THE MAGAZINE FOR ALL THINGS DOWNSTREAM

APRIL 2022

GU
GAS UTILISATION

- UNDERSTANDING IMPORTANT GAS CHARACTERISTICS FOR UTILISATION
- 20,000 SOCIAL HOMES TARGETED WITH £179M OF GOVERNMENT ENERGY EFFICIENCY FUNDING
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- HOMES WITH HEAT PUMPS TO 'PAY MORE FOR HEATING THAN GAS BOILER CUSTOMERS'

BUILDING UP

THE GOVERNMENT'S STRATEGY TO BUILD A GREENER FUTURE

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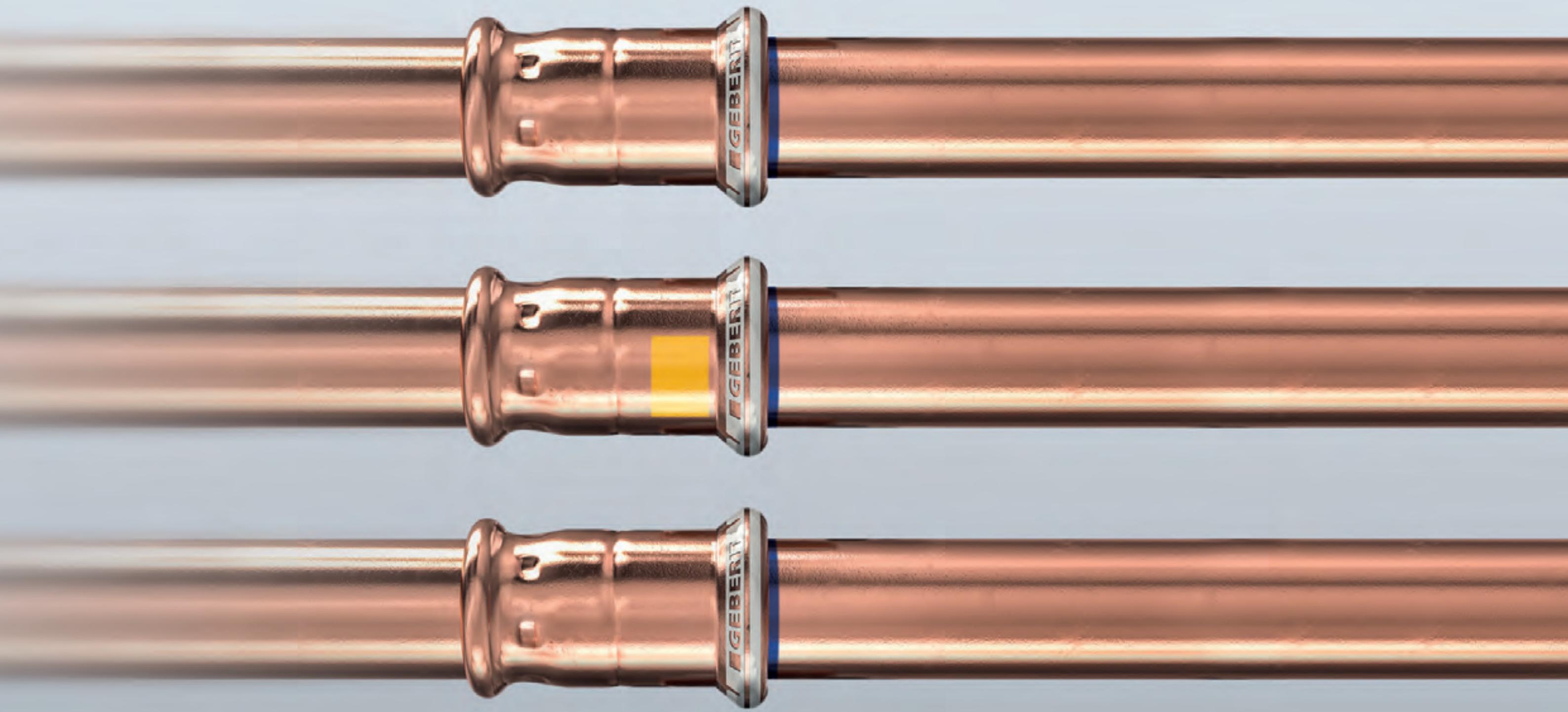

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WELCOME TO GAS UTILISATION

WITH THANKS TO OUR CONTRIBUTORS…

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Principal Gas Engineer at Health & Safety Executive

Steve Critchlow is a Fellow member of IGEM, having joined the institution as an EngTech in 2010. He is a Gas Safe-registered engineer and works for the Health and Safety Executive's Science Division. Having worked for HSE for more than 20 years, Steve now covers the whole of the UK, investigating gas explosions, carbon monoxide incidents and making assessments of poor engineering concerning gas, oil, solid fuel and biomass installations.

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RODNEY HANCOX
Director, Gas Distribution Solutions Ltd and IGEM/G/5 Panel Chairman

Rodney Hancox joined the Eastern Gas Board in 1970, where he held numerous positions after graduating with a CNAA degree in Mathematics for Business from Enfield College of Technology. In 1991, he took on the role of Senior Training Advisor (Engineering) at British Gas Regional Services.

Following the break-up of British Gas in 1996, he worked as a freelance consultant before joining Exoteric Gas Solutions Ltd (EGS) as a Senior Engineering Consultant in 1999. In 2007, he formed his own consultancy company, Gas Distribution Solutions Ltd. Rodney has also been active in IGEM panels including IGEM/G/5, IGEM/G/1, IGEM/TD/4, IGEM/GL/4, IGEM/GL/6 and IGEM/UP/2. He was Chairman of IGEM's Eastern Section in 1999/2000.

EDITOR'S LETTER

WELCOME TO THE spring edition of *Gas Utilisation* (*Gu*).

In October, the government's long-awaited Heat and Buildings Strategy was released. In this edition, we're exploring the strategy, which lays out how the government plans to reduce carbon emissions from the UK's 30 million homes and workplaces, and looking at the key findings and responses from the industry.

Steve Critchlow, Principal Gas Engineer at Health & Safety Executive, continues our series of technical articles, sharing a piece about understanding important gas characteristics for utilisation.

Following the publication of IGEM/G/5 Edition 3 *Gas in multi-occupancy buildings* in February, Rodney Hancox, Chair of the IGEM/G/5 panel and Director of Gas Distribution Solutions, outlines the changes to the standard and explains why the highly anticipated document is important.

We're also taking a look at two recently published supplements to IGEM standards with particular importance for the downstream gas industry: IGEM/IG/1 Supplement 2 *Domestic training specification* and IGEM/G/11 Supplement 1 *Responding to domestic CO alarm activations*.

Meanwhile, Ben Kuchta, Engineering Resilience Lead at National Grid, is exploring the concept of professional resilience, and we're catching up with Lance Newhouse, Senior Engineer at Cadent and recipient of the 2021 EngTech Development Grant, as he tells us about his career so far in our latest member profile.

We hope you enjoy this edition.

JODIE SHEPHERD
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GOT SOMETHING TO SAY?

If you would like to send any readers' letters or have any comments or feedback, then please get in touch with us. We are also looking for contributors for future editions of Gu so, if you are interested, contact us by emailing jodie@igem.org.uk with details of your proposed contribution.

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PREPAYMENT METER CUSTOMERS WILL SEE BIGGEST HIKE AS MAXIMUM TARIFF SOARS TO £2,017

MORE WILL BE PLUNGED INTO FUEL POVERTY

PREPAYMENT METER CUSTOMERS will see a bigger hike to their energy bills than default tariff consumers, as the cap limit soars to £2,017 – an increase of 54 per cent, *i news* reports.

Ofgem announced these households, who are often the most vulnerable, will see a rise of £708, from the previous limit of £1,309.

Prepayment meters are usually fitted in homes that have slipped into debt with their energy supplier as a way of helping them manage their debt and budget more efficiently. As such, these homes are often the most susceptible to price hikes and the dramatic increase in costs will have a damning effect on many of these customers.

Sadly, it is likely many more will be plunged into fuel poverty because of the changes.

Sue Anderson, Head of Media at debt charity Stepchange, said: "The higher differential price cap for those using prepayment meters reinforces how it's lower income households who often bear the highest costs.

"Among our clients, those who use these meters are likely to be on lower incomes and may already be struggling to make ends meet.

"Even if people do manage to meet these higher costs, they may well have to fall behind on other financial commitments to do so, by cutting back on other essentials or using credit to pay their bills.

"As well as significant, targeted support for those on low incomes, the government should look at additional safeguards that prevent prepayment meters being installed, or risk exposing more financially vulnerable people to higher costs."

Meanwhile, for households on default tariffs, the cap has soared to £1,971 – a £693 increase from the previous limit of £1,277.

This is the highest increase yet and comes as a time when the cost of living is squeezing families across the country.

ZERO EMISSION BOILER TECHNOLOGY RECEIVES £1M INNOVATE UK GRANT

HEAT SYSTEMS MANUFACTURER tepeo has received £1 million in grant funding to support research to optimise production of its Zero Emission Boiler (ZEB) technology, reports *H&V News*.

The funds have been supplied by the Innovate UK agency to support high volume manufacture of the ZEB system and supporting technology.

According to tepeo, the ZEB is devised as an affordable electric alternative to existing natural gas or oil boilers that is easy to install and can match the heat temperature performance of technologies designed specifically to run on fossil fuels.

The system is also compatible with existing thermostats, the manufacturer has claimed.

The ZEB combines an electric heating system with a thermal storage solution. It is used alongside the company's control technology to source electricity for heat at the cheapest and greenest point of the day with the energy then being stored until needed, the company added.

Johan du Plessis, Founder and Chief Executive of tepeo, said the funding from Innovate UK was recognition of the potential of its ZEB to provide a "sensible heat storage technology" for domestic use. He therefore welcomed the financial support for further developing the system.

