H21: Public perceptions of converting the gas network to hydrogen

Introduction

The next decade will see fundamental changes in how people heat their homes. The global energy system is changing in response to the need to transition away from fossil-based generation towards more environmentally sustainable alternatives.

Hydrogen offers one such alternative, but currently there is limited understanding of public perceptions of hydrogen, the information that people need in order to make an informed choice about using hydrogen in their homes, and how misunderstandings could present barriers to the uptake of hydrogen technology. Gaining greater understanding of public perceptions is crucial to ensure the success of future policy and investment.

The H21 concept is to convert the UK gas distribution network to 100% hydrogen over time, thereby decarbonising heat and supporting decarbonisation of electric, large industrials and transport. This would be achieved using the existing UK gas grid network and technology available across the world today, whilst maintaining the benefits of gas and the gas networks in the energy mix for the long-term future. Additionally, this would maintain choice of energy for customers, i.e. they would be able to use both gas and electricity.

The H21 project is being delivered by the UK gas distribution networks Northern Gas Networks, Cadent, Wales & West Utilities and SGN. It consists of an experimentation and testing programme, supported by the Health & Safety Executive Science Division (HSE-SD) and DNV GL, which provides evidence on whether the GB distribution network of 2032 will be as safe operating on 100% hydrogen as it is on natural gas.

As part of the H21 project, Leeds Beckett University has been working with Northern Gas Networks to gain insight into public perceptions of hydrogen as a domestic fuel. Using innovative social science methods, the research team explored, for the first time, public perceptions of moving the UK domestic fuel supply to 100% hydrogen. We have identified what people think and feel about a potential conversion, the concerns and questions that they have, and how to address them clearly. The findings presented in this report will ensure that issues around the current perception of hydrogen are identified and addressed prior to any large-scale technology rollout.

↑ Stage 04 Explaining the conversion

Methods

STARTING POINT

01

01) Discovery interviews

12 interviews to explore how to talk to people about hydrogen and the H21 project and to establish the topics that might underpin their response to a potential hydrogen conversion.

02

02) Profiling the population

An online survey with over 1000 people to identify attitudes to a hydrogen conversion, and how these align with energy-related attitudes and behaviours.

03

03) Deliberative workshops

Deliberative workshops are facilitated group discussions that encourage participants to explore an issue in depth, challenge each other's views, and to consider evidence on the issue so that they can reflect on it and reach an informed view.

04

04) Explanation of the potential conversion

Together with the experts, our participants co-designed clear and easy-to-understand explanations that answer the questions they believe the public will have if the conversion goes ahead.

FINISH POINT

The results

The results highlight the need to develop a suite of communication resources for the general public.

This diagram shows an overview of the different research stages

Population profile of attitudes to hydrogen

We used a two-stage process to identify the attitudes that the public have towards a potential conversion of their domestic gas supply to hydrogen. The first stage comprised a series of discovery interviews, which explored how to talk to people about hydrogen and the H21 project.

The interviews covered:

- current and previous use of gas in the home
- how and why energy is valued
- thoughts on where gas and electricity come from
- imagined responses to a scenario of the current gas supply ceasing, and being replaced with an unspecified “new gas”
- response to a potential hydrogen conversion

Stage 03
Deliberative Workshops

Stage 01

None of the participants were aware of hydrogen as a domestic fuel, although a few had heard of hydrogen fuel cells used in vehicles. Most had given very little thought about where their gas and electric comes from and had very little interest in it, although a few were concerned about fracking. Other than switching supplier to get a better tariff, their domestic energy supply is simply something that is there at the flick of a switch or the turn of a knob and is not something that they think about. They had not previously considered their domestic heating as a source of carbon emissions and were surprised that there may be a need in the future to change their gas supply. They had very little concern about safety of either their current supply or a future hydrogen supply. They assumed that if hydrogen were supplied to their home it would have been thoroughly tested and found to be safe. They were more concerned about getting enough notice of a future change so that they don’t buy new appliances that soon become obsolete.

