Future Billing Methodology

Unlocking a low carbon gas future

National Grid Gas Distribution Ltd

Our vision

Unlocking a low carbon gas future

Executive summary

Great Britain (GB) is committed to an 80% reduction in emissions on 1990 levels by 2050, and the de-carbonisation of GB's heat sector has proved the most difficult area to tackle so far. Gas is used to fuel most of the space and water heating for around 23 million domestic and commercial premises. Approximately 83% of homes have gas central heating.

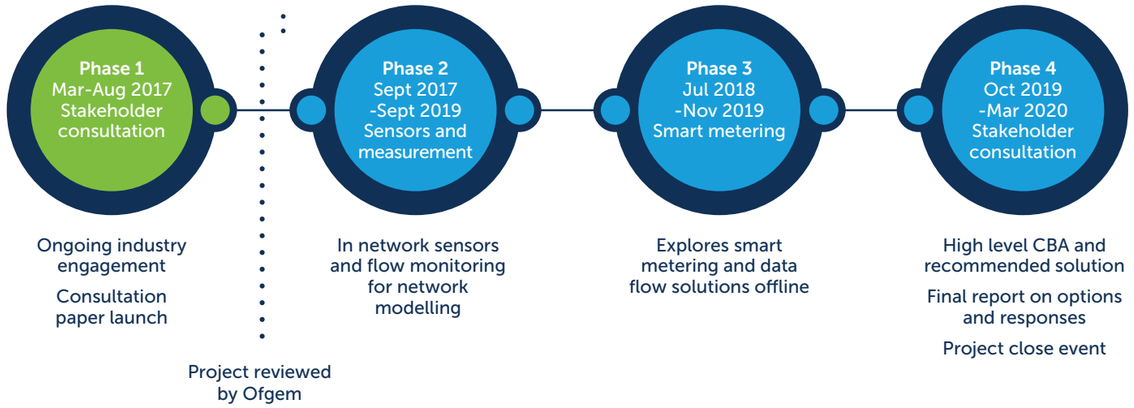
The Future Billing Methodology Project is a "proof-of-concept" exercise which could provide the key to unlock the de-carbonisation of heat using existing gas grids. For consumers, this would mean a low carbon future without the need for a lot of additional investment.

The existing gas transportation billing regime for GB's gas networks is designed around fossil-based North Sea Gas. However, the gas market is evolving, with more reliance on imported fossil-based LNG and relatively small but growing renewable supplies of biomethane. Transporting more biomethane and other renewable and lower-carbon gases such as hydrogen blend through our networks could help de-carbonise heat. However, there's a problem...

North Sea Gas is a fairly homogeneous gas source, and the billing framework therefore has a narrow range for the energy content (calorific value or CV) of gas in each Local Distribution Zone (LDZ). Any out-of-range gases require "pre-processing" prior to entry to the gas network. This means lower-CV gases like biomethane must be "enriched" by adding high carbon, fossil-based propane, which effectively undoes any "green" benefit from this renewable gas source. So today's framework is a barrier to de-carbonising heat.

The Future Billing Methodology Project seeks to explore options for a future billing regime. It will be looking specifically at how CV zones could be created, to enable distribution of a wider range of alternative and low carbon gases without the need for costly pre-processing. This would unlock the potential to de-carbonise heat using existing gas networks. The project will explore two options under which existing gas network planning tools could be used to create CV zones. It will include a field trial within two gas networks to help validate CV zone modelling, and will also trial the transmission of CV data to smart meters.

Project timeline



We need your views

Before we undertake this project, we really need to hear the views of stakeholders. We want to understand the industry's views on the need for changes to the billing framework that would move towards decarbonising heat in GB, and our proposed approach.

