) interest in our case is covered by a test house, no any manufacturer.		
FR	yes	TSO, DSO, LNG Operator, Storage Operator, Suppliers, GAR French Notified Body, Gas appliances manufacturers (boilers, overhead radiant heaters), Testing laboratory. (All stakeholders listed in the group receive the documents but do not regularly attend	Yes, if and only if	Yes if and only if: It is specified that - the upper and lower limits of the specified class are given locally by TSO/DSO with a bandwidth of 3,7 MJ/m3 (to remove "with specifying the actual bandwidth") - For both classes, concerning the WI range, it should be written "with indication of WI limits defined per "WI Range exit area" (i.e. geographical area with the same WI range), based on the distributed gases, within the entry range" We would like to propose another wording for the classes: - specified class becomes safety and performance class - Extended class becomes safety class France would like to state that the biomethane market is growing exponentially in France and that most of the biomethane injections within an "LNG area" will fall into the "extended class", which in return may hamper the development of the biomethane sector. As we stated before while presenting the French case study during a TF1 meeting, a "specified class" of 4 MJ/m3 would be more realistic for the classification purpose. Difficulties were met while trying to define a legal framework and the role and

		the meetings nor answer the consultations)		responsibilities of the different stakeholders involved. Legal framework should be dealt within a specific working group involving the European commission, the national authorities and the regulatory bodies as well as the EU affairs department from the different gas companies/stakeholders [competent authorities] Meanwhile the methodology behind the classification of exit points has to be dealt with in a relevant working group by the people responsible of the gas flow, and who have the knowledge of Gas Quality data i.e. the gas operators. Needless to say that it is crucial that those two points (classification methodology and legal framework) have to be handled and agreed before voting on the revision of EN 16726 standard.
GIE	yes		yes, if	GIE supports the wide EU entry WI range and a classification system at exit. But the implementation of the classification of the WI exit should not introduce unnecessary additional obligations, complexity or costs to the gas infrastructure operators. GIE would like to highlight that operators cannot provide a firm guarantee to comply with the exit bandwidth(s) proposed. Therefore, GIE supports the use of percentiles in the definition of the exit classes. In addition, operators should not have any legal responsibility at the exits due to this narrower range. It's not justified that the proposed numerical solution is the most economic and efficient one. Opening too many Extended class procedures and too frequent changes of classification may lead to additional unnecessary costs for the involved parties. Therefore, GIE proposes to further elaborate on reasoning of the chosen values of bandwidth (3.7 MJ/m3) and percentiles (1-99%). It should be ensured to the operators that any costs related to the implementation of this classification system will be recovered. A cost/benefit analysis would be helpful to demonstrate the right solution for the benefit of end-users overall. This cost/benefit analysis should include the possibility the exit points, that are sensitive to WI change, to make changes at their sites to address the impacts, they experience due to variation in WI.
HU	yes	Hungarian Horizon Energy	yes	

		Ltd., MOL Hungarian Oil c Gas Plc., O&GD Central Ltd., Riverside Ltd., Tét-3 Gázkút Ltd., Vermilion Energy Hungary Ltd. The above companies cover all HC production in Hungary.		
IFIEC	yes		yes	confirmative comment: The 29th Madrid Form on 16 October 2016 acknowledged the interests of the end-users and requested to elaborate on the possibility of regional bands, to be included in the updated standard while ensuring the integrity of the existing standard. After 3 years discussions CEN succeeded to reach an agreement for specified regional Wobbe Index ranges of < 3,7 MJ/m3 (15:15) and a compromise that an extended range should be possible, on condition that its range should be properly substantiated including a consultation with "eligible" end-users on how they can safeguard their interests. As volatility and plug flow remains a difficult problem to manage for TSOs, we agree with a compromise of an explanatory annex to the standard which an acknowledgement that plug flow may be detrimental for specific end-use applications including chemical feedstock
IOGP			no reply to this question	
Marcogaz	yes	Authorities, regulators,	yes	Yes with the possibility of regional/national/local WI exit bands, as far as the integrity and the free

