INTRODUCTION

2020 was anticipated to be a pivotal year for the climate agenda.

We had become the first economy to commit to net zero carbon emissions by 2050, Glasgow was due to host the UN Climate Conference - the largest gathering on global warming since the Paris Agreement was signed in 2015 - and newly elected Prime Minister Boris Johnson promised “to make this country the cleanest, greenest on earth”.

We’d experienced a year of record-breaking disasters – from hurricanes in the Atlantic to wildfires in Australia – met with rising outrage among young activists who skipped school and took to the streets.

The world had finally woken up to the climate emergency, and 2020 was the year for serious change.

Cue COVID-19. A modern-day plague that has fundamentally changed every aspect of our lives. An unprecedented health and economic crisis on a global scale.

To date in the UK, the pandemic has killed over - people, caused around - redundancies and we’re facing the biggest economic collapse since the Great Depression of the 30’s.

No one knows what the next 6 months will bring, but as we start to build back our economy, it’s critical we don’t lose sight of our Net Zero commitments.

During lockdown nature momentarily enjoyed a pause from the polluting effects of human activity.

With fewer planes in the air and cars on the road, UK air pollution fell by over 60%, we went two months without burning coal, and greenhouse gas emissions dropped by an unprecedented 27%.

However, these figures are no cause for celebration. This is not the result of decarbonising our economy, but the unintended consequence of economic paralysis, with huge costs to our lives.

Analysis suggests that even if these measures lasted until the end of 2021, global temperatures would only be 0.01 degrees lower than expected by 2030.

So, we’re now faced with two options; recover the carbon-intensive economy that has set us on a path to environmental destruction or accelerate efforts towards a net zero future that will prioritise the health of people and planet.

WHAT IS NET ZERO?

In June 2019, the UK became the first major economy in the world to commit to net zero greenhouse gas emissions by 2050. This means that in 30 years, all emissions produced must be offset by the equivalent removed from the atmosphere, through natural carbon sinks such as oceans and forests.

Put simply, we reach net zero when the amount we produce is no more than the amount we remove.

Now, it’s estimated that over the next 40 years, 230 billion square metres of new construction will be built across the globe - the equivalent of adding Paris to the planet every week.

This means we must act now to decarbonise our buildings, not just to meet government targets, but to ensure a better future for all.

100% of UK buildings need to be decarbonised by 2050, and to get there we'll need to make substantial changes to the way we build, manage and heat our homes.

THE HISTORY OF HEAT

Heat like electricity is generated. For heat generation to work well it, requires sophisticated equipment to serve communities and achieve economies of scale that wouldn't otherwise be available to the individual.

We generate heat by burning fossil fuels such as coal, oil and natural gas which releases Carbon Dioxide (or CO2) into the atmosphere.

It therefore follows that if we generate heat more efficiently, using fewer fossil fuels in the process, we will actively reduce our CO2 production and contribution to global warming.

Our leading scientists are working tirelessly to discover the "holy grail" of green heat production. However, whilst we wait for a breakthrough, we still need to keep our homes warm and our water hot.

It wasn't that long ago when most households didn't have the benefit of central heating or running hot water. Instead, many would use open coal fires and a range to generate hot water for the weekly routine of a bath, which in many cases would be enjoyed by the whole family in rotation.

The advent of the electric immersion heater and domestic-scale gas boiler allowed for wider affordability, and many homes were able to enjoy a ready supply of heat and hot water in increasing abundance.

This represented a significant evolutionary move from the Victorian model, where a plentiful supply of heat and hot water was for the privileged few. Now, as a society, we consider access to heat and hot water very much a necessity of modern life.

The thought of needing to stoke the boiler or light an open fire is a distant memory for the majority, whilst those with no memory of these tasks would view them as a throwback to Dickensian England.

Heat production has evolved dramatically over the decades and we've now arrived at the point of "on-tap" supply, although the underlying principle remains the same. We're still unlocking heat from one form and transferring thermal energy into another, harnessing this heat to keep our homes habitable and our showers warm.