Mr du Plessis said: "This research is a vital step toward enabling large scale adoption of our ZEB technology and we are building a great project team to achieve it.

"As the nation works towards net zero, renewables must play a significant role, but in 2020 National Grid spent over £280 million on curtailing wind generation because energy storage was simply not available - devices like the ZEB will play a huge role in reducing and hopefully eliminating this wastefulness."

Innovate UK has partnered with the manufacturer to provide funding as part of the Knowledge Transfer Partnership programme that was established by the government to support technological innovation and research in a range of fields.

20,000 SOCIAL HOMES TARGETED WITH £179M OF GOVERNMENT ENERGY EFFICIENCY FUNDING

UPGRADES FOR SOCIAL HOUSING

A SELECTION OF local authority housing providers across England have been unveiled as the first recipients of the Social Housing Decarbonisation fund to support low carbon heat and insulation.

Sixty-nine local authority social housing projects across England will share £179 million of government funding intended to improve the energy efficiency of their properties, *H&V News* reports. The funding, delivered as part of the first wave of the Social Housing Decarbonisation Fund (SHDF), is being offered to upgrade some 20,000 social housing properties across the country that fail to meet the Energy Performance Certificate (EPC) C rating. A longer-term aim is to reduce carbon emissions from all social housing and ensure more affordable heating by covering the costs of fitting wall and roof insulation, heat pumps, solar panels, as well as energy efficient doors and windows.

All upgrades planned under the first wave of the funding scheme are expected to be completed by the end of March 2023.

A second wave of funding with a value of up to £800 million will open for applications later this year, according to the Department for Business, Energy and Industrial Strategy (BEIS).

Business and Energy Minister Lord Callanan said the SHDF scheme would provide billions of pounds to curb the heating demand and energy bills of social housing tenants, as well as supporting the country's net zero carbon ambitions.

He said: "The £3.8 billion we're investing through the Social Housing Decarbonisation Fund is helping drive down energy bills for thousands, targeting help to those who need it most by making their homes warmer, more comfortable and greener."

Kate Henderson, Chief Executive of the National Housing Federation, said that housing associations across England were committed to work with the government on improving the efficiency of the country's housing stock through the fund.

She said: "We warmly welcome the announcement of the first Social Housing Decarbonisation Fund recipients. Alongside helping us to achieve our crucial net zero target, this will mean warmer, more comfortable homes for social housing residents, and importantly help to protect them from rising energy bills."

HOMES WITH HEAT PUMPS TO 'PAY MORE FOR HEATING THAN GAS BOILER CUSTOMERS'

HEAT PUMPS

THE PRICE OF heating with the new price cap from April will be higher for homes using heat pumps than gas boilers, *Energy Live News* reports.

One of the findings of an Energy and Utilities Alliance (EUA) analysis of figures from energy regulator Ofgem suggests the cost of heating the average home with a heat pump will jump from £919 to £1,251.

The trade body found that generating the same amount of heating with a gas boiler would cost £984, rising from £584, and translating to a saving of nearly £267.

The report suggests the cost of running a heat pump in a five-bedroom house will soar to £1,773 from £1,301.

In comparison, heating the same house with a gas boiler will increase from £787 to £1,352.

Mike Foster, Chief Executive OF EUA, told ELN: "The analysis suggests that at the minimum efficiency rates the appliances come with, which is 92 per cent efficiency for a gas boiler, 250 per cent efficiency for an air source heat pump and the price cap figures that Ofgem recently announced, it suggests that a heat pump would cost something in the region of £268 a year more to heat your home than it would do using a condensing gas boiler.

"That is based on the Ofgem typical domestic consumption figure of 12,000kWh of gas.

"I think people need to be careful that they fit a heat pump into a home that's suitable for it. So, a highly energy efficient home will give a higher efficiency rating for the way in which your system operates and the ability to convert your unit of input energy into the heat that comes out.

"A lot has to do with the unit price, the efficiency of your product and the efficiency of your home. The analysis suggests that a heat pump is not the sole answer to decarbonising people's homes. You are better having a gas boiler in many circumstances, but that gas boiler to reach net zero has got to be run on a net zero compatible gas, such as hydrogen."

BUILDING A GREENER FUTURE

Last October, the government released its long-awaited Heat and Buildings Strategy, laying out how it plans to dramatically reduce carbon emissions from the UK's 30 million homes and workplaces. Here we look at some of the key findings and responses from across industry

The Heat and Buildings Strategy lays out a roadmap to tackle emissions in homes and businesses by incentivising homeowners to replace their gas boilers with low-carbon heating systems.

Published following delays spanning the best part of a year, the strategy outlines the government's approach, in terms of timings and technologies, for decarbonising two hard-to-abate sectors that account for a significant proportion of the nation's carbon footprint; heat for buildings alone makes up 21 per cent of annual national emissions.

The strategy features headline commitments to bring the upfront and operational cost of heat pumps for homes to price parity with gas boilers by 2030, according to sustainability website *edie*. This will lay the foundations for all new domestic home heating systems installed from 2035 to be fossil fuel-free.

Energy efficiency, electric heat pumps and energy storage are all named in the strategy as key focus areas for decarbonising domestic and commercial buildings alike in the short term, as technologies that may play a larger role in the long term, such as green hydrogen and carbon-capture technologies, scale up. It is worth noting that the strategy only applies, in its entirety, to England. Devolved UK administrations may take a different approach, although many key projects and targets are UK-wide.

Overall, the strategy details £3.9 billion of funding, with the Department for Business, Energy and Industrial Strategy (BEIS) stating that the entirety of this amount is new. The department is also touting up to £6 billion in GVA for the UK economy and the creation of 175,000 skilled jobs by 2030.

HEATING DOMESTIC BUILDINGS

The strategy measures that made tabloid headlines are, understandably, those relating to heat for homes.

Included in the strategy is a £450 million boiler upgrade scheme through which homeowners will be able to claim grants of £5,000 to assist with the upfront purchase of a new heat pump if they are choosing to replace their gas boiler. The scheme will run for three years and is targeting 90,000 homes. Many green groups had hoped for a longer running scheme, given that there are 29 million domestic properties in the UK.

A further criticism of the boiler upgrade scheme is that there is no requirement for applicants to improve the energy efficiency of their homes before installing a heat pump.

To help deliver the heat pumps and installers needed, BEIS has stated that it will work closely with the industry. BEIS is hoping that by scaling up production and making technologies more efficient the costs of a domestic heat pump will be 25-50 per cent lower in 2025 than today, and that they will be comparable with gas boilers by 2030. Operating costs will also be lowered by changes to the climate change levy, to be phased in over a decade. Gas levies will rise as electricity levies fall, thus making electrification cheaper.

There are also updated commitments to work with local authorities to help encourage individuals to choose a heat pump when next replacing their boilers. Councils are encouraged, through the strategy, to retrofit their own buildings and lead by example, while also providing communications and tailored practical support to residents.

Additionally, local authorities are urged to identify appropriate locations for low carbon district heating networks. This is not yet a legal requirement. BEIS has stated that it is working with Ofgem to "develop a better understanding of the opportunities and challenges presented by local area energy mapping and planning and is considering the most appropriate policy options to take forwards". There are currently some 14,000 heat networks in the UK, collectively serving some 480,000 customers.

IMPROVING ENERGY EFFICIENCY

The strategy provides some clarity on energy efficiency, though many had been hoping for more information and a replacement for the Green Homes Grant of the same scale, if not larger – especially given that the UK's track record on home energy efficiency has been poor for far longer.

"We recommend that consumers prioritise the most cost-effective energy efficiency measures, in particular those measures that pay back within 20 years," the strategy states. "However, we appreciate that many households and businesses will be interested in going further, for example for increased comfort or to coordinate with other planned building improvements."

To that end, a £950 million Home Upgrade Grant scheme is detailed in the strategy. This is less than half of the funding originally promised through the Green Homes Grant. The Social Housing Decarbonisation Fund, originally launched as a £60 million one-year initiative in 2020, has been extended through to 2025, with the government pledging to invest £800 million by this time.

The strategy states that the policies it details could bring up to 70 per cent of England's homes to Energy Productivity Certificate (EPC) band C or above by 2035, from approximately 40 per cent at present. It adds that BEIS will explore whether minimum energy performance standards should be set for the 2030s and 2040s, but no plans for anything similar in the shorter term are outlined.

> *"BEIS is hoping that by scaling up production and making technologies more efficient the costs of a domestic heat pump will be 25-50 per cent lower in 2025 than today, and that they will be comparable with gas boilers by 2030"*

Sky News reports that BEIS Is also looking to incentivise mortgage companies to focus their lending on properties with higher EPC bands. This could drive change at that part of the value chain, but there is the risk of penalising low income individuals with less efficient homes.

LONGER-TERM INNOVATION

Following the publication of the Hydrogen Strategy in August, there had been hopes for a commitment to hydrogen for heating homes, offices and other commercial buildings.

But the new strategy defers this decision to 2026, given that trials of the UK's first Hydrogen Village are due to be completed in 2025, with support from BEIS and the private sector.

It states: "Hydrogen offers the potential opportunity to repurpose all or parts of the existing gas network to a low carbon alternative, which could reduce the need for new network infrastructure more broadly.

"However, further work is required to assess hydrogen network requirements as the hydrogen economy scales up, and how future decisions on heat might affect this."

The strategy also states that the scale of carbon capture, usage and storage (CCUS) needed for decarbonising heat is "dependent on the balance of hydrogen production methods and ongoing research regarding using hydrogen as a heat source". Nothing new is confirmed on CCUS that was not already in the 2018 CCUS Action Plan, or subsequent Energy White Paper and 10-Point Plan.

FLEXIBILITY

The strategy acknowledges that, as the energy mix for heating changes, with natural gas scaling back and electrification and hydrogen scaling up, systems change is needed to maintain energy supply and security.