		producers/suppliers, TSO, DSO's, heating appliance manufacturers, cogeneration manufacturers/end users, technological industry, industrial gas consumers, notified body, test lab.		circulation of the existing European gas system is not hampered. It should remain clear that the class system in the CEN Standard is based on a probabilistic approach (voluntary bases) and not regulatory at European level.
NBN	Yes	Authorities, regulators, producers/suppliers, TSO, DSO's, heating appliance manufacturers, cogeneration manufacturers/end users, technological industry, industrial gas consumers, notified body, test lab.	yes, if	Yes if • the investment costs for implementing such a general classification of exit points/areas is considered as part of the TSO/DSO regulatory asset base (if a preceding cost/benefits analysis gives a positive conclusion); • the regulatory framework and related procedures, responsibilities and liabilities are clearly defined; • at least the installed gas applications covered by the Gas Appliances Regulation 2016/426 satisfy the essential safety requirements over the whole WI entry range at all time; • an assessment of the proper functioning of art. 17 and 18 of the existing network code on interoperability and data exchange is conducted; based on the outcome of this assessment any appropriate measures, if needed, could be taken on the level of the network code and/or its national implementation.

NEN	yes	TSO, DSO's, suppliers, testing and certification institute, manufacturers; stationary engines, turbines, boilers, radiant heaters, water heaters end users; industrial	yes, if	If it is noted that the suggested range of 3,7 MJ/m 3 may not be suitable for all installed applications. Shifting of the range should be part of a regulated process considering the interests of all parties concerned. Modification of an extended range should follow the same procedure. This position was not supported by the Dutch sector organization (Plagamo/DGTA) of gas turbines and engines.
PL	yes	Producers, DSOs, TSOs	yes, if	Polish mirror committee accepts the proposal on classification on exit points, however asks CEN to clarify beforehand issues such as: 1. long-term forecast on gas quality at exit points or WI range exit areas should be considered as probabilistic forecast, therefore TSOs must not be held liable for any commercial or legal lost for end-users, in case the real WI deviates from the forecast. 2. the actual gas that end-user is receiving is a product of what is injected into the system at entry point and possibility to co-mingle it in the system considering different supplies. Therefore, TSOs can deliver gas which quality is a derivative of actual flows and technical possibility of gas infrastructure to mingle or redirect the flows. It should be clarified that the definition of the exit range must have a probabilistic approach. 3. the impact of new sources or connections to the quality of gas in the grid can change the range of WI for each specified exit point or WI range exit area. A procedure for reassessing the range for an exit point/ WI range exit area must be developed taking into account the future supply sources changes. 4. for exit points/ WI range exit areas with high possibility of receiving WI outside the maximum range defined under "specified" class, the end-users might request for advanced provision of information regarding the WI. If this request is triggering new investments it can be considered only after performing cost-benefit analysis and only if it is to be a part of the regulatory assets base (RAB).

UK BSI Shadow Groups GSE/33 and GSE/-/05: Gas Infrastructure	yes	UK Oil and Gas Producers, a Gas Terminal owner/operator, Large Gas Generation Users and various Industrial, Commercial and Domestic users and appliance manufacturing interests, all as specified below. Yes, all the above stakeholder groups are represented in this UK response. Also, below, the UK stakeholder groups commenting here represent the manufacturing categories itemised below:- Manufacturers: boilers, radiant heaters, water	Please Note that the diverse interests along the gas supply chain require this Consultation to be answered in several parts, which are given in an extra table in this file	

		heaters, cookers, End-users: All these above types, including Industrial, Commercial, Residential and Own-Use by the TSO's for their normal operational purposes and for standby/emergency power support. For example, these operations depend upon the reliable and efficient operation of gas-turbines and engines.		
UK Response No1: OGUK (Producers - Oil and Gas UK)	yes		no reply	OGUK does not represent downstream businesses or users and, as a result, does not have a position on the various exit specifications. However, members identified a range of questions raised by the proposals as follows: • wider question around allocation of costs to users of dealing with different gas qualities and specification, • the requirements for additional measurement and metering equipment, • the impact of rates of change in the Wobbe within the exit range,