How to respond to this consultation

Please use the separate Word document template to respond to this consultation and return your response by e-mail to david.chalmers2@nationalgrid.com and louisa.broad@nationalgrid.com

Deadline for responses:
Friday 14th April 2017

Introduction

National Grid Gas Distribution Limited (NGGDL) is the licensed owner and operator of four of the eight gas distribution networks in Great Britain (GB): East of England, London, North West and West Midlands. Gas is transported, on behalf of Shippers and Suppliers, from the gas National Transmission System (NTS) and on-shore gas production facilities to approximately eleven million meter points comprising homes, schools, hospitals, industrial and commercial premises.

As a gas transporter, our primary duties under the Gas Act (1996) are to develop and maintain an economical and efficient gas transportation system and, subject to this, respond to reasonable requests for connection to our pipeline system. Under the charging terms of our licence, we must also take account of changes to the gas transportation business.

The GB gas industry has evolved rapidly over the last decade. New and varied sources of GS(M)R[1] compliant gas require "pre-processing" prior to entering the gas supply network because of the billing framework currently operated by the industry.

For the Future Billing Methodology project, NGGDL is partnering with our technical consultants, DNV GL. The project seeks to provide a "proof-of-concept" for a future billing methodology that could enable GB's gas distribution networks to deliver an economical, sustainable pathway to a low-carbon heat future.

[1] The Gas Safety (Management) Regulations 1996 govern the chemical composition of gas that is conveyed to consumers through gas pipeline networks.

Why Future Billing Methodology?

Meeting GB Carbon Reduction Targets

Since the 1970s, GB has relied on fossil-based North Sea Gas, with regulations and billing regimes designed for this stable and reliable source of gas. The gas supply market is now changing rapidly with liquefied natural gas (LNG) imports making up 18% of supply in 2015. By 2030 biomethane and bio-substitute (Bio-SNG) natural gas, both from renewable waste sources, could account for 10% or more of domestic gas usage.

The de-carbonisation of GB's heat sector has proved the most difficult area to tackle so far. Gas is used to fuel most of the space and water heating for around 23 million domestic and commercial premises, and around 83% of homes have gas central heating.

We believe that GB's gas distribution networks can play a vital role in helping GB meet its 80% carbon reduction target for 2050 by promoting the distribution of GS(M)R-compliant lower-carbon gas. This includes gas from renewable sources such as agricultural and domestic waste, and hydrogen blend[2].

The Future Billing Methodology project aims to provide a "proof-of-concept" for new approaches to assigning the energy content to gas flows within GB gas distribution networks. This will enable entry of all future GS(M)R compliant gases, and so open the door to decarbonising heat within GB.

Today's billing regime isn't suited to diverse gas sources

Currently gas is measured first in volume is measured first in volume and then has its energy content assigned for billing purposes. There are legal regulations, called the Gas Calculation of Thermal Energy Regulations[3], that set out how this is done. In simple terms the energy content, or CV[4], for each Charging Area[5] is measured by regular sampling at each input point on the Local Distribution Zone (LDZ). A flow-weighted average CV (FWACV) is then calculated for that LDZ.

[2] NGGDL will be trialling the introduction of 10% hydrogen blend in a private local gas network under the HyDeploy NIC Project. Use of hydrogen on public gas networks would require modifications to regulations.

[3] The Gas (Calculation of Thermal Energy) Regulations 1996 (as amended 1997) – An extract of the relevant section of these regulations is provided in Appendix 8 of the NIC Project Submission Document.

[4] Calorific Value, measured in mega joules per cubic metre of gas (MJ/m3) at an assumed standard temperature and pressure.

[5] GDNs currently deem the LDZ to be the Charging Area, although the regulations do not define this.

The regulations exist in order that consumers are charged in a consistent and fair way. They contain a capping mechanism, the LDZ FWACV Cap[6], which effectively limits the allowed variation in CV across the LDZ for billing purposes. If the LDZ FWACV cap is triggered by the presence of low-CV gas, the gas energy excluded from billing creates a transfer cost to the NTS shrinkage account, and a consequent misallocation of energy costs across users of the GB gas transportation system.