Most had given very little thought about where their gas and electric comes from.

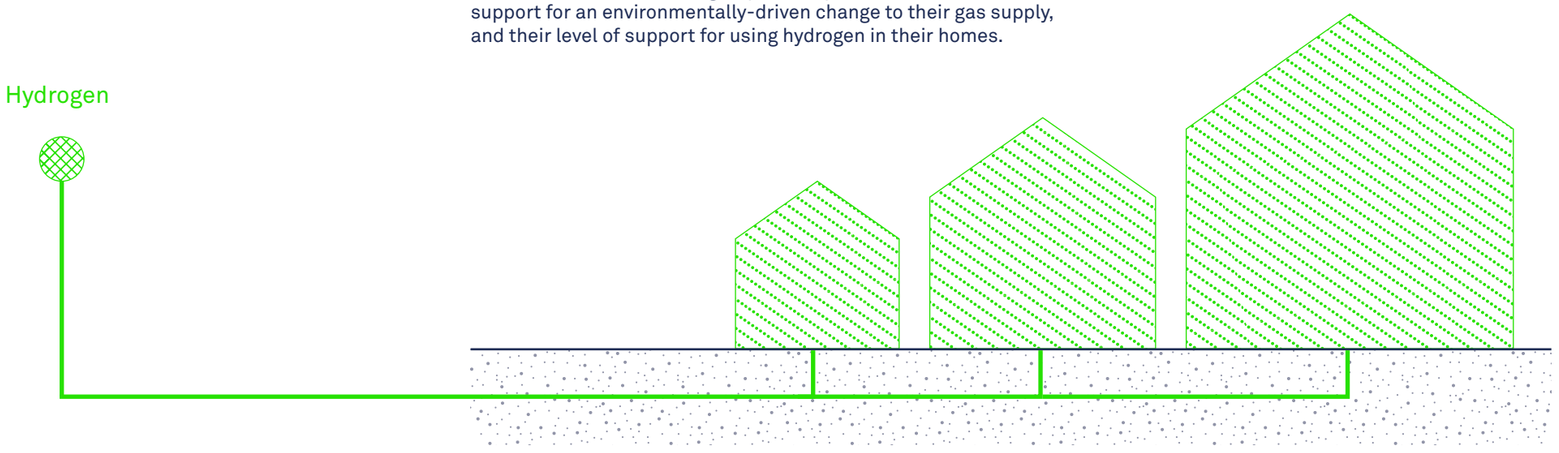
From the discovery interviews, we identified several key areas to explore in the next stage of the work.

- Beliefs about the environment
- Beliefs about inconvenience and cost
- Beliefs about safety
- Beliefs about the economic impact

Stage 02

The second stage involved a survey with a representative sample of the UK population.

The survey comprised over 50 questions with over 1000 respondents to identify the different attitudes that people have about the key topics identified in the interviews. Our analysis of the survey results identified five sub-groups of respondents, based on their support for an environmentally-driven change to their gas supply, and their level of support for using hydrogen in their homes.



Second stage survey results

Stage 02

Although the groups differed in their attitudes several areas of consensus were identified, offering insight into messages that may have cross-cutting impact:

All groups agreed that investing in technology to support environmental wellbeing was a priority. Messages that highlight the environmental benefits of hydrogen are well received.

There was scepticism amongst all groups around the motivations behind environmental action and the transition to hydrogen. It is important to be clear on motivations and benefits.

20%

Group 1
Accepters

This group is positive about a change to their gas supply and in favour of using hydrogen. People accept changes to their lives in order to reduce climate change and improve the environment, believing that climate change is a significant challenge that needs to be addressed. Effective messages for Group 1 are environmentally focused, with reassurances centred on cost and safety.

28%

Group 2
Cautious

This group is positive about a change to their gas supply but unsure about using hydrogen. They share similar attitudes to Group 1, but have less confidence in their own knowledge and understanding of climate change issues and this impacts their willingness to change. They are motivated by the environmental benefits of a hydrogen conversion but are more concerned about the likely disruption.