				• monitoring and enforcement of the requirements, in particular avoiding that the exit standards impact entry requirements on a de facto basis as a result of contractual arrangements at entry points.
UK Response 2: North Sea Midstream Partners Ltd, NSMP. As a gas terminal owner and operator: David O'Donnell	[NB: This response is included as part of the UK Response along the UK Gas Supply Chain and is made via BSI Stakeholder/mirror Committees BSI GSE/33 and BSI/GSE/-/05: Gas Infrastructure. Malcolm Howe Chairma		no	It is unclear how this would work in practice. Having different exit specifications to entry specifications implies that the system operators will be responsible for blending. At present there is no mechanism for this to occur. If the exit spec were to be different from entry who will take the liability if exit spec is not met? Who would carry the costs of blending (for example, N2 to blend rich gas or propane to blend leaner gas)? How will exit points close to inlet points be served? In such instances, in order to meet a tighter exit specification a system operator could impose an entry specification limit that is tighter than that currently set which could leave some shippers in a worse position than they are today.

	n GSE/33 and GSE/-/05: Gas Infrastructure]			
UK Response 3: GB National Grid: Gas, which is the GB TSO and makes gas available for offtake at Moffat from the UK to Dublin (2), Isle of Man and Northern Ireland (1). National Grid Gas also operates the Bacton Terminal into which both the BBL and	This reply is by National Grid Gas, which is the GB TSO and Bacton Terminal Operator etc. NGG is part of the GB Response to the Consultation via the GB BSI Stakeholder Groups BSI GSE 33 and GSE/-		no	NO. National Grid does not support the WI exit classification proposal as it currently stands because we have a number of concerns about its validity and viability. In addition, there are areas where further clarity is needed. We recognise the challenge that CEN has tried to address; namely a wide Wobbe Index (WI) range being desirable at EU entry points for security of supply and for facilitating delivery both of rich gases such as LNG as well as leaner gases such as biomethane and hydrogen blends, whilst some end users of gas that are sensitive to variation wish to maintain a stable gas quality at the point of use. We consider that the de-coupling of entry and exit specifications as proposed via the exit point classification approach is a possible concept that could be used to resolve this challenge but there are a number of issues to address before it could be implemented. As a TSO, we are obliged to accept gas that is tendered for delivery at each GB system entry point in accordance with the legal specification for WI that currently applies. We understand that the classification concept is for each TSO and DSO to make a prediction of the WI range that each of its exit points for end use is expected to offtake. (We assume that this would not extend to domestic offtakes although this is not specifically stated). Where the TSO/DSO determines that the range is expected to be within 3.7 MJ/m3 up to a 99th percentile, the offtake would be classified as ‘specified’ and otherwise would be classed as ‘extended’. We further understand that this 3.7MJ/m3 range would have upper and lower limits that would be specific to each exit point and that (although not stated in the Annexes) it has been suggested that TSOs/DSOs be required to provide information to exit points in advance where a 3.7 MJ/m3 range is expected to be exceeded.