In order to avoid triggering the LDZ FWACV cap, low CV gases such as biomethane must have their CV increased before injection to the LDZ network. This is done by adding propane, a high-carbon fossil-based gas, to the biomethane upstream of the LDZ system entry point. This process is known as "enrichment". At the other end of the scale, high CV gases, such as certain sources of LNG have nitrogen gas added in order to decrease the CV and bring it within GS(M)R tolerances, referred to as "ballasting". This gas pre-processing in order to avoid incurring the CV cap, represents a significant additional cost.

[6] The regulations cap the FWACV at 1 MJ/m3 above the lowest CV source in the LDZ.
[7] See Appendix 12 in the NIC Project document for Future Billing Methodology

Barrier to change and decarbonising heat

However, the enrichment of low CV gas creates another problem, as the combustion of propane produces 20% more carbon dioxide (CO2) output than for natural gas (predominantly methane)[7]. As a result, the application of the existing FWACV regime at LDZ level actually negates the environmental benefit from biomethane supplies. This undermines the benefit of using gas from renewable sources and is counter to GB's de-carbonisation objective.

Similarly, under the current FWACV arrangement, any other types of low CV renewable gases such as BioSNG, or alternative gases, such as hydrogen-blend, etc. would require propane enrichment prior to injection to the distribution system. It is therefore clear that the existing regime is unsustainable into the future, as it effectively "locks out" the benefits of lower carbon gases from the gas grid.

For higher CV gases, such as LNG, separate developments through SGN's "Opening up the Gas Market" NIC project in Oban may well lead to revisions to GS(M)R. This may remove the need for nitrogen ballasting for gas quality purposes. However, the FWACV arrangement would be likely to retain the need for ballasting in order to maintain LDZ input CVs within the narrow tolerance required to avoid CV capping. A more specific CV attribution regime could release the full thermal benefit of LNG, where practicable.

Our thinking on change

Attributing gas energy in a more specific way

If the industry is to realise the true benefits of all GS(M)R-compliant gases, including those from renewable sources, it needs ultimately to remove the need for gas pre-processing such as enrichment and ballasting (where the latter is practicable).

The Future Billing Methodology Project seeks to achieve this by exploring ways gas energy can be attributed to gas flows in the LDZ network at a more specific level. However, we believe the journey to accepting all GS(M)R compliant gases will require a phased development. The first phase of which will focus on gas from embedded[8] input points within the LDZ network, such as biomethane.

For gas from an embedded source, the key requirement is to identify the zone of influence exerted by that input point within the LDZ pipeline network (i.e. which pipes carry that gas and how far it reaches) and how this zone changes under differing system conditions, e.g. diurnal and seasonal changes in demand.

[8] Embedded input points are those where gas is injected to the LDZ pipeline network other than from the Gas National Transmission System (NTS).

Using Gas Distribution Network Planning Models

The GDNs' existing network planning models use data on gas pressures at input points and governors located across the pipeline network; together with pipe diameters and other asset data to model the flow of gas throughout each LDZ network under a large range of system conditions across the year.

These network planning models have been in place for many years, are subject to audit and are proven to be reliable. We believe these models provide a sound basis for identifying the charging areas for a more specific billing CV attribution methodology, but it will be essential to validate the use of models for billing purposes using a field measurement exercise.