30%

Group 3
Disinterested

This group is unsure about a change to their gas supply and also unsure about using hydrogen. Despite believing in the importance of climate change, they are disinterested in a potential hydrogen conversion as they do not believe they understand the issue well enough. As a result, the most appealing messages for Group 3 are centred on safety, cost, and the local economy rather than environmental benefits.

10%

Group 4
Unconvinced

This group is concerned about a change to their gas supply and unsure about using hydrogen. They are concerned about climate change but lack confidence in their knowledge of the issues, which means they are unconvinced that a transition to hydrogen is the most appropriate response. They want to be reassured about cost.

12%

Group 5
Rejecters

This group holds mixed views about a change to their gas supply and are against using hydrogen. They do not accept the role of humans in climate change and are reluctant to make lifestyle changes to reduce their environmental impact. They reject the need for a hydrogen conversion and are sceptical about the need for a change. They need convincing that hydrogen is a novel,renewable energy technology and need reassurance about safety, cost and disruption.

Group 1 Group 2 Group 3 Group 4 Group 5

Explaining a hydrogen conversion

Stage 03

It's particularly important to communicate effectively with groups 2, 3 and 4 because they form a large proportion of the population (68%) who are undecided about their response to a potential hydrogen conversion. They will be unable to make an informed choice about using hydrogen in their home if they receive information that they misunderstand or that generates unnecessary fears. The next stage of the research involved people in these groups, together with hydrogen experts, exploring their questions about a potential conversion and their responses to it, and co-designing explanations of what would happen. We held deliberative workshops in three locations: Leeds, Manchester and Birmingham. In each location eight members of the public (our participants) and three hydrogen experts attended two workshops, held two weeks apart. In the first we introduced the concept of a hydrogen conversion and facilitated discussion between the public and the experts. In between the two workshops, participants were given the task of interviewing a friend or family member about the conversion and sending us the audio recording of the interview. The same participants returned for the second workshop to discuss their experiences of conducting the interviews, the responses of their interviewees and to develop a set of explanations of the conversion.

We identified six themes that describe the questions and concerns that participants and their interviewees had and how participants' views evolved from their first reaction to a more informed and reflective position.

Theme 01

Justifying a hydrogen conversion

Even though all our participants were in groups 2, 3 and 4, and so were initially unsure about a hydrogen conversion, over the course of the two workshops, they all accepted a potential conversion and promoted its benefits to others. A few were sceptical about the impact of a UK hydrogen conversion to global carbon emissions and believed that there is little point in the UK converting to hydrogen if other countries are not going to do so. Others, however, were enthused by the UK leading the world in hydrogen technologies.

I didn't realise that gas was such a big influence to the environment and everything….You don't assume heating your house is a big thing

(DW1, Manchester)

It sounds a bit like a no-brainer.

(DW1, Leeds)

Theme 02

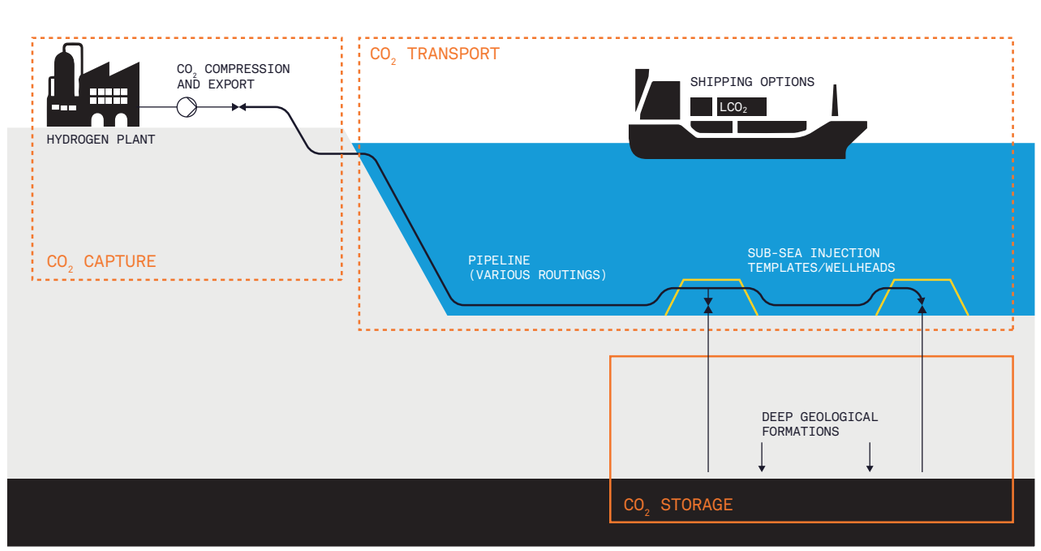
Where does hydrogen come from?