Interconnector UK pipelines are connected. National Grid Gas. Philip Hobbins	/05: Gas Infrastructure. Malcolm Howe Chairman BSI GSE/33 and GSE/-/05.			There are a number of practical challenges that we would face to produce such a classification. Whilst historical WI data at entry and exit points may serve to inform the assessment, we would also need access to information about the future WI of gases that upstream parties plan to deliver and a means by which the resulting blend of WI could be modelled through the transmission system. At present, we have neither of these. Also, we are not in control of the quantities of gas that are delivered at each GB entry point, nor the pattern of demand across the network, which changes from day to day, and even within a gas day which affect the WI that individual exit points receive. The GB network has a high level of supply diversity with network entry points in the north, east and west that deliver gas at both the higher and lower end of the allowable WI range. The volumes delivered at these points vary; as an example, LNG importation terminals have the capability to deliver significant quantities of gas to our network but whether they do so is subject to a global market. When LNG is not flowing, demand has to be met from other sources of supply with a different WI which would have an impact on the WI of gas that many GB exit points would receive. Variations in demand patterns also mean that the majority of GB exit points could receive a commingled WI from more than one entry point on any particular day, making a WI range prediction difficult to achieve. Operational incidents that periodically occur such as compressor trips, pipe breaks or supply failures that necessitate gas flows to be re-routed would also compromise such an assessment. Confidence levels in a prediction of WI at exit points are likely to be higher where they are located close to entry points, yet even at entry points we experience WI variations due to the prevailing inputs from different fields and which fields may be subject to planned or unplanned outages. It is not clear how the impact of new connections would be managed, which could alter flow patterns in an area of the network. This could lead to a situation where an exit point designs its plant based on the classification it receives from a TSO/DSO which subsequently becomes inappropriate due to changed flow patterns and quality that arise due to a new exit point / storage point / entry point connecting in its vicinity. If end users that are

				sensitive to WI variation suffer commercial loss as a result, we are concerned that they may seek to recover this by holding the TSO/DSO liable, although we appreciate that the probabilistic approach recognises that a guarantee of whether the WI will be within the 3.7 MJ/m3 range for 'specified' exit points cannot be provided. If gas is made available for offtake outside of a 3.7 MJ/m3 range, we understand that a TSO/DSO may be required to provide advance notice on the day of how the WI may change. At present, we do not have the capability to make such an assessment. If we did, it would be a best view that carried a risk of error. In this scenario, if the TSO/DSO's prediction of WI change did not occur, an exit point may have taken mitigation measures (including ceasing to offtake gas) that were unnecessary, or, alternatively, if the WI of gas offtaken were to change which the TSO had not foreseen or communicated then the exit point may have continued to offtake gas when they would otherwise have not done so or taken mitigating action. Assuming it were feasible to model WI in order to generate a classification of exit points, National Grid would incur additional systems, process and resource costs to do so. If additional information were required to be provided, new tools would also be required; either additional chromatographs to be installed upstream of offtake points or a real-time capability to track WI through the network. We are concerned that the funding for this would generate a cross-subsidy whereby all consumers would be funding these investments for the benefit of a section of large-scale industrial consumers that are sensitive to WI variation. We have also not seen any evidence that the proposed classification solution is more economic than the exit points that are sensitive to WI change making changes at their sites to address the impacts they experience due to variation in WI. We therefore suggest that a cost/benefit analysis should be completed to demonstrate whether this is the right solution for the benefit of consumers overall. We also note that the proposal does not specify what the triggers for reassessment of the classifications would be or otherwise with what frequency TSOs / DSOs would be required

				to make such reassessments.
UK Response 4: Large Gas Generation Users (CCGTs), *Energy UK. Ms Julie Cox*	Replying as part of the BSI GSE/33 and BSI GSE/-/05 Gas Infrastructure Response		no	The proposed classes are not consistent with the previous definitions of classes A to C defined in CEN SFGas GQS TF1 N 120: Draft reflection paper for the further development of the Integrated Scenario/classification approach provided by AhG, 2019-07- 9 and presented at the Madrid Forum, June 2019. These definitions covered the possible situations well. The two proposed classes are not materially different as they both require that the WI be within the overall entry range and be specified. The only difference is whether the range is greater or less than 3.7 MJ/m3. Neither class allows for fuels outside the EU-wide entry range that may be required to accommodate local gas production. We do not believe that this provides a workable classification system.
UK Response 5: Utilisation, which represents various Trade Associations, i.e. 5 Heating and Hot Water Industry Council, HHIC. Neil Macdonald	This Part 5 response from HHIC is part of the UK response along the UK Gas Supply Chain, via Gas Industry Stakeholders represented in BSI		Yes, if	Again, of paramount importance here is the individual member states national gas quality specification, as governed by schedule 3 of GS(M)R in the UK. Gas qualities differ and gas appliances are designed to be safe for that particular gas quality. This is why member states must declare information about gas quality under the Gas Appliances Regulation (GAR) obligations (for examples gas pressure and Wobbe Index). This relates to achieving the essential safety requirements in the annex to the GAR. As regards gas quality in the UK currently, careful step by step consultations on various potential changes are being progressed, a process which must be maintained to ascertain the tolerability, or otherwise, of gas appliances to changes in the UK specification. This work encompasses H2NG blending (HyDeploy), raising the normal upper limit of the UK WI (SGN's "Opening up the Gas Market"), and now new work by DNVGL on potentially lowering the normal lower limit of the permissible UK WI. This is not an exhaustive list, and it is feasible several of these changes could occur in combination in future. Such projects show the concerns in the UK on "broad brush" changes to regulations without full consideration on the appliances that utilise the gas supplied, and the health and safety