At a top-line level, BEIS has stated that it will work with Ofgem and National Grid to assess how supply and demand are likely to change, and how flexibility can be built in using technologies like batteries to manage that change. It also states that strategies will be developed to help coordinate the installation of heat pumps with other technologies that assist the low carbon transition, including rooftop solar, battery storage, electric vehicle charging and smart technologies.

However, in-depth information remains lacking, with the strategy largely reiterating existing policy packages and pieces of government research.

INDUSTRY RESPONSE

Energy UK's Chief Executive Emma Pinchbeck said: "Converting our homes to low carbon heating is a major challenge on the road to net zero but one that will help to deliver more comfortable houses heated with affordable clean energy, as well as providing better air quality, reduced emissions, jobs and investment.

"Having a strategy and target in place, with financial support for customers, means our industry can get on with the job of rolling out low carbon heat options like heat pumps and heat networks at scale, driving down costs and increasing the choices on offer for customers.

"The current situation underlines the need to get on with making sure that customers are no longer left exposed from our dependence on gas."

David Smith, Chief Executive at Energy Networks Association, said: "Decarbonising heat is a tough nut to crack, but heat pumps and other low carbon technology like it will be key.

"[The] plan from the government sets the country on the path to a greener future. Central to delivering

these plans and impossible without them, are our energy networks which provide the backbone for keeping Britain's energy flowing.

"We are unlocking choice for customers by preparing gas pipes for hydrogen and the electricity grid for more electric vehicles, heat pumps wind and renewable power."

"Having a strategy and target in place, with financial support for customers, means our industry can get on with the job of rolling out low carbon heat options like heat pumps and heat networks at scale, driving down costs and increasing the choices on offer for customers"

Kate Henderson, Chief Executive of the National Housing Federation, said: "The Heat and Buildings Strategy marks an important first step towards decarbonising homes, which in England emit more carbon than all the country's cars combined. From what's been released so far, we particularly welcome the commitment of the first part of the Social Housing Decarbonisation Fund, as well as the clear signal that heat pumps are likely to be the primary source of home heat and the commitment to bring down electricity prices. We look forward to reviewing the strategy in its entirety.

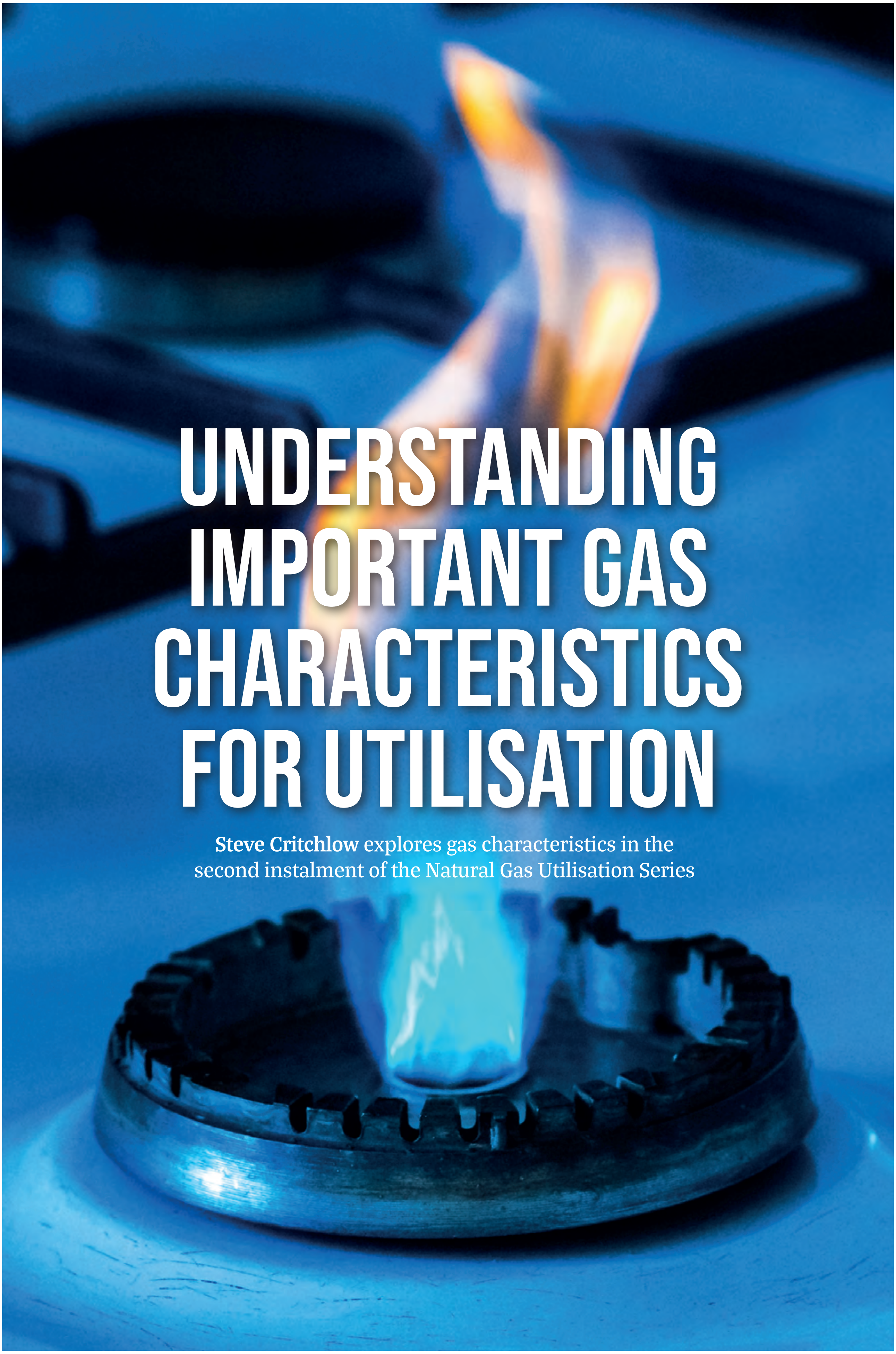
"Housing associations are committed to working with the government over the coming months and years to help it deliver on its ambitious net zero plans. However, our new report on decarbonising England's social homes shows there is a lot of work to do to achieve this.

"We urge the government to use the upcoming spending review to make good on its commitment of a £3.8 billion Social Housing Decarbonisation Fund, which would allow housing associations to invest and plan long term. It's also critical that we can work with government to give clarity on energy efficiency standards and guidance on decarbonising our oldest and most inefficient homes."

James Prestwick, Director of Policy and External Affairs at the Chartered Institute of Housing (CIH), said: "Decarbonisation of the housing stock is one of the biggest hurdles that must be overcome for the United Kingdom to achieve its net zero ambitions. It also provides a great opportunity to provide warm, comfortable homes for everyone that are affordable to heat.

"[This] announcement includes much to be positive about. We particularly welcome the announcements that mean people can access new funding to install low carbon heating in their home and it is good to see an initial £800 million allocated to the Social Housing Decarbonisation Fund. CIH has long called for the detail of the scheme to be brought forward and this first tranche is a solid step in the right direction.

"So while welcoming the announcements, we also urge greater ambition from the government. Achieving overall net zero targets will require more significant long-term investment in energy efficient homes as a key part of the UK's approach to tackling the climate emergency and delivering a zero carbon future for all."



UNDERSTANDING IMPORTANT GAS CHARACTERISTICS FOR UTILISATION

Steve Critchlow explores gas characteristics in the second instalment of the Natural Gas Utilisation Series

This article is the next in a series of technical articles, which are aimed at introducing those in the utilisation sector of the gas industry to some of the fundamental science underpinning their work. **Steve Critchlow** is a Fellow of IGEM and a Principal Gas Engineer at the Health and Safety Executive Science Division. Here, he takes a look at the important gas characteristics for utilisation

In my last article, published in the first edition of *GU,* I discussed gas combustion and how to understand your measurement of it. This time, we're going to look at the different characteristics of gas – sometimes referred to as gas quality (although this term includes things like water and sulphur content, and odorant concentration). Gas transmission and distribution companies use extremely expensive and accurate kit to continually monitor gas quality as it's an important aspect of ensuring safe combustion and accurate heat output. Many of these qualities and their maximum quantities are defined by law.

Given all the proposed changes with the introduction of hydrogen, these gas characteristics are hot topics and are important to understand. You'll hear lots of discussion about calorific value, energy density, diffusivity, Wobbe number etc. So, what do all these mean and why are they important? Let's take a look.

CALORIFIC VALUE (CV)

The reason something can be considered a fuel is because it contains energy which we can release to use. Food is a fuel, and you will of course be familiar with food's energy content being measured in calories. We of course need calories - just not too many! Fuel gases contain energy which we can release by burning them. Essentially, we input energy to the fuel molecules, and that energy breaks the fuel molecule apart allowing a reaction to take place. This is what we studied last time. If the reaction gives out heat as a product is said to be exothermic. The word has the Greek roots exo - 'outside' and therme - 'heat'.

The calorific value of a gaseous fuel is the quantity of heat released by the complete combustion of one cubic metre.

Now, the standard unit for energy is the Joule, named after English physicist James Prescott Joule. A Joule is equal to the energy transferred to (or work done on) an object when a force of one newton acts on that object in the direction of the force's motion through a distance of one metre (1N/m).

In the UK, the calorific value of gas fuels is generally given in megajoules per m^3 (MJ/m^3). You should notice that these units are per volume; we are quoting energy content on a volumetric basis. This of course makes sense for low pressure gases.

Solid and liquid fuels, however, are measured on their energy content per unit of mass, MJ/kg. Those of us who work with LPG will be familiar with the notion of its quantity being measured in mass rather than volume. And it is common in higher pressure gases too, where mass flow rather than volume flow is measured.