Measurement and validation – field trials

Phase 2 of the Future Billing Methodology project focuses on embedded gas supplies. It seeks to track the penetration of biomethane across the LDZ network, using a combination of oxygen, pressure and gas flow sensors. These will be located at strategically placed points across the LDZ network, around two carefully selected biomethane entry sites, as follows:

a) Hibaldstow (MP[9] connection in East Midlands LDZ) – sensors located across interconnected medium pressure and low pressure networks

b) Chittering (MP connection in East Anglia LDZ) – sensors located across a low pressure network which this site feeds into

The use of oxygen as a means of tracing biomethane is essential, for the following reasons:

- Tracing by CV difference would be impractical. This is because any biomethane in the network is already propane-enriched and so the difference in CV between this and natural gas from NTS sources will be minimal;
- Propane enrichment cannot be temporarily suspended for the purpose of this exercise. Any suspension of propanation would automatically trigger CV capping and would create significant impacts on customer billing and transfer excluded gas energy costs into the NTS shrinkage account;
- The oxygen content of biomethane is normally significantly higher than for NTS-sourced natural gas. This means that biomethane should be clearly detectable even when propane-enriched. (Please refer to Appendix 7 of the project submission document for further information.)

The field trial measurement phase will last for twelve months, to provide an annual profile of the zone of influence of the specific embedded gas source. Further analysis and application of the field trial data within network modelling tools, off-line, will produce a time-based probability for the extent of the zone of influence for the example biomethane entry point. It is envisaged that a charging area boundary can be derived for attribution of the CV measured at that embedded biomethane entry point.

Findings from the project will be shared with the industry. *(Further detail on the above field trials is provided in Section 2 and Appendices 2 and 6 of the Future Billing Methodology Submission Document.)*

A further aim of this exercise is to produce a scalable, replicable set of procedures which GDNs can apply to determine CV zones of influence for LDZ-embedded gas supplies such as biomethane.

[9] Medium Pressure, i.e. operating at or above 2.0 Bar (gauge).

Exploring three approaches to change

In addition to the essential measurement and validation phase, we will look to find a way of defining the CV zones of influence using data that can be linked to customers' Meter Point data in the billing system operated by Xoserve (and onwards into Shipper/Supplier invoices). The Future Billing Methodology Project seeks to do this using three approaches. These could also be thought of as three evolutionary steps to a future smart-metered GB gas grid.

The first two approaches focus on sub-dividing each LDZ into CV zones. The third explores the direct application of CV data to individual smart meters, using an off-line grid simulation laboratory operated by our Project partners, DNV GL. The three approaches are referred to as Pragmatic, Composite and Ideal, and are described at high level as follows:

Pragmatic – This approach would look to identify isolate the zone or zones of influence from any embedded gas inputs to the LDZ from the rest of the LDZ network. Meter Points located in each embedded gas supply zone would be attributed the CV of the relevant embedded entry point. Meter points in the remainder of that LDZ would have their gas CV attributed using a FWACV calculation excluding the embedded entry point(s) CV and volume.

For example, in an LDZ with one embedded biomethane input point and four NTS input points, there would be two Charging Areas under the Gas (Calculation of Thermal Energy) Regulations: one for the biomethane zone and another for the remainder of the LDZ.

Composite – Under this approach, the LDZ would be sub-divided into CV zones for each input point. Using the above LDZ as an example, this approach would create a total of five Charging Areas, each with their own input-specific CV. This option also envisages additional CV measurement within the LDZ network.

Development of the Pragmatic and Composite approaches sits alongside the Field Trials within Phase 2 of the Future Billing Methodology Project.

Ideal (Smart Metering) – This approach, which comprises Phase 3 of the Future Billing Methodology project, will use the data generated in the field measurement exercise in Phase 2, to transmit live CVs to smart meters in simulated network locations using a stand-alone smart-meter simulation facility. This will help develop an understanding of the data hierarchy that will be required in a wholly smart-metered future. This could provide an evolutionary precursor to actual energy measurement at the smart meter itself. *(Further detail on this approach is provided in Section 2 and Appendices 3 and 9 of the the project submission document.)*

Considering other changes and timing

Changing Xoserve's shipper billing system

The delineation of new charging areas (based on CV zones) within each LDZ must be firmly linked to customers' Meter Point data in a way that can drive the daily energy attribution and Meter Point reconciliation processes. Throughout the project, there will be on-going liaison between NGGDL / DNV GL and Xoserve to investigate how this can be achieved and to inform the high-level implementation cost-benefit analysis (CBA) that is a key project output.