We have pressures coming in from several directions. Our stocks of North Sea gas are dwindling, if not already expired, and we seek to extract oil and gas from ever more challenging environments.

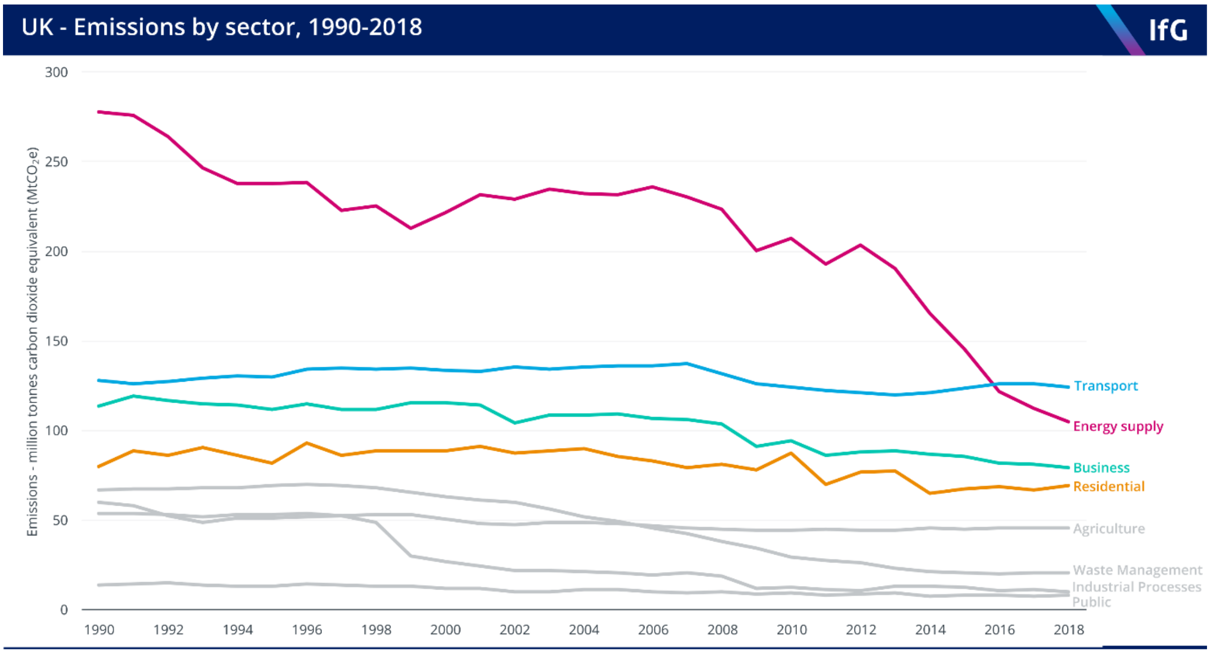
We import vast quantities from our neighbours, transporting gas over entire continents. For example, we receive gas via a pipeline that runs all the way from Russia to the UK, travelling in part through the many territorial waters of the Baltic sea.

Liquified natural gas also arrives by sea, typically to Milford Haven, where vast tankers unload, and gas undergoes regasification before entering the UK distribution network.

All of this demonstrates the great lengths we as a society go to heat our homes.

THE CHALLENGE OF DECARBONISING HEAT

As this graph shows, the four highest-emitting sectors are transportation, energy supply, residential and business usage.



Source: Institute for Government analysis of: *Final UK greenhouse gas emissions national statistics*, BEIS, February 2020
Note: Net negative emissions from LULUCF not shown.

The challenge of meeting net zero is feasible but ambitious. For it to be achieved, we'll need to evolve as a nation and develop new technologies that will reduce the amount of CO2 we emit into the atmosphere.

To understand the challenge and arrive at possible answers, it's important we recognise the underlying factors that could influence the effectiveness of any strategy that might be adopted.