FIGURE 1 COMBUSTION RELEASES THE INTERNAL ENERGY IN THE FORM OF HEAT

As natural gas is a natural product, its energy content can vary depending on its source, which can affect its constituent parts. Typically, in natural gas engineering we consider the calorific value to be about 38.7MJ/m^3. If the CV of the natural product happens to be too low, gas production companies can 'ballast' the gas by injecting carefully calculated amounts of propane to increase its calorific value. This is common on biomethane sites, of course. Propane is given as having a CV of about 93MJ/m^3. Hydrogen has a calorific value of 12.3MJ/m^3, so you'll see its internal energy value is around a third of natural gas when considered on a volumetric basis. However, if we look on a mass basis, hydrogen has a CV of 142MJ/kg which compares to natural gas with 50MJ/kg – so around three times more. So be careful; if we are comparing calorific values, we must compare like with like, and we need to decide which quantity is important to us.

Those of us working in utilisation will be all too familiar with the fact that there are two types of CV that get quoted: gross CV and nett CV. But what is the difference?

Those of you who read my combustion article will be well aware that water is a major product of combustion when we burn gas. To create that water vapour takes energy, energy we ideally want to release as heat for our process. When the gross CV of gas is measured, all the water vapour product is condensed back into a liquid, and therefore this energy from the water vapour is released.

If the water vapour is released, then the energy content not including that lost in the water vapour is the nett CV. In utilisation, of course, it is common to lose this heat in water vapour so the nett CV is the standard one that downstream gas technicians and engineers will quote.

Nett CV = Gross CV – Heat released from water condensation at 15°C

To make water evaporate, we need to put heat (or energy) into it - heat which is absorbed. This heat is released when the water is cooled.

A kilogram of water absorbs 2.466MJ of energy to change state from liquid to vapour. We say therefore that the 'latent heat' of water (or, more specifically, the enthalpy of vaporisation) is 2.466MJ/kg. This is very important for heat transfer, whether it's a steam driven turbine or a domestic central heating system.

We can say therefore that:

H_2O (liquid phase) = H_2O (gaseous phase) + 2.466MJ/kg.

And we can express nett and gross CV in terms of enthalpy of vaporisation of the water:

Nett CV = Gross CV – (Mass of water x 2.466MJ/kg.

Without going too far into thermodynamics at this stage, its perhaps important to say that this figure of 2.466 is only valid at the standard temperature of 15°C. If we consider it at, say, 25°C then the enthalpy of vaporisation would be lower at 2.442MJ/m³.

RELATIVE DENSITY/SPECIFIC GRAVITY

Density is a basic property of all substances, and it gives us an idea of how tightly packed the molecules are. Gas has molecules which are well spaced (relatively speaking) and therefore its density is much lower than that of a solid where the molecules are packed tightly together. We measure density by its mass per unit of volume (kg/m³), which allows comparison between different substances.

Of course, we must remember that density will change with temperature and/or pressure, so it's very important that we compare substances at standard conditions.

In gas engineering, it's extremely useful to be able to compare the density of our fuels to that of air. This can help us work out how a gas will behave within a pipe and at the burner. It's also very important when it comes to considering how a gas leak will behave when released to atmosphere. This ratio of gas density to air is known as the relative density, or the specific gravity (SG), and is calculated thus:

Relative density (RD) = Density of gas / Density of air

If we consider air to have a density of one, then natural gas has a density relative to air of nearly 0.6, meaning it is approximately twice as light as air. Given this, a release of natural gas will rise though the air. Note, you may see the RD of natural gas quoted as 0.5. This is because methane, the main constituent, has an RD of 0.5 but natural gas contains heavier gases such as ethane, propane and nitrogen.

Propane has a relative density of approximately 1.5, meaning it's heavier than air and when released will tend to fall to the ground. For this reason, we have specific requirements for hydrogen to be stored in well ventilated areas outside, away from drains and gullies, and with the requirement that low level plant room ventilation must be close to the floor. These factors are vital to a compliant DSEAR assessment of any site using LPG.

FIGURE 2 BIOMETHANE SITES OFTEN INCREASE THE CV BY INJECTING PROPANE

Hydrogen has an RD of 0.07 and is therefore extremely buoyant. This will mean its behaviour at the burner and upon release is somewhat different to that of natural gas.

WOBBE NUMBER

You may well have seen and heard a lot about the Wobbe number (often referred to as the Wobbe index), given the current research and proposals around hydrogen where it is mentioned frequently.

So, what is it? Well, having introduced you to CV and RD, it's time to explain the Wobbe. The Wobbe number is named after the Italian engineer Goffredo Wobbe, who, in 1926, published a paper defining a measure of fuel gas 'quality', with the idea that fuels of the same quality would be interchangeable.

We've discussed CV and explained that it's the internal energy contained within the fuel. However, this is not a direct indicator of how much heat will be released at the burner for that specific gas.

Imagine gas flowing to atmosphere through a fixed injector such as happens on a burner. The higher the density of the gas, the lower the volume flow through the orifice. Or to put it another, slightly more simplistic, way, the thicker the gas is, the less gas flows through the orifice.

This is easy to picture in your mind with liquids, but the same applies for gases which, after all, are still fluids. In fact, the volume flow rate through the orifice is inversely proportional to the square root of the relative density. This can be written as:

Equation 1

$$Volume\ Flow\ (V) \propto \frac{1}{\sqrt{RD}}$$

The potential heat for that volume flow *V* of a gaseous fuel is given by:

Equation 2

$$potential\ heat\ (Q) \propto gross\ CV\ x\ V$$

Now, given that our first equation above showed the volume flow to be inversely proportional to the square root of the relative density, we can rewrite the equation for potential heat to say:

Equation 3

$$Potential\ Heat\ (Q) \propto \frac{Gross\ CV}{\sqrt{RD}}$$

What we see here is that the calorific value of the fuel, divided by the square root of the relative density gives us an indication of the potential for heat release through a gas burner for a particular gaseous fuel. The CV divided by the square root of the RD gives us the Wobbe number.

Equation 4

$$Wobbe\ Number\ (WN) = \frac{Gross\ CV}{\sqrt{RD}}$$

Now, this is extremely important and allows us to compare different fuels. Also, by ensuring the Wobbe index of a fuel gas is within certain limits we can ensure that the heat output of an appliance remains fairly constant, and that the flame will maintain its stability on a well-maintained burner designed to burn gas with set Wobbe limits. It gives us an indication of how interchangeable a gas is also. Therefore, we can add propane to a very low CV sample of natural gas to raise its Wobbe to within the set limits and it will burn to give us the correct heat input at the burner. If we consider the Wobbe of a typical natural gas sample, we will get:

Equation 5

$$\text{Natural Gas Wobbe} = \frac{38.7}{\sqrt{0.6}} = 49.96\ MJ/m^3$$

If we do the same calculation for propane gas we get:

Equation 6

$$\text{Propane Wobbe} = \frac{93}{\sqrt{1.5}} = 76MJ/m^3$$

So, you can see that propane cannot be used in a natural gas burner, and vice versa.

Those of us working in utilisation will of course know that using LPG on a burner designed for natural gas should be treated as 'Immediately Dangerous' when applying the standard IGEM G/11 *Gas industry unsafe situation procedure*.

Changes in gas composition and hence Wobbe number can lead to a deterioration in performance of an appliance, and ultimately safety concerns. If the Wobbe is too high, we might start to expect more incomplete combustion with carbon monoxide formation increased. If the Wobbe is too low, it will mean the heat output from our burner is noticeably lower and the flame can start to lift off the burner, giving rise to the possibility of the flame going out.

To ensure gas is delivered to the burner with a Wobbe that achieves safe, reliable combustion with a steady heat output, the Gas Safety (Management) Regulations place legal limits on the Wobbe, which must be supplied. Currently, GSMR states that the Wobbe must be between 46.5 and 52.85MJ/m^3 for natural gas.

So, lets return to hydrogen again. We saw that its gross CV was approximately one third of that of natural gas. Let's consider its Wobbe however:

Equation 7

$$\text{Hydrogen Wobbe number} = \frac{12.3}{\sqrt{0.07}} = 46\ MJ/m^3$$

Despite its CV, you can see the heat output using hydrogen is likely to be a little less, but not too dissimilar, to natural gas. It is, however, just below the lower limit for Wobbe set by GSMR and so, if we are to use hydrogen, this regulation must be altered. Much research is being undertaken to demonstrate the safety of lowering the GSMR Wobbe limits.

FIGURE 3 ENERGY MUST BE PUT INTO THE WATER TO CHANGE PHASE, WHICH CAN BE RELEASED ON CONDENSING THE WATER

DIFFUSION AND EFFUSION

The molecules of a gas are constantly in motion, moving at random speeds and in many different directions, and will spread out to fill a container (albeit with a lowering of the pressure). If we release a small quantity of odourised gas in a room, we can quickly notice the smell throughout the room. This is because the relevant molecules have spread out and mixed with the air. The gas, and its odorant, are said to have diffused into the air in the room.

Diffusion refers to the process of particles moving from an area of high concentration to one of low concentration. The rate of this movement is a function of temperature, viscosity of the medium, and the size of the molecules. One would expect therefore that a small molecule moving quickly (for example, at elevated temperature) would have an increased rate of diffusion. Diffusion results in the gradual mixing of materials, and eventually, it forms a homogeneous mixture throughout the room. Not only do gaseous particles move with high kinetic energy, but their small size enables them to move through small openings as well; this process is known as effusion. For effusion to occur, the hole's diameter must be smaller than the molecules' mean free path (the average distance that a gas particle travels between successive collisions with other gas particles). The opening of the hole must be smaller than the mean free path because otherwise the gas could move back and forth through the hole.

It's obviously vital for us to contain gas to stop it spreading to areas where we don't want it. This also includes the need for us to move it from one place to another in pipes without losing it.