It is important to note here that the Future Billing Methodology project will deliver the "proof-of-concept" only, in order to inform a CBA for a potential future implementation phase. It will not provide a detailed specification for implementation, nor associated modifications to the Uniform Network Code, as these areas should be the subject of a separate industry change programme, should a recommendation for change from this project be agreed by the industry.

Future Billing Methodology changes on top of "Nexus"?

At the time of writing this paper, the billing system which Xoserve operates on behalf of gas transporters is undergoing a major update, with a new SAP-based system, termed "Nexus" being implemented in the summer of 2017. NGGDL is actively involved in this implementation and we recognise the high degree of effort and upheaval involved in this fundamental change.

We believe that the potential changes being explored by the Future Billing Methodology project represent a logical evolutionary step in the journey to a low carbon energy future. If implemented, we believe these changes would bring significant benefits in terms of cost savings and reduction in environmental impact from the removal of propane, together with the wider economic benefits described below.

Timing of potential implementation

As a "proof-of-concept", this project excludes implementation of the changes being explored. This project is expected to conclude at the end of March 2020 and there would need to be a separate industry project to create a detailed specification for system changes and corresponding changes to the Uniform Network Code (UNC) and other relevant industry procedures. The envisaged changes would probably take effect early in the new decade, by which time the Nexus billing system will be well established.

Considering the big picture for energy users

Benefits of a Future Billing Methodology

NGGDL's project submission contains a high-level projection of future cost savings from the removal of propane to 2050. This indicates net present value (NPV) savings in the region of £170 – £300m, depending on uptake of lower-carbon gases, with an equivalent indicative saving of 1 – 2 million tonnes of CO2.[10] However, we believe that using GB gas networks as a significant element in the heat decarbonisation route to 2050 would bring much wider savings to energy consumers in terms of total energy bills, compared to alternative approaches.

A number of recent reports produced within the energy industry indicate that the costs of electrifying heat would be extremely high[11], as doing so would require significant additional generation plant, together with developments in electricity storage to meet demand peaks, and full-scale upgrades to the current electricity transmission and distribution infrastructure.

In addition, high-efficiency electric heating systems such as air source and ground source heat pumps are expensive and would mean significant cost outlay for customers, particularly the 83% who use gas for space and water heating today.

A range of alternative heat scenarios, including diversified energy sources such as local heat networks and consumer-based generation either require significant public intervention, planning and funding, or require very high initial customer investment in appliances that may still not support peak dual energy requirements. Whilst further technological improvements will arise, their initial cost can also be expected to be high.

Compared to the above, a low-carbon gas-based solution could continue to meet the bulk of future heat requirements to 2050 at a much lower incremental cost to the consumer, for the following reasons:

- It would use existing gas distribution infrastructure in which gas customers have already invested significantly over many decades
- Customers could continue to use their existing heating systems[12] as replacing old gas boilers with high-efficiency condensing boilers would still be cheaper than switching to an electrical heating system

In a future where the GB gas market is more reliant on diverse, smaller-scale gas sources, it may be the case that GB-extracted shale gas could play a key role in maintaining security of supply.

The Future Billing Methodology project aims to provide a "proof-of-concept" for maximising the use of alternative GS(M)R compliant gases in GB gas networks and will therefore help provide the basis to deliver an economical pathway to decarbonise the heat sector towards 2050.

[10] Projected benefits relate to "Gone Green" and "Slow Progression" scenarios shown in Appendix 1 to the NIC Future Billing Methodology submission document.

[11] KPMG 2050 Energy Scenarios July 2016; "Too Hot to Handle?" How to decarbonise domestic heating – Policy Exchange 2016; Next Steps for UK Heat Policy – Committee on Climate Change (October 2016).