	GSE/33 and GSE/-/05: Gas Infrastructure. Malcolm Howe, Chairman of these committees.			of the installers and end users. This careful approach in the UK, we believe, supports our above statements and the topics from these studies have already shown limits to what is possible, and in the final distribution quality needing to be maintained. For example, the Oban study ("Opening up the Gas Market") concluded a narrower increase in WI than originally proposed was appropriate for safety, and this was itself a narrower band than proposed by EASEE gas. It may not be until relevant projects have concluded, and we have a holistic view of future gas quality potential in the UK, that we can more fully address some of these questions. It is pleasing to see greater cognisance given to the repercussions of any accompanying regulatory framework at EU level, but as with earlier comments to ENTSOG proposals (to link EN 16726 to the INT-NC and so make legally binding), this should be totally transparent first, as it will influence the technical agreements which may or may not be reached, through standardisation (i.e. EN 16726) within CEN on these matters. A 3.7 MJ/M3 range for regular "class" may not in itself pose a concern, as the current UK "normal" range is 4.2 MJ/M3, but it would need to fall specifically within the accepted UK WI range, for the reasons given. Wider class ranges would need to be similarly agreed within the UK regulatory framework, e.g. the current 4.2 MJ/M3 range would likely be acceptable, but with the bespoke UK values applied for lower and upper WI limits.
UK Response 6: The Industrial and Commercial Energy Association, ICOM, Ross Anderson,	Yes, via *BSI GSE/33 and GSE/-/05: Gas Infrastructure*: Chairman		Yes, if	The current range of WI detailed in the UK GS(M)R is 4.21 MJ/m3 and therefore the 3.7 MJ/m3 proposed as the exit WI would be acceptable to the UK manufacturers providing that it is within the 47.20 to 51.46 MJ/m3 range as detailed in schedule 3 of the GS(M)R. In the table below, "Exit 1" would be acceptable under current UK legislation. There is no evidence as to whether WI ranges outside the current UK GSMR would be safe and not affect the life of the appliances and therefore at this time, we could not accept any of the other "Exit" specifications.

and the Energy and Utilities Alliance, EUA. Peter Day. (ICOM Energy Association represents the commercial /industrial heating equipment manufacturers.)	Malcolm Howe			
UK Response 7: Cadent (DSO) Cadent falls in the UK Gas Supply Chain between the National Grid Gas, as the GB TSO, 3, then Cadent a DSO and the	Yes, via *BSI GSE/33 and GSE/-/05: Gas Infrastructure*: Chairman Malcolm Howe		no	It is recognised that the proposed bandwidth does encompass the variation of gas quality at many exit (and entry) points at the current time, as confirmed by the studies undertaken by SFGas and ENTSOG. If the aim is to establish limits for the future then this is restrictive and the bandwidth could be larger. Current studies in the UK are focusing on extending the flexibility of the gas networks by enabling a wider range of gas types and qualities. The proposed gas quality bandwidth of 3.7 MJ/m3. Is already narrower than the current UK range of 4.2 MJ/m3. The aim in the UK is to widen the range and also enable hydrogen to be admitted. NB. The EN 437 composition for G23 mentioned in Conclusion 22/2019 is incorrect.