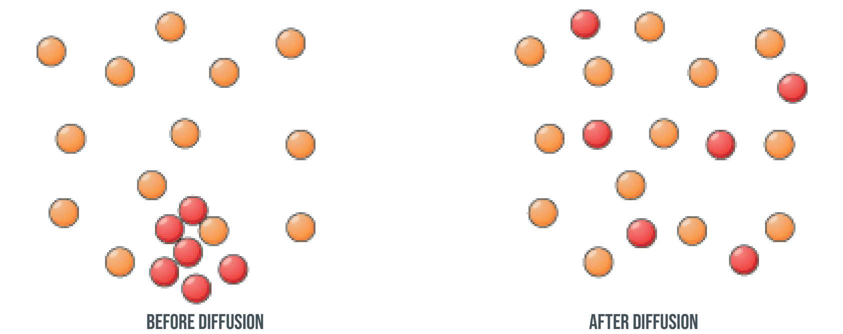
As hydrogen has a much smaller molecule than natural gas (hydrogen has two hydrogen atoms as at standard conditions hydrogen is a diatomic molecule having the formula H_2, whereas methane has four hydrogen atoms and a single, heavier carbon atom), you may think that it therefore has a greater propensity to leak than natural gas.

Research performed by the HSE Science Division as part of the H21 hydrogen research found that typical gas pipe material and assemblies that were gas tight on natural gas would remain gas tight when used for hydrogen. However, where leaks exist, the volume of leakage would be greater with hydrogen. The ratio of the hydrogen to methane volumetric leak rates varied between 1.1 and 2.2, which is largely consistent with the bounding values expected for laminar and turbulent (or inertial) flow, which gave ratios of 1.2 and 2.8, respectively.

So, does this mean a greater risk from leakage? Well, that's up for debate as part of the ongoing research, but remember that it's energy which is important - not just pure volume. Methane is eight times denser than hydrogen, so in volumetric terms, the hydrogen flow rate is roughly three times greater than methane. The energy density per unit volume for hydrogen is just under a third of the energy density for methane. Therefore, in terms of energy flow rates, the same leak geometry and pressure produces a hydrogen energy flow rate that is around 10 per cent lower than the methane energy flow rate.

I very much hope this article has been of interest to you. There will be more in the series of technical articles within *Gu* magazine, which I hope will stimulate learning and understanding amongst utilisation engineers.

FIGURE 4 MOLECULES OF ONE GAS CAN DIFFUSE INTO ANOTHER TO FORM A MIXTURE



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STANDARDS

NEW STANDARDS

Two new supplements to IGEM standards with particular importance for the downstream gas industry have been released and are now available via the institution's website

IGEM/IG/1 SUPPLEMENT 2 DOMESTIC TRAINING SPECIFICATION

This specification is a supplement to the IGEM/IG/1 *Standards of training in gas work* document, which is the only recognised standard approved by the Standard Setting Body (SSB) and required in ACoP L56. The relevant parts of this specification are also applicable to persons wishing to extend range or scope (as defined in Guidance Note 8 (GN8)).

Safety in the installation and use of gas systems and appliances; Approved Code of Practice and guidance L56; ACoP 3(1) paragraphs 81 and 82 state:

81. Gas work should only be undertaken:

a) by a person, who has successfully completed an industry-recognised training course followed by assessment of competence. Training that leads to assessment of competence in safe gas work should be recognised by the industry's standards setting body, or

b) in the case of a currently or previously registered person, where they have proved competence through a certification scheme; or

c) for those working at premises that fall outside the scope of the regulations (see regulation 2(4) and associated guidance), by a person who has successfully completed an appropriate full training course followed by assessment of competence.

82. Training should be of a standard to enable a gas engineer to achieve competence in the safe installation, purging, commissioning, testing, servicing, maintenance, repair, disconnection, modification and dismantling of the gas systems, fittings and appliances with which they are working. This should include an adequate knowledge of:

a) relevant associated services such as water and electricity;

b) the potential exposure to asbestos;

c) the dangers they may give rise to;

d) the precautions to take.

Training providers who wish to deliver training to new entrants are required to have their training programmes approved by either a Recogniser of Training or by the Authoriser (currently IGEM).

New entrant training for domestic natural gas shall meet the requirements of this specification which has been updated by a panel from industry, training providers, recognisers, the SSB and regulatory bodies.

The specification stipulates the subjects and duration required for both off-site training (undertaken in a classroom or workshop) and the requirements for building an on-site (in the workplace) portfolio of evidence.

The specification recognises the importance of new entrants spending time on-site with a mentor and provides detailed requirements for building a portfolio of evidence. The portfolio is to include details of the numbers and types of jobs completed by the new entrant under the supervision of a mentor. The portfolio of evidence is to be reviewed by the Training Provider or Recogniser of Training prior to a certificate of training being issued.

The minimum overall programme duration is six months consistent learning and the maximum time spent to complete the programme is expected to be two years.

On satisfactory completion of the programme, a certificate will be issued detailing the name of the training provider and the scope of the programme. This certificate will be required as proof of training prior to attending initial ACS assessment.

Among the changes in this latest edition of the specification, new entrants to the industry are required to understand CO poisoning and detection including the sources and migration of CO and the symptoms of CO poisoning.

Also, candidates taking the central heating option are also required to learn about central heating system design and controls. This is an important step in ensuring that engineers have the correct skills and competencies to enable them to provide energy efficient systems for their customers.

All other subjects in the specification have been updated and modernised to improve safety and knowledge which will lead to gas engineers entering the industry with more competence and their customer receiving a better experience.

IGEM/G/11 SUPPLEMENT 1 RESPONDING TO DOMESTIC CO ALARM ACTIVATIONS

By Martin Garbutt, Head of Gas Policy and Investigation at HomeServe Membership Ltd and G/11 panel member

With the increased sales of carbon monoxide detectors within the UK, it is quite likely that a Gas Safe-registered engineer may be called to a property where a CO detector has activated or there has been a report of fumes from a gas appliance within that property.

This raises the question from engineers of: "What should I do if I receive such a call? Can I attend?"

Unfortunately, there has never been any clear guidance as to what engineers could/should do in these circumstances. Without clear guidance, it is quite possible that nuisance CO detector activation could be misdiagnosed as a faulty CO detector – as opposed to truly identifying the root cause of the CO detector activation.

There is confusion around whether an engineer without an additional competency, such as CMDDA1 Domestic carbon monoxide/carbon dioxide atmosphere and appliance testing; appliances burning 1st, 2nd and 3rd family gases, can attend a report of a CO alarm activation/report of fumes. The short answer is "Yes, they can". After all, confirming appliances are safe to use is what competent engineers do every day.

The gas industry recognised this problem and work began on a new IGEM document: IGEM/G/11 Supplement 1 *Responding to domestic CO alarm activations/reports of fumes after attendance by the emergency service provider or the liquefied petroleum gas supplier.*

IGEM/G/11 Supplement 1 is aimed at both domestic and non-domestic installers and provides clear guidance as to what a gas engineer should do or not do when attending a property recently visited by the ESP or gas supplier following the activation of a CO detector.

Perhaps most importantly, the document indicates where further specialist competencies may be required e.g., CMDDA1.

This approach builds on an article which appeared in Registered Gas Engineer dated circa 2016, which provided a reference point where additional competencies are required.

It is important to note that the document is written for an engineer attending after the emergency service provider or the LPG supplier, who has made the appliance safe and deemed the property's atmosphere safe.

The document provides escalation routes for the engineer for situations where an obvious cause cannot be found or it is a repeat visit requiring further investigation. The key process is detailed within a flowchart contained within IGEM/G/11 Supplement 1.

IGEM/ G/11 Supplement 1 sits under the overall document of IGEM/G/11 *Gas industry unsafe situation procedure*.

It is important to remember that any situation that has occurred which meets the criteria of RIDDOR 11(1) e.g., death, unconsciousness or a person being taken to hospital, no work shall be undertaken apart from turning off the gas supply to the property until the Health & Safety Executive (HSE) has been informed and granted permission to proceed. Proceeding without permission may compromise a legal investigation and may be a breach of the law.

As mentioned above, gas engineers may not always be able to pinpoint the cause of the CO detector activation. In these situations, the document provides a defined route of escalation. An extract of some of the escalation scenarios contained within the document is shown in Figure 1.

For more information on IGEM standards and how to access them, visit www.igem.org.uk/technical-services