[12] The HyDeploy NIC project aims to prove that hydrogen blend of between 10 and 20 per cent with methane can be safely used in existing domestic gas appliances. (Note that an increase in hydrogen content will require changes to regulations; the HyDeploy project is liaising with HSE throughout).

Other considerations

Are changes to the Regulations required?

The Future Billing Methodology project specifically avoids seeking a change to the existing regulations. This is for the following reasons:

- The Gas (Calculation of Thermal Energy) Regulations defines the FWACV calculation mechanism, and that this applies to each Charging Area, but the regulations don't define where the charging area is. So this could be a whole LDZ, or a defined part of an LDZ. There would need to be a consistent set of rules under which GDNs would define Charging Areas within LDZs, but we believe these would not need to be part of the regulations themselves.

- At the point of initiating this project, our view is that the Gas (Calculation of Thermal Energy) Regulations do not require modification to enable the future billing changes envisaged under the three options being explored. However, we would welcome views from others on this.

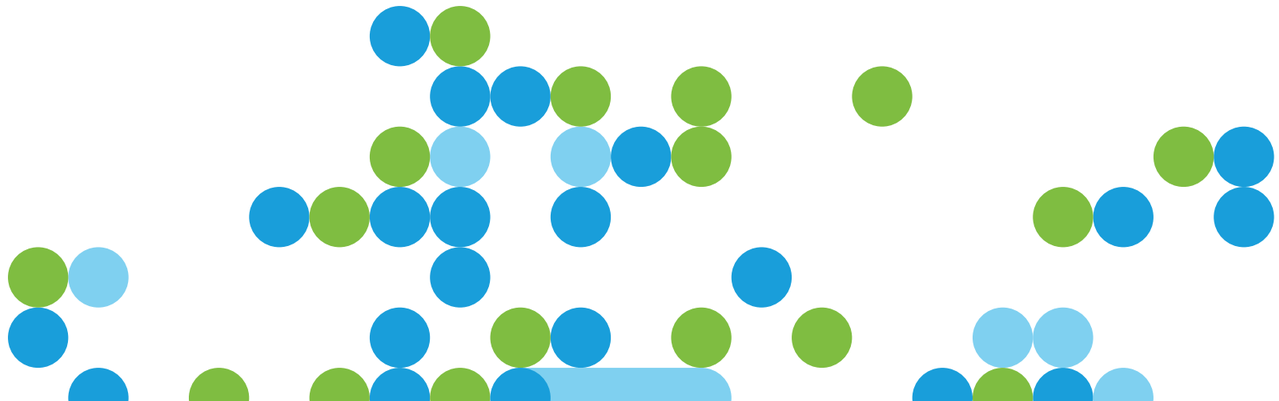
- If the Pragmatic approach is applied, customers that are deemed to be within the CV zone(s) affected by embedded gas supplies would be allocated to a separate charging area with bills based on the CV of that embedded gas source, rather than the LDZ CV. The existing FWACV mechanism would remain the most appropriate mechanism for attributing CV to customers elsewhere in the LDZ.

It should be noted that if CV measurement capabilities were to be developed within smart meters, the regulations would need to be modified to allow that functionality to be used for billing purposes.

Why is this 'innovation', not business as usual?

The installation of instrumentation such as gas and flow sensors might normally be regarded as part of a GDN's business as usual operations. However, this will be the first time that the tracking of biomethane has been undertaken using novel oxygen tracing to physically detect the presence of biomethane within a live gas network. In addition, doing this to explore a new approach to billing can clearly be considered as innovation.

Further, until the full detail can be investigated, it remains unclear how CV zones can be delineated and how these could be linked to Meter Point data in order to drive daily energy attribution and reconciliation, and so success cannot be guaranteed at this stage. However, the potential gains from success would be very significant, as described above.



Why is this being led by a Gas Distribution Network?

As a Gas Distribution Network, NGGDL is naturally concerned to establish a sustainable future for the gas distribution networks that our customers have invested in for many decades. We also believe that significant wider economic benefits would be realised by using gas grids as a key part of the transition to a low carbon energy future.