Large Scale Generators, at 4.				
SE (SIS)	Yes	TSO's, DSO's, suppliers, end users (industrial, power generation, renewable production)	Yes* (see RoC)	
Individual replies:				
Assotermica […]	yes		Yes, if	Class (specified) with a Range of 3,7MJ/m³ would fit if there were a set point for an appropriate setting. E.g. +1MJ/m³ and -2,7MJ/m³. Only a plus or minus in one direction does not fit. Class (extended) should be limited. 3,7MJ/m³ plus xMJ/m³ should be limited to + xy MJ/m³ and -xy MJ/m³
FNBgas	yes		yes, if	We as FNBgas know that it is an enormous challenge for CEN to come up with an acceptable solution for an EU-wide Wobbe Index range at EU entry points. We are aware that the proposed solution with an EU wide Wobbe Index range in combination with a classification system at exit points is a compromise to meet all requirements such as security of supply, diversification and decarbonisation of gas supply in combination with a safe and efficient end use. We consider that the de-coupling of entry and exit specifications as proposed via the exit point classification approach is a could be a useful concept to resolve this challenge. Therefore, we support the chosen path. However, there are some major issues that need to be addressed in this context. However, as a TSO we cannot guarantee a Wobbe Index exit range smaller than the allowed entry range at any point in the network. Furthermore, the gas flow and gas quality in the Transport System is heavily influenced by nominations from shippers/transport customers and different gas sources.

				Therefore, we support this classification scheme if • a clear regulatory and legal framework in this context will be developed before or minimum in parallel to the revision of the gas quality standard. This regulatory and legal framework must give clear provisions in minimum for definition of points (entry, exit), definition of roles, responsibility and liability, definition of cost carrying and reimbursement, non-discrimination behaviour for all networks and system operators EU-wide. • Smart solutions to mitigate Wobbe Index related issues are preferred in contrast to major investments into the network (such as conditioning facilities at interconnection points or additional pipelines for blending purposes). • there are no penalties or disadvantages towards a TSO for assigning the extended class since the appropriate class for a certain exit point or area is usually not in the TSO's control. • any investment costs for TSOs (such as additional PGCs, steering regulators, conditioning facilities, valves, etc.) are considered part of the regulatory asset base and any additional operational costs are covered by regulation. • TSOs are only obligated to provide predictions of future gas quality without being legally bound to provide the predicted gas quality. • there are no legally binding rules concerning rate of change since this can generally not be sufficiently controlled by TSOs (as described in conclusion 25/2019). It's not given, that the proposed numerical solution for the class "specified" is the most economic and efficient one. Opening too many Extended class procedures and too frequent changes of classification may lead to additional cost for the involved parties. Therefore, FNBGas advises CEN stakeholders to further elaborate on reasoning of the chosen values of bandwidth (3.7 MJ/m3) and percentiles (1-99%).
Glendimplex (Faber)	no		no	WI exit range classification for EN 16726 is ok but as gas fireplace manufactures we are missing the max allowed PE value for the distributed gas. The max PE value is also missing in the EN 16726. A value over 10% PE will cause high soot deposit in gas fire places. For most gases PE= 0.5*(CH2H6)+1*(C3H8)+1.5*(C4H10) + 2*(C5H12) + 2.5*C6H14)

Swedish Gas Association			yes	

C.3.3 Third question related to rate of change of Wobbe index

Table C.3 — Replies on the rate of change of Wobbe index

NOTE Only one descriptive reply is given on this question, therefore, only this is copied into this document.

SE (SIS)	Yes	TSO's, DSO's, suppliers, end users (industrial, power generation, renewable production)	*Even if Rate of Change (RoC) is taken out of the equation at the moment and not part of this consultation we would still like to comment on this particular topic. Though we agree that RoC-criterias are difficult to achieve with the measurement resolution (granularity/frequency) available today this should not restrain the natural gas industry from trying to assist industrial customers sensitive to plug flows.