Participants wanted to know where hydrogen comes from and how it is produced. Few were aware of the different methods of producing hydrogen and most accepted that, in the short term, the process of producing hydrogen would involve carbon being captured and stored.

They were keen that action is taken to reduce carbon emissions in parallel with research on alternative production methods, rather than no action taken until all the technical solutions have been developed. A few questioned whether enough research resources are being dedicated to finding a sustainable method of producing hydrogen but most tolerated the uncertainty about when technology will be sufficiently advanced to produce sustainable hydrogen at scale.

They're going to just separate it because it's one-part carbon, four-parts hydrogen. Separate the carbon, which is the bit that we're not okay with, pump that back into the ground in the salt caves. Obviously keep that sealed, and the hydrogen's going to go from there, straight to our home, and we'll have zero carbon in our homes.

(DW1, Manchester)



↑ Carbon capture, storage and transport method.

Theme 03

Cost

Our participants were relatively unconcerned about the estimated 7% by which their gas bill could increase should a conversion go ahead, although they were concerned that other more vulnerable people might struggle. When explaining the conversion to others, they highlighted the potential cost of not taking action. They were, however, concerned about the need to purchase new appliances and wanted reassurance that there would be an incentive scheme to help with the cost.

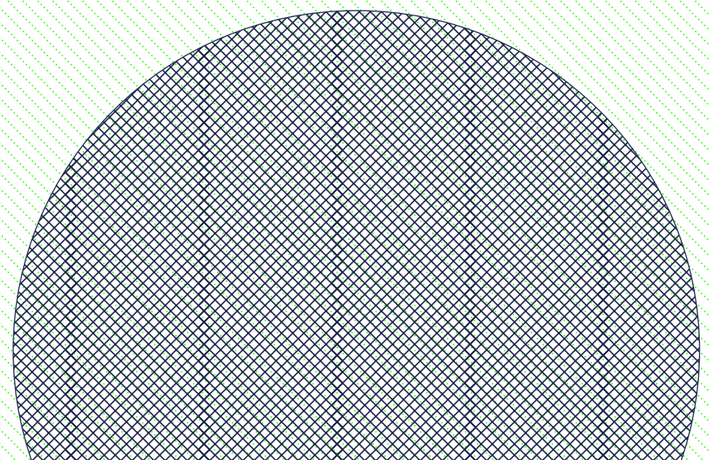
I know people who would struggle with the increases a bit.
(DW1, Manchester)

There will be a cost to you…. Having said that, it's for your children, and your children's children, and their children. It's very important, if we don't do something about this climate change, then obviously we're not going to have the world as we know it at the moment.
(DW1, Birmingham)

Projected average gas bill 2035

The 7% increase a hydrogen conversion would add to the average 2035 gas bill

(source: H21 North of England report, 2018)

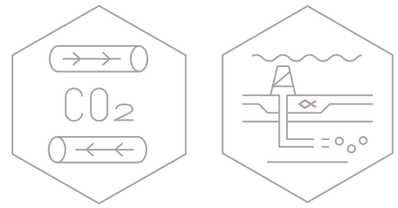


Theme 04

Safety

The results show that safety is not a major concern for most people: they assume that if their supply is converted to hydrogen then it will have been robustly tested and found to be safe. Indeed, they appreciate the safety benefit that hydrogen carries no risk of carbon monoxide poisoning. There were more concerns about how securely carbon dioxide is stored during the process of Carbon Capture and Storage than the safety of hydrogen in their home.