We understand the first law of thermodynamics; that energy can be transformed from one form to another but cannot be created or destroyed.

We also know that if we supply a certain amount of energy to a home, in theory at least, this energy should not escape unless we let it.

But is this the case?

Let's start from the beginning; fossil fuel in the form of natural gas arrives at a gas meter.

Now, the calorific value of this gas may change, but ultimately, we have a single unit of energy which will remain in this form until it's required for use.

When this time comes, the energy is released through a process known as "hydrocarbon combustion", a chemical process that involves hydrocarbon reacting with oxygen to create heat, water and CO2.

The water and CO2 produced represent by-products with limited use and are simply expelled through the boiler flue into the atmosphere.

The useful bit, heat, is then thermally transferred through an exchanger to a medium, which transports the converted energy for use within the home.

This is the conversion of energy. It exists in its original form until it's transformed into something else or transferred from one place to another.

For example, a lightbulb converts electricity into light, which is then absorbed by a surface and converted back to heat.

So, what's the problem?

Unfortunately, the reality is that at the point of use, the energy enjoyed is of significantly less value than the initial unit of energy that entered the gas meter.

This is because not all energy is retained during the exchange process. Some is lost through boiler fabric and exhaust gases, and a good amount is lost through distribution to emitting devices.

But what we need to remember is that this energy hasn't just disappeared. It still exists - just not necessarily in the form we want it.

Our interest is how we can access heat and harness it efficiently to be applied with maximum effect.

Mainland Europe has many innovative ways to harness heat that would have otherwise been written off as a worthless by-product.

An example of repurposing heat would be a pulping mill in Scandinavia. Here, residents enjoy a plentiful source that is circulated to large areas of the population to heat their homes.

The UK has similar sources - typically industry - however in most cases, the population and the heat source are not sufficiently close to make the principle workable, and therefore cannot be viewed as a providing a quick fix.

The UK's options are therefore increasingly limited. Our infrastructure is dependent on natural gas in the absence of any other fuel, our reserves are dwindling, and we're increasingly dependent on imports to fill the gap.

Our only option is to make our energy go further in a way that is environmentally sound. But how do we do that?

Theoretically it's simple; by improving efficiency we will in turn preserve our energy.

The efficiency ratio is a measure between what is received by the consumer, versus the energy entering the home. Inefficiencies representing *forgotten* or *lost* energy are the areas we must target in order to drive efficiency.

What we need to do is harness our energy and do as much as we can to preserve it for use where required, and not lose it along the way.

Imagine you buy a kilogram of sweets and accidentally drop half on the way home, that's a loss of 50%. You enjoy the remaining sweets when you get home, however half the weight you originally purchased has effectively cost you double. Make sense?

Efficiencies are critical in this equation, and the key would seem to be two-fold:

1. We must make buildings more thermally efficient, and
2. We must use energy more efficiently

Considering point 1, most new builds constructed have amazing insulation qualities. However, in some instances they are so well insulated that they actually overheat, which is of no benefit to our net zero efforts. Considering this, we can to an extent rule out the thermal qualities of buildings as a route to energy preservation.

The objective of point 2 is to achieve 100% efficiency with no waste, however at present this isn’t possible due to the simple practicalities of controlling energy and how it’s lost.

Although we’re developing technology that will help us retain energy in the future, today, energy loss is a reality that must be accepted. But how much of a loss is acceptable?

When we look at how we’ve heated our homes from the arrival of the North Sea gas, there’s a policy in place that allows homes to select an option for a heat, typically gas, electricity, coal and oil.

Coal and oil are now considered unsuitable for urban environments and electricity is regarded expensive in comparison to natural gas. Therefore, gas has prevailed, mainly due to the costs that apply.

The UK strategy has been to install independent heat generation solutions within every new home. This has proved a sound principle, allowing individual dwellings to decide how these systems are operated, maintained and so on.