C.4 SFGas GQS TF 1 Conclusions related to Wobbe index proposal (2019-10-30)

Number	Subject	Conclusion
20/2019	CEN competency regarding definition of WI aspects	Framework issues raised during discussions will be collected in a dedicated list and forwarded to EC together with the result of the SFGas GQS process results and with the recommendation to launch the required process.
21/2019	EU wide WI entry range – Definition	Use of the definition already given in EN 16726:2015:
		*"**entry point:** a point at which gas enters a gas distribution or gas transmission system"* [EN 16726, 3.2]
22/2019	EU wide WI entry range – Need and WI range limit values	An indication of WI limit values for the EU wide entry range in EN 16726 is requested.
		The WI range limits 46,44 MJ/m^3 to 54,00 MJ/m^3 (EASEE-gas CBP) are to be put in the consultation initiated by Conclusion 26/2019.
23/2019	EU wide WI entry range – WI set point of appliances and safety range	The fact that the whole safety range shifts with a shift of the set point is taken note of. Whilst the related responsibility/liability issue is not subject to the CEN process, technical standardisation work on adjustment of WI set points and on related requirements for installers could be initiated in a CEN Technical Committee which covers the corresponding scope.

24/2019	WI exit range– Definitions	• **exit area:** geographical area connected to the same grid in which all exit points receive the same gas quality.
		• **exit point:** point at which gas leaves the distribution or gas transmission system for end use.
		• **WI range exit area:** geographical area connected to the same grid in which all exit points receive the gas with the same WI range.
		These definitions will be forwarded to CEN/TC 234 as part of the final SFGas GQS process results/report for consideration in the revision of EN 16726:2015.
25/2019	Classification of WI exit – Proposal as basis of consultation	Referring to the proposal of a Class A with (pre)defined WI range values as described in SFGas GQS TF1 N 120rev, considering the presentation by JRC (SFGas GQS TF1 N 141) providing a sensitivity analysis of the classification as SFGas GQS TF1 N 120rev based on all Survey 2 data sets, SFGas GQS TF1/CAG concludes to delete Class A from the classification system, as there is no agreement on a class with (pre)defined WI range values possible.
		Referring to rate of change (RoC) as an element of the classification as described in SFGas GQS TF1 N 120rev, SFGas GQS TF1/CAG concludes that the rate of change cannot be part of the classification system, yet, as it can technically not be granted. (RoC cannot be measured with the needed granularity; thus, the occurrence of plug flow would not be detected with the possible measurement frequency.)

However, SFGas GQS TF1/CAG acknowledges that plug flow may be detrimental for specific end-use applications (e.g. engines, chemical feedstock) even in case of feedback control systems and shall be avoided at an utmost. Therefore, SFGas GQS TF1/CAG recommends to integrate an informal explanative annex into EN 16726. A draft could be provided with the final SFGas GQS results/report.

Reflecting the two aspects above, SFGas GQS TF1/CAG agrees on the following classification of WI at exit points/areas. This will be subject to the intended consultation (see Conclusion 26/2019):

Classes	**WI range**	**Bandwidth**	**Percentiles**	**RoC**
Class (specified)	With indication of WI limits defined per exit point, based on the distributed gas, within WI entry.	Below or equal to 3,7 MJ/m^3	1 to 99	**RoC is not part of the classification system, yet.**
		with specifying the actual bandwidth.		However, reference to Survey 2 report (page)
Class (extended)	With indication of WI limits defined per exit point, based on the distributed gas, within WI entry.	Above 3,7 MJ/m^3	1 to 99	(aim: avoidance plug flow; plug flow might be dealt with in informative, explanative annex)
If deviating bandwidth.		with specifying the actual bandwidth.		