The idea is that hydrogen will be used, and it will be no less safe than methane.
(DW3, Leeds)



Theme 05

Practicalities

Participants queried whether they would be able to choose to remain on their current type of gas (i.e. methane) and were surprised when they found out that their only choice was to switch to hydrogen or electricity. They had questions about what they would need to do to prepare for a conversion but most assumed the impact would be minimal. They had questions about whether there will be any disruption from roads being dug up to replace pipes, how long the process will take, whether they will notice any difference in how their appliances work, and how they will find out about the conversion. Nobody asked how long their gas might be disconnected for, instead assuming that it would be hours rather than days.

What do we need to do to be prepared? Does anything need to change in my house?
(DW1, Leeds)

Theme 06

Timing and certainty

There were concerns about whether a decision will be made about the conversion quickly enough to prevent irreversible environmental damage arising from climate change, and also that people would be given sufficient notice so that they can avoid purchasing expensive appliances that may soon become obsolete.

Just say 'Right, this is happening' Maybe this is the one thing that people would probably accept: to save our planet, this has to happen. We can't wait 20 years, 30 years to educate people.

(DW1, Birmingham)

The explanations that participants gave their interviewees about the hydrogen conversion showed two striking features.

First, their explanations included complex technical information which they managed to convey to their interviewees in a simple and easy-to-understand way.

The second striking point is that none of the participants gave negative or critical accounts of the potential conversion. They were specifically told that they were not being asked to "sell" the conversion but simply to explain what might happen and to answer any questions the person they were interviewing might have. Despite this, all the participants gave a positive account, stressing the importance of taking action and the environmental benefits that a conversion would bring. Several also highlighted that the UK has an opportunity to lead by example in using hydrogen technology to address carbon emissions.

The insight gained from the first deliberative workshop and the interviews was used to develop a draft set of explanations of a potential hydrogen conversion in a way that is relevant and easy to understand. During the second deliberative workshop, participants refined the explanations. They highlighted the importance of using concise language and definite statements, rather than long descriptions and information that dwelled on the current uncertainties. The final set of explanations developed by the participants addresses what people want to know should a conversion go ahead, so they assume the decision to convert has already been made.

↖ Stage 03
Deliberative workshops

↖ Stage 03 Deliberative
Workshops

Participant explanations of a hydrogen conversion

Stage 04

→ Why are we converting to hydrogen?

The gas that we currently use to heat our homes – methane – releases carbon dioxide when we use it, and carbon emissions are causing climate change. Hydrogen doesn't contain any carbon: it only produces water and heat when we use it.

→ Do we have to convert to hydrogen?

You can't keep using methane when your area is converted as it will no longer be available. It doesn't matter which company currently supplies your gas as they will all change from supplying methane to supplying hydrogen. But you can choose to use electric appliances instead, if you prefer.

→ When will the conversion happen?

It will start in the late 2020s, and gradually the whole country will be converted by 2050.

→ What do we need to do to be prepared?

Over the next few years, hydrogen-ready appliances will be available. If you have them, then when your area is converted a gas engineer will visit your home and simply make some adjustments to your appliances. If you don't have hydrogen-ready appliances, you will need to replace them. There may be incentive schemes to help with the cost.

→ Will my gas bill increase?

Yes, your gas will cost a little more, and we expect that people's bills will rise by less than 10%.

→ Will I get more information?

You will receive lots of information and plenty of notice of when your home will be converted. There will be information officers and gas engineers visiting every property to make sure everybody knows what is happening and to check that the conversion will go smoothly and safely.