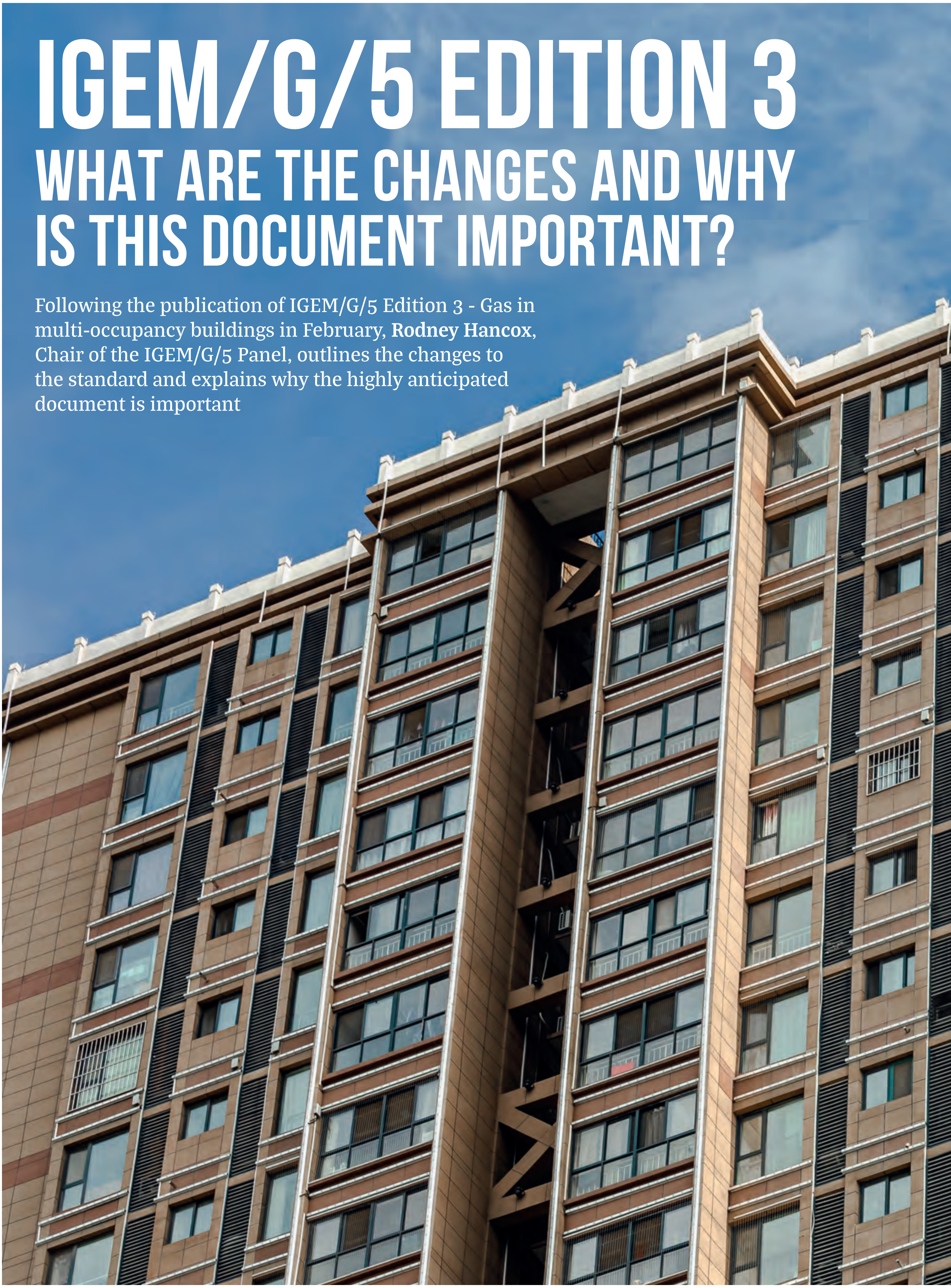
FIGURE 1

	SITUATION	RECOMMENDATION
1	After an initial investigation by an engineer with appropriate appliance competencies has failed to identify the cause of the CO alarm activation/source of fumes or smell. Investigations must consider other sources of CO: see 2 below.	Leave gas disconnected and installation classified as ID. Escalate to an engineer with further specialist investigation competence e.g., CMDDA1.
2	If other potential sources of CO have not been inspected/checked: - Suspected gas appliances in neighbouring properties, - Suspected other sources - solid fuel, oil appliances, etc.	Where CO from neighbouring properties is suspected, contact the ESP or gas supplier (in the case of LPG) For other fuel sources solid fuel, oil appliances, etc., contact the relevant competent person (see table scenario 1.4 of IGEM/G/11.
3	To rule out ambient CO in the property atmosphere where gas appliances are satisfactory, but no cause of alarm activation or symptoms has been identified.	Escalate to an engineer with further specialist investigation competence e.g., CMDDA1.
4	The gas user/responsible person reports a previous occurrence of CO alarm activation, reports of fumes or smells within the property (within a three-month timeframe) with no identified obvious cause.	If not on-site report to the ESP or gas supplier (in the case of LPG) If on-site disconnect the gas supply and escalate to an engineer with further specialist investigation competence e.g., CMDDA1.

IGEM/G/5 EDITION 3

WHAT ARE THE CHANGES AND WHY IS THIS DOCUMENT IMPORTANT?

Following the publication of IGEM/G/5 Edition 3 - Gas in multi-occupancy buildings in February, **Rodney Hancox**, Chair of the IGEM/G/5 Panel, outlines the changes to the standard and explains why the highly anticipated document is important



IGEM/G/5 Edition 3 is particularly important to gas engineers and other professionals concerned with gas in multi-occupancy buildings. It is hoped that Edition 3 will facilitate knowledge being shared between disciplines and enhanced co-operation between parties so that safety of gas systems in multi-occupancy buildings will be enhanced.

Edition 3 of IGEM/G/5 replaces Edition 2, which was published in 2012. It covers gas infrastructure to and within multi-occupancy buildings, including those designated as high-risk buildings. It follows a root and branch review of Edition 2, a review of relevant sections of Approved Document B of the Building Regulations and reports and draft legislation published since the Grenfell Tower fire.

Following the Grenfell Tower fire, the Government asked Dame Judith Hackitt to lead a review of building regulations and fire safety. Dame Judith's report entitled "Building a Safer Future" was published in May 2018. In drafting Edition 3 of IGEM/G/5, the G/5 Panel took account of her report - as well as her Sir Denis Rooke Memorial Lecture of 20 March 2019.

Dame Judith identified that the regulatory system covering high-rise and complex buildings was not fit for purpose. In particular, she highlighted what she termed "silos of Knowledge" within each individual discipline that were not being shared with other disciplines and the inability of professionals to see beyond the narrow boundaries of their discipline.

Changes have been made to the layout of the Standard, text, notes, figures and appendices. Short descriptions of the principle changes are as follows:

FIRE SAFETY ORDER, DRAFT FIRE SAFETY BILL AND THE BUILDING (AMENDMENT) REGULATIONS 2018

The legislation section of the standard has been enhanced.

Regulation 6 of DSEAR and Article 12 and Part 4 of Schedule 1 of the Fire Safety Order are virtually identical.

The Draft Fire Safety Bill introduces the concept of a High Risk Building in England and Wales being one where the height of the top storey is 18m or more above ground level. The Building (Amendment) Regulations 2018 requires, amongst other things, materials in or on walls of high risk buildings to be non-combustible. In Scotland, the same requirements have been included in the Technical Handbooks for buildings where the height of the top storey is 11m or more above ground level. Hence, when the term 'High Risk Building' is used in Edition 3 it means that, in England, it is one where the top storey is 18m or more above ground level and, in Scotland, it is one where the top storey is 11m or more above ground level.

RESPONSIBILITIES

A completely new section addressing who is responsible for design, construction, operation, maintenance and decommissioning of the network pipeline, meter installations, meter houses, installation pipework, appliances, ventilation, fire stopping, and records has been included. A set of tables covering different typical scenarios is contained within the section.

One significant change is that when the upstream GT specifies the fitting of EFV &/or TCO on the outlet of the ECV following its risk assessment, it shall be deemed part of the ECV and, hence, the GT shall be responsible for accounting for the fitting's pressure drop in the design of the network pipeline and for its ongoing operation and maintenance.

An example memorandum of understanding has been included as an Appendix to help prevent any confusion, misunderstanding and disputes between GTs and Building owners. It is structured to enable the expectations and responsibilities of the parties involved to be stated clearly.

BULK METER SUPPLY

The diagram has been updated to describe the building owner's role as a "Gas Conveyor", where the individual end user's ECVs are within their dwellings and they do not have access to the valves to the bulk meter installation.

COMPETENCE

The work of the Competence Steering Group set up in the wake of Dame Judith Hackitt's report is signposted.

DESIGN OBJECTIVES The following design objectives are specified:

- ensure gas will be delivered to consumers at a suitable pressure to ensure the safe operation of any gas appliance which they could reasonably be expected to operate
- minimise the risk of fire and/or explosion resulting from the ignition of gas escaping from the proposed gas infrastructure
- minimise the risk of serious aggravation of any building fire
- ensure that additional third-party safety risks are not created
- ensure that the gas infrastructure can be inspected and maintained in the future
- ensure the fire integrity of the building is not adversely affected

HIERARCHY OF DESIGNS

The hierarchy has been updated to the following:

1. Above Ground Energy Centre: Gas not supplied to Individual Flats
2. External network with laterals supplying primary meter installations located immediately on the inside of an external wall.
3. (i) Network pipeline with internal riser in common area supplying meter installations within flats
   (ii) Network pipeline supplying external primary meter installations or meter bank only accessible from outside.
4. Network pipeline with above ground entry with internal riser only accessible from within flats.
5. Network pipeline with below ground entry with internal riser only accessible from within flats.

Below each option in the hierarchy, the advantages and disadvantages of each option are listed.

SELF-CLOSING DOOR

It is noted that a cupboard door with rising hinges does not qualify as a self-closing door.

COANDA EFFECT & PE RISER & LATERAL SYSTEM

Given

- a fire escaping from a room through a window is a reasonably foreseeable event,
- work by the Building Research Establishment has found that flames in the absence of combustible cladding can extend over 2 m above a window opening,
- the aforementioned requirements of The Building (Amendment) Regulations and
- the absence of any evidence that the PE riser and lateral system is fire resistant

Edition 3 now states that PE pipe shall not be installed on to the external wall of a high-risk building. Subject to a risk assessment, which addresses the risk of fire, PE pipe may be installed on the external wall of a building which is not deemed high risk.

PRESS-FIT STAINLESS STEEL Press-fit stainless steel up to 108mm diameter has been shown to be fire resistant and it is now included as a suitable material for use in or on multi-occupancy buildings. Expansion and contraction charts have been included.

It is hoped that Edition 3 will facilitate knowledge being shared between disciplines and enhanced co-operation between parties so that safety of gas systems in multi-occupancy buildings will be enhanced

PIPE SUPPORTS

Guidance has been enhanced.

VENTILATION OF DUCTS

Guidance has been enhanced.

INSTALLATION PIPEWORK

Guidance has been enhanced.

COOKER HOSES New or replacement gas cooker hoses shall be to BS EN 14800 and hence they will be fire resistant.

CHIMNEYS/FLUES

Guidance has been enhanced.

ENERGY CENTRES

Guidance has been enhanced.

RECORDS, INSPECTION & MAINTENANCE

Guidance has been enhanced.