<table>
<tr><td rowspan="3"></td><td rowspan="3"></td><td>Case by case assessment (rules to be specified in legal process).</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Procedures are to be provided to specify classes (incl. at least switch to other class, time scales, liabilities and responsibilities) in a parallel process on legal framework with European and national authorities.</td></tr>
<tr><td colspan="5">As side information, JRC identifies a bandwidth that covers 98% of gases based on survey 2. The analysis gives an idea what the extended WI bandwidth could be.</td></tr>
<tr><td rowspan="9">26/2019</td><td rowspan="9">Informative consultation on current proposal of integration of WI aspects at stakeholder/national mirror committee level</td><td colspan="5">Organize an informative consultation on the current proposal on integration of WI aspects in EN 16726 at stakeholder and national mirror committee level. The aim is to share the current status of work with a broader group and to get feedback on the general acceptance.</td></tr>
<tr><td colspan="5">Subjects to consultation:</td></tr>
<tr><td colspan="5">— WI limit values for EU wide WI entry range (Conclusion 21+22/2019)</td></tr>
<tr><td colspan="5">— Classification of WI exit (Conclusion 24+25/2019)</td></tr>
<tr><td colspan="5">Timeline:</td></tr>
<tr><td colspan="5">— launch: as soon as possible;</td></tr>
<tr><td colspan="5">— deadline for reply: 11 December 2019.</td></tr>
<tr><td colspan="5">The outcome will be subject to discussion at the next meeting on 18 December 2019.</td></tr>
</table>

		Aim is to present a result of the SFGas GQS process to EC DG Energy after the next meeting, taking into account the expectation of DG Energy to receive a final WI proposal by end of 2019, expressed by Klaus-Dieter Borchardt at the 33rd MF and as announced by SFGas GQS at the 32nd MF.

Annex D
(informative)

Involvement of national mirror committees and European sector associations

D.1 CEN and CENELEC Members (NSBs and NCs),

AFNOR (F), ASI (A), BSI (UK), DIN (GE), DS (DK), NBN (B), NEN (NL), NSAI (IRL), NQIS ELOT (GR), MSZT (HU), PKN (PL), SIS (S), SIST (SLO), UNI (I), UNE (E)

D.2 European organizations/associations

— afecor

— CECOF

— C.E.F.A.C.D.

— CEFIC

— COGEN Europe

— EASEE-gas

— EBA

— EHI

— ELVHIS

— ENTSOG

— EUGINE

— EURO-AIR

— Euromot

— EUTurbines

— FARECOGAZ

— GIE

— IFIEC

— IOGP

— Marcogaz

— NGVA Europe

D.3 European Commission and EU agencies

EC DG JRC is participating actively in the project, carrying out data surveys and analysis and supporting the reporting towards DG Energy.

With EC DG Energy continous exchange is given, including reporting to the Madrid Forum

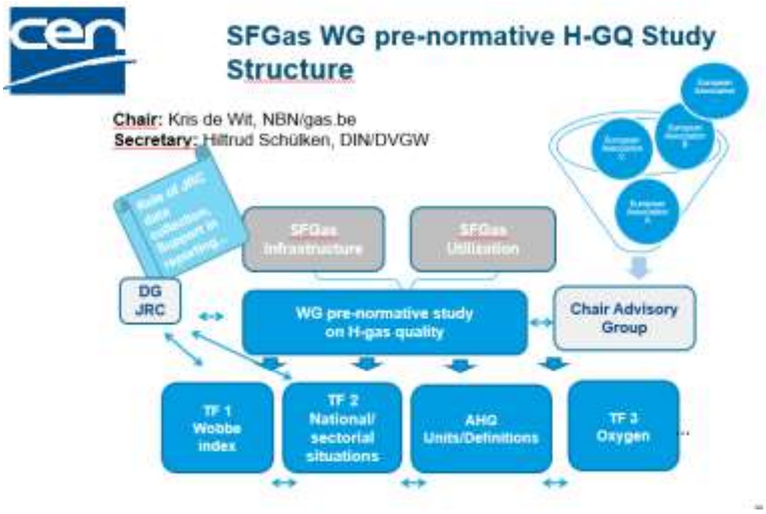


Figure D.1 — CEN SFGas WG pre-normative study on H-gas parameter (short: SFGas GQS)