However, this means that invariably performance efficiencies will differ and will be largely dependent on how much owners are willing to invest. Therefore, it could be argued that this is the area to target, but is it realistic?

Unfortunately not, as the retrofit principle would be difficult to enforce. However, it is possible to change the way we approach heating new homes, using technology to monitor how the heat is used.

The Government has pledged that from 2025, installation of individual gas boilers in new homes will be banned. This in effect means the solution of choice for house builders has been removed, and alternatives are required to meet our decarbonisation principles.

Fortunately, there’s already an alternative that’s gaining increasing traction, though it’s not an entirely new principle.

The alternative is a Heat Network; a solution that can be traced right back to the Victorian times and was marginalised by the introduction of the independent boiler solution.

Heat networks remain a popular solution for social housing requirements, where largescale developments can benefit from industrial scale heat production at a competitive price.

When looking outside of the UK, it’s surprising to find that heat networks are a common solution in many European cities. This makes perfect sense, particularly where there’s a localised source of heat that’s a by-product of another process.

We’re is now looking towards Germany and Scandinavia, and seemingly we have all the evidence on our doorstep that this tried and tested solution is readily available and could be applied to the UK.

So, what is a heat network?

WHAT IS A HEAT NETWORK?

A heat network supplies heat in the form of hot water from the point of generation to the point of use. It's a similar principle to electricity, whereby energy is generated at a power station and distributed through power lines up and down the country, just not on the same scale.

The scale of heat networks can vary from a few users in a small block of flats to thousands spread across numerous buildings.

For instance, the Olympic Park in Stratford has a heat network supplying almost 3,000 homes, making it one of the largest in the country.

Heat networks generate energy in a way that is low carbon. Using economies of scale, it's possible to reduce the average amount of fossil fuel per home when compared to alternative technologies.

Longer-term, there are possibilities that will allow the fossil fuel heat source to be switched out for a zero-carbon alternative, typically hydrogen.

The key objectives of heat networks are to:

- Reduce carbon emissions through careful design and operation, delivering high efficiency levels
- Ensure the cost of heat is competitive when compared to other sources
- and provide a reliable heat supply 24/7

The benefit of heat networks is that when operated well, they deliver "on tap" low-carbon heat and efficiency levels that will reduce the cost per unit supplied.

The downside is complexity. Heat networks are highly sophisticated systems that deliver results when properly designed, commissioned and installed. Like all complex solutions, to ensure optimum performance the underlying engineering requires technical expertise.

STAKEHOLDERS

Heat network stakeholders fall into five main categories, and involvement will vary throughout the heat network life cycle.

First there's the **Developer**, who has the objective of delivering a development that can be sold at a margin, to cover the investment and speculation risks that apply.

Designers work for the developer, refining ideas to allow the planning process to run, and producing specifications for the construction phase.

Constructors then bring the project to reality, managing all elements including installation of the heat network and delivering a completed building to be handed over.

The completed building is then handed over to the **Managing Agent**, who is then responsible for operating the heat network for the benefit of occupants, typically the **Leaseholders or Tenants**.

COMPONENTS OF A HEAT NETWORK

The first component of a heat network is the basement **Energy Centre**, home to array of complex plant and equipment such as a boiler, pumps, valves and control system. Here heat is generated and circulated around the building via the Distribution Network, to be extracted for use.

The **Distribution Network** is a system of pipes that travel around the building to each apartment. These pipes are heavily insulated to minimise energy losses, and depending on the scale of the network, there will be intermediate heat exchangers to provide hydraulic separation.

Each apartment has a **Consumer Level Interface** installed, typically a Heat Interface Unit, which allows the consumer to access heat and adjust controls to suit personal preferences.

A **Heat Meter** records the amount of energy removed from the heat network by the consumer. This consumption data is then used by a billing agent to raise charges for the heat used.

COMMON ISSUES ARISING WITH HEAT NETWORKS

Given the overall complexity of heat networks, there will be some areas that fall short of the ideal.