REACTION TO FIRE & FIRE RESISTANCE TESTS

Guidance and appropriate cross referencing have been included in Appendices. In particular, summaries of different fire resistance tests are provided.

ELECTRICAL SAFETY

Requirements for electrical safety are specified in BS 7671 - Requirements for Electrical Installations and authority for the design of the building's electrical system rests with a qualified electrical engineer or other Competent Person working in accordance with BS 7671. BS 7671 appears to be the subject of frequent amendment.

Section 14 of IGEM/G/5 Edition 3, which deals with electrical safety, provides high level requirements consistent with the current edition of BS 7671. The detailed guidance in Appendix 5 of Edition 2 has been removed as it not consistent with the current edition of BS 7671.

IGEM/G/5 brings together the gas sub-disciplines of distribution, metering and utilisation in the complex environment of multi-occupancy buildings. Edition 3 will not only assist the Gas Engineer to understand how each of the gas sub-disciplines will impact upon the life cycle of a multi-occupancy building but it should enable them to work effectively with other disciplines.

FROM THE PANELS

IGEM regularly receives technical queries and provide responses from the panels. In this series, we are sharing some of those queries and responses

ENQUIRY

IGEM/UP/10 7.2.1.3 states that the ventilation requirement for gas plant rooms with biomass boilers should have 6 and 3cm per kW heat input natural ventilation, and 8 and 4cm per kW heat output. I think that, if using input as a reference, then heat input will be higher than heat output, so the ventilation should be higher if referencing heat input. Can you advise on whether the rule is correct?

RESPONSE

Please note: in relation to the IGEM/UP/10, the input and output rates cause confusion (as do Nett CV and Gross CV) when determining ventilation sizing.

We assume that a boiler is 75 per cent efficient, so the output will be 75 per cent of the input, which is why the requirement appears to be greater when based on output.

Take a 80kW input boiler – based on 75 per cent efficiency, the output will be 60kW. So, based on input, the ventilation is 6x80 and 3x80 = 480cm & 240cm, and based on output, the ventilation is 8x60 and 4x60 = 480cm & 240cm – the same!

ENQUIRY

I would like to ask a query in relation to a report that has been produced for an organisation that I work for: I am being advised that a butterfly valve that we have installed on-site would now be deemed Not to Current Standards (NCS) as an AECV or ECV, and we have been advised to replace the valve at a cost of more than £7,000.

Could you confirm if it is necessary to replace the valve under the regulations if there are no other operating or maintenance issues with the valve? We have been advised that the non-compliance would be noted on all future service reports. I'm sure there are many circumstances where regulations change and no action is required on installations until a repair or replacement is required and at that point the repair or replacement would need to comply with the current standards.

Is that the case here?

RESPONSE

The requirements are set out as per IGEM /UP/2 *Installation pipework on industrial and commercial premises*. The following information should be helpful to you. The butterfly valve installed should be a fully lugged one.

Butterfly: A disk with a pipe-section body is pivoted across the pipe and rotates up to 90° between the fully open and fully closed positions. The fully lugged version, incorporating bolts or studs which can be screwed from both sides, is the only acceptable type.

14.2.2: Consideration shall be given to Table 20 and the valves selected shall meet the requirements of the following standards, as appropriate:

- BS EN 331 *Ball and taper plug valves*
- BS EN 593 *Butterfly valves*

The need to replace the valve depends upon the application. Following the risk assessments, if it is deemed a critical isolation valve (for example, to a building or appliance) then yes, it will need to be replaced. However, if it is a section isolation valve and there are other suitable valves installed upstream then possibly it need not be.

ENQUIRY

I wonder if you would be able to help me with a technical matter relating the IGEM/UP/10 document. In the introduction, Section 1.4, it states that deviation may be allowed from the prescribed ventilation and chimney requirements.

I have a building where the flue termination of 1 metre above finished roof level (as in BS 6644) won't be allowable due to the listed status of the building. It will only terminate 200mm above flue level.

How do I go about correcting this and who do I speak to in relation to having the flue termination deviation 'accepted' in writing?

RESPONSE

Section 1.4 states:

Both IGEM/UP/10 and BS 6644 allow deviation from prescribed ventilation and chimney requirements, for example for summer heating loads or to meet the requirements of the local authority (normally the Environmental Health Officer). It is a requirement that any calculations, methods of assessment and conclusions are recorded and retained with the plant records. A system design verification notice (SDVN) to that effect is required to be displayed to assist those performing work on the installation (see Appendix 4). In this respect, any deviation from the requirements of this standard needs to be made by a Competent Person with respect to gas safety issues (see sub-section 3.2.10).

As an example, for the flue described, the 'deviation' would usually be subject to satisfying the following:

1. Is the flue discharge safe at 200mm and is it properly terminated?

2. Is there any possibility of re-entry of products into any nearby building?

3. Is there any likelihood of the discharge causing a complaint e.g., by steam looking like smoke?

4. Does the appliance need approval from a local authority Environmental Health Officer due to its high rating? If so, obtain that approval for lower termination. If all are satisfied, then the information would be added to the technical file and an SDVN issued to cover the reasoning.

If the enquirer is not competent to make these judgements, then he would need to employ a suitably Competent Person. You can find a consultant through the IGEM website for your specific requirements: *www.igem.org.uk/membership/directories/consultants-directory*

Our technical standards enquiry service is designed to provide answers to queries regarding the scope and content of IGEM technical standards. If you would like to submit a technical query, you can do so on the IGEM website: *www.igem.org.uk/technical-services/technical-standards-enquiries*

HOW TO SAIL THROUGH STORMY SEAS

EXPLORING THE CONCEPT OF PROFESSIONAL RESILIENCE

Ben Kuchta, Engineering Resilience Lead at National Grid, explains how developing new capabilities can enable your business' future readiness

In 1970, the futurist Alvin Toffler authored the book *Future Shock*, alongside Adelaide Farrell. In the thought-provoking international bestseller, Toffler describes a future where society is unable to keep up with the pace of change.

Change, by its very nature, is complicated and disruptive. Furthermore, it means different things to different people. For some, the fear of the unknown can be paralysing – for others, it's viewed as an exciting challenge.

In the modern world, change is constant and will require an individual to be resilient by broadening their experience, knowledge and understanding across many subjects, including the ability to successfully utilise many different skills in order to anticipate, react and recover from disruptive events.

In this article, we will explore some essential concepts and how they contribute towards achieving a fundamental level of resilience.

TREND SPOTTING, CRITICAL THINKING AND EMOTIONAL INTELLIGENCE

Trend spotting can provide an individual or business with useful information that allows them to form early judgement. This requires strong critical thinking skills as there are many sources of information available to us.

An individual must use objective analysis in order to form reasonable judgement rather than accepting it as presented. This is extremely useful when interrogating information for authenticity or determining future outcomes based on factors relating to social, technological, economic, environmental,political legal, or ethical matters (STEEPLE).

Once a conclusion has been reached, the acceptance of a new future can be a challenging intellectual and emotional task, as shown by the Kübler-Ross model.

A person's ability to maintain their self-awareness, manage emotions, sense the emotions of others, maintain good levels of motivation, and demonstrate effective social skills during times of change is key.

Managing risk tends to be approached in a universal way, as shown in Figure 2, but to do so effectively depends on the ability of an individual to determine credible trends and have the emotional intelligence to navigate change.

Having now developed the ability to anticipate change, the level of acceptable risk will dictate the form of mitigation. In some cases, the form of mitigation may be unattainable due to one or more of the STEEPLE factors impacting the individual at a micro level. In such instances, the ability to formulate creative workarounds needs to be explored, and this requires grit along with a growth mindset.

This enables an individual to move through the five stages of grief remarkably quickly, determine a reasonable course of action and ultimately move to a changed, but stable, state faster.

EXPERIENCE AND FORESIGHT

The wisdom of an accomplished engineer is extremely valuable. They have the foresight and experience to be able to navigate sudden change and complex scenarios with astonishing speed, accuracy, and resilience.

Whilst experience is obtained over time, foresight can be developed rapidly through the development of the aforementioned skills and by expanding one's knowledge of the seven STEEPLE factors. This can be done through reading about concepts new and old, actively listening at cross-sector events, reflection with peers or participating in a group that outwardly demonstrates unwaveringly exceptional conduct and technical ability.

CRISIS MANAGEMENT AND THE FUTURE OF ENGINEERING

The intricacies of interconnected trends are plentiful. Because of this, it should be expected that not every trend and its associated threat or opportunity can be spotted before impact.

Individuals with different levels of resilience may need to draw on the strength of others to cope with adversity, change or challenging situations. This is where membership to a professional engineering institution or communities of practice is advantageous.

There remains a skills and age gap that may lead to future struggles, so a focus on adaptability, further learning and group discussions could increase an individual's resilience in any future crisis. It's for this reason that resilient engineering must be explored further, fostered, and practiced, ensuring the delivery of a strong and robust future for all.

Ben is the Chair of IGEM's Engineering Technician Working Group. If you're interested in becoming an IGEM EngTech member, visit www.igem.org.uk/membership for more information or call our Membership Services team on +44(0)1509 678150.