→ Will hydrogen use the existing gas network?

Yes, so there will be no need to dig all the roads up to replace all the pipes. Disruption will be minimised.

→ How is hydrogen produced?

Hydrogen is the most abundant gas in the universe but pure hydrogen doesn't exist in nature, it's always with other elements. For example, hydrogen is in water: it is the H in H_2O. At the moment there are two main ways of producing hydrogen. We can break up water into hydrogen and oxygen, and this will be the main method in the future as technology improves. At the moment, most hydrogen is made from methane (which is the natural gas we use in our homes at the moment). Methane is four hydrogen atoms and one carbon atom, so we can remove and store the carbon, leaving hydrogen.

→ Where is the carbon dioxide stored?

It is stored securely underground in rocks and caverns where the natural gas originally came from. Once a cavern is full of carbon dioxide it is sealed and regularly inspected to make sure it remains safe.

→ Is hydrogen safe?

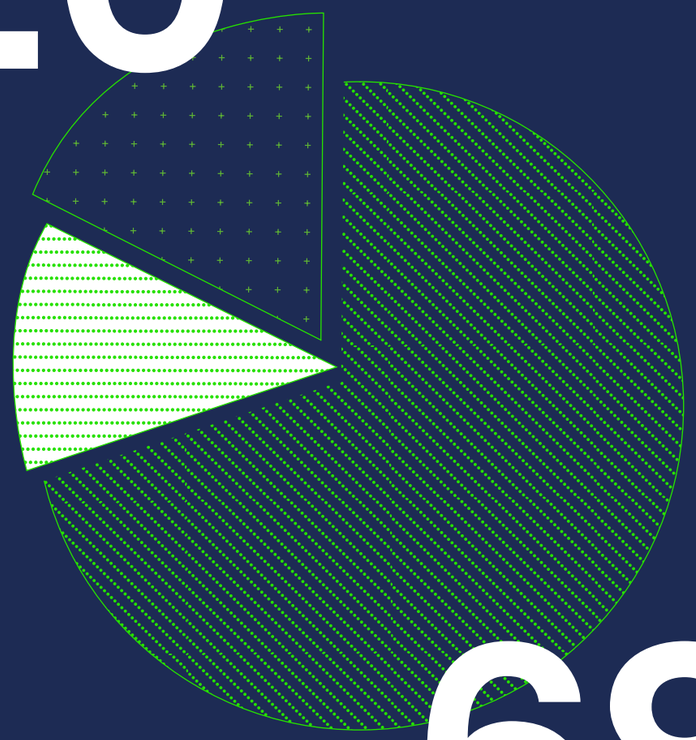
Extensive safety tests are being carried out to make sure that a hydrogen gas network is just as safe as the gas network heating our homes today. Tests are being carried out on the underground pipes carrying the gas, and also on the appliances in homes. One of the benefits of hydrogen gas is that it cannot produce poisonous carbon monoxide, because it contains no carbon.

→ Are any other countries converting?

There is a lot of interest from other countries, and many are also planning to convert. The UK is trying to lead the world in developing hydrogen technologies and therefore protecting the environment.

Conclusion

20% of the population will accept the conversion with little reassurance required



12% will reject it as they do not believe that carbon emissions lead to climate change

68% are indifferent or undecided about a hydrogen conversion

This research explored how people respond to the prospect of converting their domestic gas supply from methane to hydrogen. Our results show that we can segment the public into five groups based on their reaction to a potential hydrogen conversion. 20% of the population will accept the conversion with little reassurance required. 12% will reject it as they do not believe that carbon emissions lead to climate change. The remaining 68% are indifferent or undecided about a hydrogen conversion and so it is essential that communication about a potential conversion is clear and addresses people's concerns as the wrong messages could mean this large proportion of the public reject hydrogen as a domestic fuel based on misperceptions or unfounded fears.