Typically, heat losses from distribution will cause a building to overheat. This is especially noticeable in new builds with high levels of building insulation where heat losses are low. Inadequate pipework insulation will release heat, increasing ambient air temperatures.

Another issue is an over-sized or poorly designed energy centre. Designers have a habit of over-engineering to protect their professional indemnity insurance, which often results in increased running costs. It might not be immediately obvious; however, this will have an influence on carbon emissions.

There’s often a disconnect between the Managing Agent and Construction Team, which ultimately results in a poor handover process. This is a key moment in the heat network lifecycle, when vital information is exchanged which will allow the Managing Agent to run the system effectively.

The success of a heat network is defined by the consumer experience. If residents receive a poor service, typically involving high costs or an unreliable supply, there’s little interest in the low-carbon benefit, meaning the whole concept becomes flawed.

HOW PM’S SHOULD ADAPT TO GET THE MOST FROM A HEAT NETWORK

Heat networks need to be technically complex, by harnessing elements of advanced engineering to ensure heat is generated as efficiently as possible. These systems are not intended for operation by the traditional heating engineer; they’re carefully designed and require specialist expertise to operate effectively.

This is commonly overlooked, and many heat networks fail to meet expectations due to the technical abilities of those who operate them.

The typical plant life of a heat network should be at least 50 years, however poor maintenance often compromises the longevity of these systems.

There are minimum requirements that apply for those responsible for operation and maintenance, including certification in various ISO standards. (listed)

To ensure an effective heat network, there are five crucial areas a property manager should focus on:

Pre-handover preparation

The heat network must be reviewed and assessed prior to handover. This is a key opportunity to address any non-conformities with the developer and contractors whilst they're still onsite.

Handover from Developer to Managing Agent

This process must comply with CIBSE and BSRIA guidance documents.

If in any doubt, the managing agent should not accept handover of the heat network. It's important to understand responsibilities will start from the day they system is handed over, and generally can't be reversed once formally complete.

Most importantly, be sure to take a photograph of the gas meter as a record during the handover process.

Commissioning Data

Commissioning documents should be handed over to confirm all plant and equipment has been installed to manufacturer requirements. Documentation should cover

- The energy centre and plant room
- Control and distribution systems
- Heat interface units
- Heat metering and meter reading platforms, including data logging equipment, and
- System dosing information

Operation and Maintenance (or O&M) Manuals

These documents should be reviewed for thoroughness and made sure to contain

- Manufacturer literature and operation and maintenance instruction
- Health and safety information
- Compliance with mandatory and statutory requirements

Remember, many constructors rely on subcontractors to provide their respective sections within the O&M documentation, so it will often be delivered to differing standards.

Ongoing Operation

Following handover, the Managing Agent is required to operate the heat network for the benefit of all residents. The following elements are crucial to delivering resident expectations:

- The **health and safety** of everyone involved in the heat network, typically leaseholders or maintenance engineers, should be a priority

- There should be **sound legal frameworks** in place, typically via the lease, and in some cases a separate standalone Heat Supply Agreement

- **Precise maintenance regimes** should be enforced to achieve carbon objectives, prolong equipment life and ensure reliability and value for money.

- **Operative monitoring** will provide an understanding of actual system performance in relation to projected performance and efficiency levels.

- An **effective metering system** is essential to comply with requirements under the Heat Network Regulations.

- A **billing platform** will allow for accurate recharging of heat, and

- A **debt management system** will reduce the impact of bad debt and non-payment.

- Finally, remember that transparency is key, and residents should be updated on any tariff and price reviews that apply.

The success of a heat network is defined by consumer experience, and all of these factors must be considered to build confidence and incentivise these systems to progress.

It’s recognised we’re facing serious, if not irreversible environmental damage, and we must act now to decarbonise and create environmentally sound places to live.

We all have a role to play, and the property industry can make a valuable contribution by investing in low-carbon solutions that will benefit both people and planet.

We have no option but to change our ways now or face the catastrophic consequences of inaction.