FIGURE 1 THE FIVE STAGES OF GRIEF BY KÜBLER-ROSS

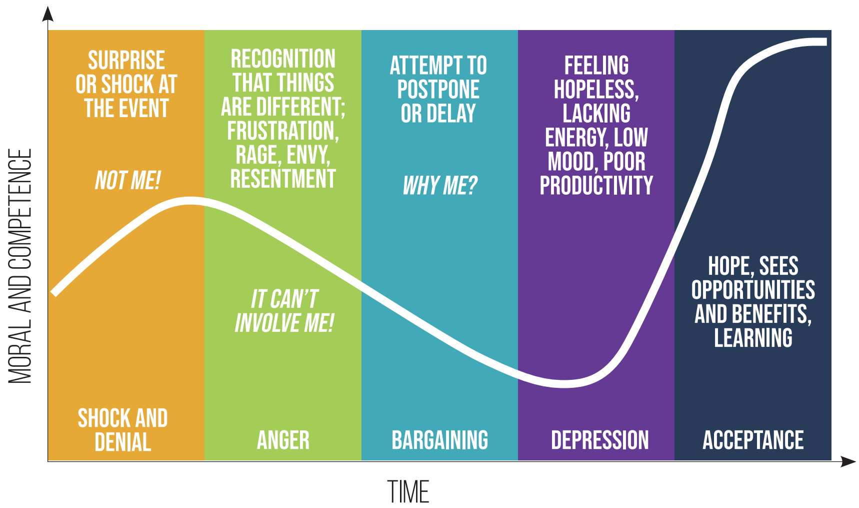
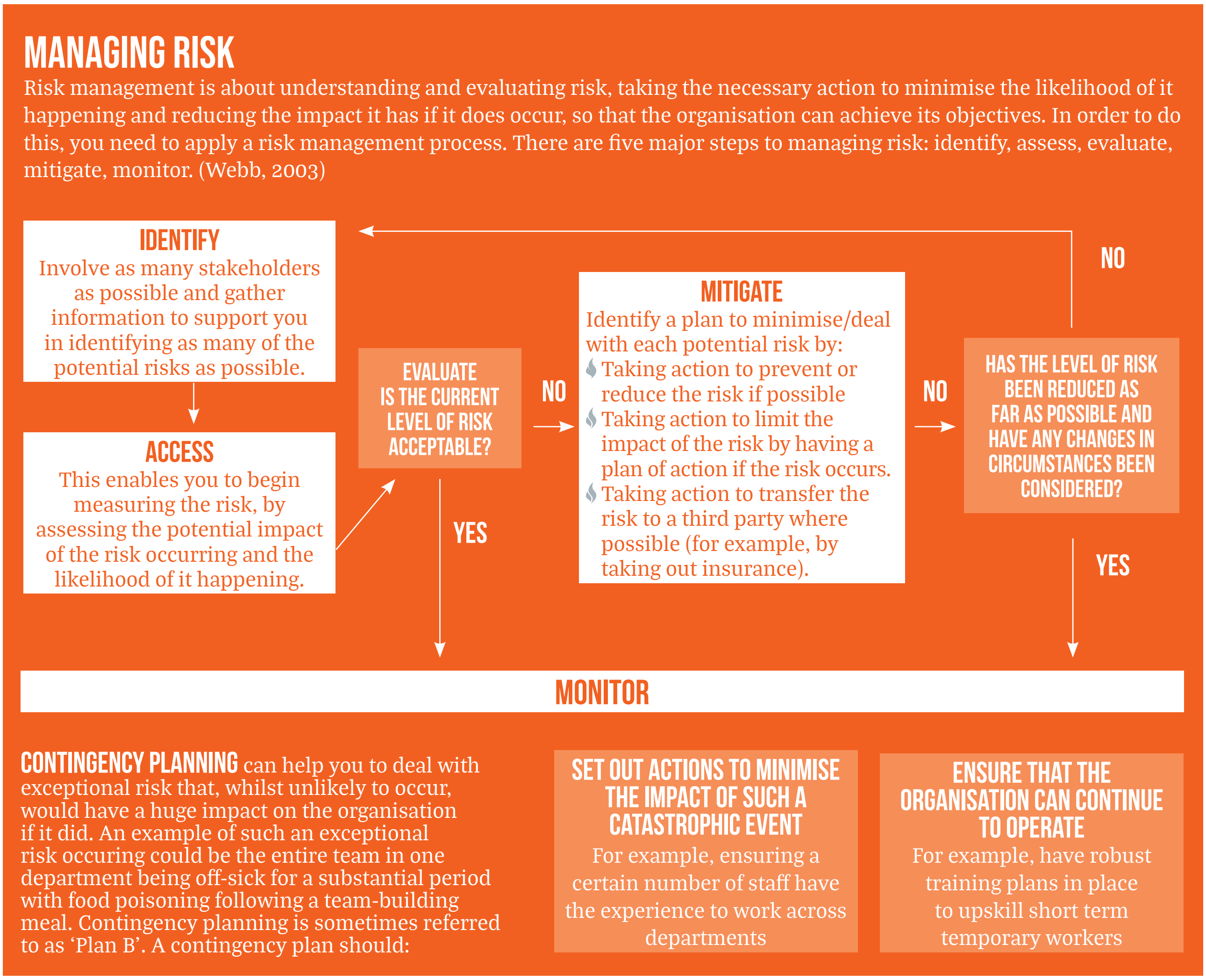


FIGURE 2. MANAGING RISK CONCEPT



SPOTLIGHT ON...

ENGTECHS

In our series of case studies, we've been speaking to some of our members, asking them about their careers to date, how IGEM has supported them up to now and what their thoughts are on the future of gas. **Lance Newhouse** is a Senior Emergency Engineer at Cadent and the recipient of the 2021 EngTech Development Grant. Here, he tells IGEM Marketing Assistant **Jodie Shepherd** his story so far

LANCE'S CAREER IN the gas industry began in 2005, when he left school aged 16 and joined a small family business called Wheildon's while completing an advanced apprenticeship in mechanical services at Lancaster and Morecambe College. He remained at the company from 2005 to 2018, undertaking various roles including working as a Gas Safe and OFTEC-registered technician. This predominantly involved commissioning, servicing, and repairing boilers and heating systems. During this time, he gained invaluable industry experience while developing his fault-finding expertise and confidence. He also successfully attained ACS accreditations and experience in domestic and commercial gas installations for both natural gas and LPG fuel types.

In 2018, Lance decided that it was time for a change and moved to a slightly larger company in a more senior role, working as a supervisor primarily with Worcester Bosch products. "I carried out plant room design and installations, boiler installations and maintenance alongside procurement and compliance," he says.

"I was fortunate enough to be provided with lots of training opportunities and mentoring, giving me a broader knowledge of other non-gas aspects of mechanical services. I was also able to mentor two employees through their gas diploma, providing them with work experience and support, which I found very rewarding. This is something I would like to continue going forward."

Another change came in 2020, when he made the decision to change direction within the industry, joining a much larger company, Cadent, to aid his development and progression. He started work as an Emergency Gas Engineer at Cadent in January 2021. "This new role has given me an appetite for the industry and I am constantly looking to engage with new opportunities," he says.

"Most of my work at Cadent involves responding to gas emergencies such as gas escapes, carbon monoxide alarms, fires, explosions and supply/pressure related issues.

"Since joining IGEM, I've actively encouraged colleagues to join. I would also recommend applying for the grant"

"I enjoy working with a wide cross-section of society and having a customer facing role. It's important to me to provide excellent customer service and support vulnerable members of society - something which is also a key part of the Cadent ethos."

In March 2021, Lance was successful in attaining EngTech membership with IGEM and has enjoyed an exciting year, also receiving the 2021 EngTech Development Grant, which he says he was "delighted" to receive.

"So far, I've used the funding to complete two IOSH courses and I am nearing completion of the NEBOSH General Certificate. I am hoping to move forward with an Engineering HNC in the future. I'd like to give a special thanks to Sheila Lauchlan and David Tomkin for their support during this process.

"During my short membership at IGEM, I've enjoyed interacting with people of varying levels and disciplines within the gas industry. I have just been promoted to Senior Engineer within my current role and hopefully my completion of the NEBOSH course will lead to further opportunities."

Lance joined IGEM because he's constantly looking for ways to better himself and develop his knowledge. As an IGEM member, he was recently able to attend the Hydrogen Homes Project as part of the Young Person's Network, where he says he enjoyed meeting a broad range of people from various

fields within the industry including the YPN Chair George Brookfield.

Lance is keen to advocate joining IGEM to other field force staff, so that they too can empower their professional development – especially given that IGEM membership isn't overly prevalent amongst field force engineers in his region.

"Since joining IGEM, I've actively encouraged colleagues to join. I would also recommend applying for the grant. I was apprehensive about applying for it myself at first as I had only recently become a member, but I'm glad I did – if you are considering apply for it, just go for it," he says.

"I feel that becoming professionally registered has provided a milestone in my career and a springboard for further career opportunities. It feels good to have recognition from a professional body memorialising my experience and ability.

"IGEM brings together people from all areas of the gas industry, at all stages of their career journeys, affording networking opportunities to people who wouldn't normally work together. If you need information about anything, it's useful to have a broad range of people to turn to for support and advice."

Discussing his thoughts on the future of gas, Lance notes that the future of gas clearly must evolve to tackle climate and environmental change. He believes that the gas industry will remain relevant as the main provider of heat energy for decades to come. "Hydrogen certainly appears to offer a promising alternative and we are at an exciting crossroads within the industry," he adds.

He also extends special thanks to his current managers, Cadent's Gareth Lloyd, Matthew Harbour and Chris Cocker, who he says have been a "great source of inspiration, encouragement and support" in his career, all having risen through the ranks from being Gas Safe engineers themselves.

If you're interested in becoming an IGEM EngTech member, visit www.igem.org.uk/membership for more information or call our Membership Services team on +44(0)1509 678150.

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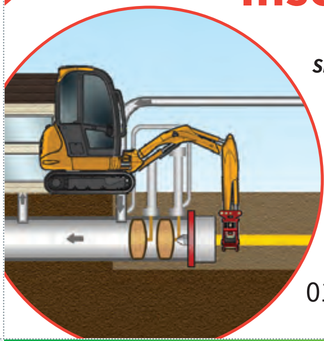

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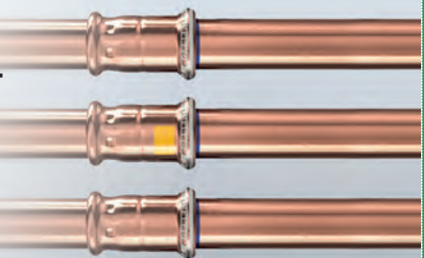

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