We recognise, but are neutral to, the diversity of market position across the many organisations that bring gas onto our system for distribution to customers. We also recognise the wider benefits of enabling open access to all GS(M)R-compliant gas sources.

We therefore believe we are uniquely placed to explore the potential for change and to act in customers' best interests. Although this innovation project lies outside the normal course of our transportation business, we remain bound both to comply with the relevant terms of our Licence which prohibit undue discrimination and to comply with Competition Law.

Supporting information

Supporting information on the Future Billing Methodology Project can be accessed using the links below:

Future Billing Methodology project website »

Future Billing Methodology submission document – full Ofgem submission »

Contact the project team »

Consultation questions

1. Do you agree that the existing LDZ FWACV methodology presents a barrier to a low carbon gas future and that alternative methodologies should be explored?

2. Do you agree that the Future Billing Methodology Project could provide the basis to deliver an economical and sustainable pathway to decarbonising heat for 2030 and 2050?

3. Do you agree that the proposed Measurement and Validation Field Trials could provide an understanding of the modelled zones of influence of LDZ-embedded gas entry points?

4. If your answer to Q2 and Q3 was "Disagree", what alternative or modified approach would you like to see considered?

5. What factors and impacts would you like to see considered through the Future Billing Methodology Project?

6. If implemented, how would the suggested changes to the existing LDZ FWACV billing regime benefit your company/organisation, e.g. what savings would the changes bring?

7. Do you envisage any legal or regulatory issues arising if any of the Future Billing Methodology options were to be implemented?

8. Do you have any other comments on the Future Billing Methodology Project? (e.g. issues not covered in this document)

How to respond to this consultation

Please use the separate Word template available on the project website to respond to this consultation. Return your response by e-mail to david.chalmers2@nationalgrid.com and louisa.broad@nationalgrid.com

Deadline for responses:
Friday 14th April 2017

What happens next?

Your responses will be collated and published on our Future Billing Methodology project website in May 2017. The collated responses will inform our deeper engagement with the industry as we work to prepare our Phase 1 report for submission to Ofgem for review in August 2017.

Regular updates will be provided directly to respondents and wider industry stakeholders and will be available on the project website.

Confidentiality

Responses will be anonymised where the respondent has clearly indicated that their response to a particular question(s) should be treated as confidential.

Glossary of terms and acronyms

Term	Explanation
CV	Calorific Value – Energy content of gas, measured in megajoules per cubic metre (MJ/m3) at an assumed standard temperature and pressure
GB	Great Britain – England, Scotland and Wales (Gas transportation in Northern Ireland is subject to separate licensing and regulation.)
G(CoTE)R	Gas (Calculation of Thermal Energy) Regulations 1996 (as amended 1997) – govern the way in which the thermal energy of gas is calculated for the purpose of conveyance to consumers through gas pipelines
GDN	Gas Distribution Networks – The licensed owners and operators of the eight gas distribution networks in Great Britain
GS(M)R	Gas Safety (Management) Regulations 1996 – govern (among other things) the composition of gas conveyed to consumers through gas pipelines
LDZ	Local Distribution Zone – a discrete group of gas distribution pipeline networks, fed from a specified set of NTS Exit Points in a defined geographical area.
LNG	Liquefied Natural Gas – Imports of fossil-based LNG make up an increasing proportion of GB gas supply
NPV	Net Present Value
Shipper	An organisation licensed by Ofgem for the purpose of bringing gas onto the GB gas transportation system for onward sale to customers, who may be gas consumers or gas suppliers.
Supplier	An organisation licensed by Ofgem for the purpose of selling gas to gas consumers (may also be a gas shipper).
GB	United Kingdom - England, Scotland, Wales and Northern Ireland
Xoserve	The agency used by GDNs for billing gas transportation to gas shippers.