→ **Our results show that with clear information, even these indifferent groups make an informed choice to accept a potential conversion.**

They are able to grasp complex technical information about the hydrogen conversion which they can convey to others in a simple and easy-to-understand way. Some remain sceptical about the contribution a UK hydrogen conversion can make to global carbon emissions, although others are enthused by the UK taking a leading role in developing hydrogen technologies.

→ **People assume that if their supply is converted to hydrogen then it will have been robustly tested and found to be safe.**

Indeed, they appreciate the safety benefit that hydrogen carries no risk of carbon monoxide poisoning. There were more concerns about the safety of stored carbon dioxide than the safety of hydrogen in the home.

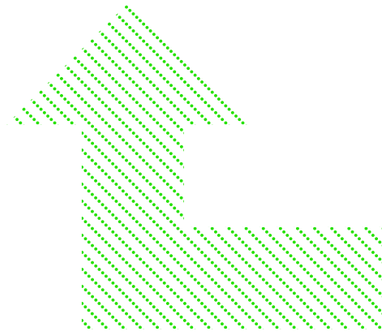
→ **People accept that their gas bill is likely to rise, and find the anticipated 7% acceptable but they are concerned about the cost of purchasing new appliances.**

Our participants wanted a decision about a hydrogen conversion to be made and acted upon quickly, and if it is to go ahead, to receive sufficient notice so that they can avoid purchasing expensive appliances that soon become obsolete.

→ **We found that it is important to help people to understand key concepts such as carbon capture and storage.**

With this understanding, they are able to tolerate the current uncertainties over the timescale of a conversion and the technical challenges of producing sustainable hydrogen at scale.

People accept that their gas bill will rise, and find the anticipated 7% increase acceptable.



Next steps

The results highlight the need to develop a suite of communication resources for the general public.

We recommend that this includes:

→ A glossary of terms that explains the key concepts underpinning a hydrogen conversion and the safety testing that has been completed.

→ An animation that explains the reasons for a hydrogen conversion and what it involves, including how hydrogen is produced, and how the captured carbon is safely stored.

→ An interactive display to demonstrate how hydrogen is stored and transported, and the practicalities of any future conversion.

Phase 2 of the H21 project started in March 2020, and part of the project will be to produce these communication resources.

↖ Stage 04 Explaining the conversion

GAS GOES GREEN

DELIVERING THE PATHWAY TO NET ZERO

GAS GOES GREEN

The Gas Goes Green programme will deliver the world's first zero carbon gas grid, helping meet the UK's net zero carbon emissions target.

Bringing together the engineering expertise of Britain's five gas network companies with the wider energy industry, policymakers, and academics, it will make the changes needed to move Britain's gas network infrastructure from delivering methane-based natural gas to zero carbon hydrogen and biomethane.

Learn more about Gas Goes Green at:
www.energynetworks.org/

Register for update via email:
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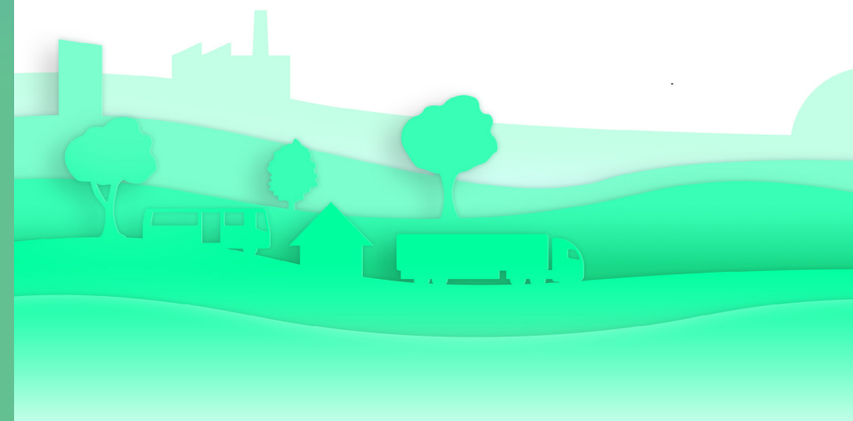

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