HOUSE OF COMMONS

# Business, Energy and Industrial Strategy Committee

## Oral evidence: Decarbonising heat in homes, HC 851

Tuesday 9 February 2021

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Watch the meeting

Members present: Darren Jones (Chair); Alan Brown; Richard Fuller; Paul Howell; Mark Jenkinson; Charlotte Nichols; Mark Pawsey; Alexander Stafford.

Questions 1 - 75

### Witnesses

I: Dr Richard Lowes, Research Fellow and Lecturer, University of Exeter; Professor Janette Webb, Professor of Sociology of Organisation, University of Edinburgh; Dr Will McDowall, Associate Professor, University College London; and Professor Nick Eyre, Professor of Energy and Climate Policy, and Senior Research Fellow, University of Oxford.

II: Craig Dyke, Head of Strategy and Regulation, National Grid Electricity System Operator; Graham Halladay, Operations Director, Western Power Distribution; Gus McIntosh, Director of Energy Futures, SGN; and Ian Rippin, Chief Executive Officer, Microgeneration Certification Scheme Service Company.

Written evidence from witnesses:

– National Grid Electricity System Operator (DHH0034); SGN (DHH0057)

# Examination of Witnesses

Witnesses: Dr Richard Lowes, Professor Janette Webb, Dr Will McDowall and Professor Nick Eyre.

Q1 **Chair:** Welcome to this morning's session of the Business, Energy and Industrial Strategy Select Committee. We are kicking off our first oral evidence session in our inquiry on decarbonising heat in homes. Before we get going, I should declare my interest. My wife works for the Association for Decentralised Energy.

On the first panel today, we are delighted to welcome Dr Richard Lowes, who is a lecturer at the University of Exeter; Professor Jan Webb, who is a professor at the University of Edinburgh; Dr Will McDowall, who is a professor at UCL; and Professor Nick Eyre, who is professor of energy and climate policy at the University of Oxford. Welcome to all four of you this morning.

When preparing for this inquiry, I was very struck by the fact that the UK's housing stock is one of the oldest and worst insulated in Europe, with only around 15% of our homes being built since 1990. We are expecting still to be living in those homes by 2050, which of course is our net-zero target. Heating our homes accounts for 13% of our country's annual carbon emissions, which I am also told is the same as all petrol and diesel cars put together. Only 5% of our heating across all 29 million homes is from low-carbon sources, so it seems like we have a huge task ahead of us and that this is a really important part of our net-zero journey as a country. The Committee on Climate Change estimates that it is going to cost us about £250 billion to get it right. That is why we are kicking off this important inquiry today to see how we can make good progress on this, given that it is such an important part of our decarbonisation priorities as a country.

Before I call in other colleagues on the Committee, Nick, could I come to you first? We have made great progress as a country on the decarbonisation of power. In fact, we often talk about that globally as a success story from the UK's perspective. Why have we made such little progress in terms of heating?

***Professor Eyre:*** It is because it is more difficult. That is the short answer. It is a systemic problem. We will doubtless talk a lot about individual technologies, but, if we are to decarbonise heat, we need to change where the energy comes from, we need to change how it gets into homes and we need to change the technologies with which it is converted into useful heat within homes. We need to do all of those at the same time.

As you said, the amount of energy we use for heating in homes is a huge problem. It is about 400 terawatt hours. That is significantly more than the output of the whole electricity supply system. It is a very big amount of energy, and people often underestimate that. If we are to decarbonise it all, it will almost certainly have to be a much smaller number than that,

which means we will need to reduce the amount of energy we use. We can do that in two ways. We can do it by improving the fabric of buildings—as you said, we have a notoriously old housing stock—but we can also reduce it by changing and improving the efficiency of conversion of energy into useful heat in homes. That is very significant.

There are a number of network options for how we get the energy from where it comes from into homes. We will doubtless talk more about them. Basically, they are electricity, decarbonised gas—probably hydrogen—and heat itself as a network. They interact, but they are all highly capital-intensive. We will probably need to avoid the duplication of those where we can, and that may lead to some hard decisions.

Finally, on end use, we currently convert electricity and gas very largely with resistance heaters and boilers. Those are about three times less efficient than available technologies like heat pumps and combined heat and power. Essentially, we run our homes with heating systems as though we did not know the second law of thermodynamics, which we have known for 150 years. There is a lot of progress we can make there.

I would make one other quick point, which is another difficulty. Heating is, for pretty obvious reasons today, highly peaked in one season and, indeed, on some days within that season. Some amount of storage within the overall system is going to be needed as well. I will leave it there as a quick overview.

**Chair:** That is useful. We are going to go into most of those issues in a bit more detail with questions from colleagues. I should note that our friends on the Environmental Audit Committee are doing an inquiry on energy efficiency, which is about how we improve the insulation of our housing stock. That is running in parallel with our inquiry on how we heat our buildings. Everybody is agreed that we need to do both; it is not one or the other.

Q2 **Alan Brown:** Richard, Nick already touched on this, but I was wondering whether you could outline what low-carbon technologies can most effectively decrease the carbon emissions generated by homes? You could highlight the strengths and opportunities but also any relative weakness, risks and barriers to deployment.

***Dr Lowes:*** Good morning, everyone. Analysis I have been involved with from the UK Energy Research Centre has, along with plenty of other analysis, pointed quite strongly to moving towards a more electrified heat system than we have today. We talk about electrification, but central to that is heat pumps. I prefer the term "heat-pumpification," because much more of the energy associated with heat pumps is extracted from the environment, from the ground or the air, than actually comes out of the electric system.

The Committee on Climate Change and the UK Energy Research Centre agree, as do many others, that we need to have significant growth in the

number of heat pumps in people's homes. In fact, the Committee on Climate Change analysis is quite clear. In its cost-effective 2050 scenario, you either have a heat pump of some variety—that could be a hybrid system, a ground-source heat pump or an air-source heat pump, potentially topped up with low-carbon gas, though not necessarily—or you are connected to a district heating network, if you are in an urban area.

It is interesting. Over the decade I have been working on heat, we have seen hydrogen emerge as a stronger contender in the argument, but at a systemic level the things we have seen is that renewable energy has become a lot cheaper and heat pumps have become more efficient and also cheaper. Technologically, there seems to be a groundswell towards electrification, heat pumps and also heat pumps potentially supplying district heat networks. You would not necessarily know that if you read some of the media.

There is huge potential. The backbone of the energy system could be offshore wind providing heat pumps, certainly for heating. That can be a very important thing. In doing that, it could provide all sorts of national benefits. It could reduce imports, increase investment and, importantly, increase investment in heat pump supply chains. We currently have a very large gas boiler manufacturing base. That is primarily putting bits together rather than producing the actual metals and plastics in the first place. We could become a market leader because we have such a large heating market.

Q3 **Alan Brown:** You said heat pumps have become cheaper. What is the typical cost of a heat pump versus a gas boiler?

***Dr Lowes:*** It is complicated. The heat pump unit itself is probably around double or triple the cost of a gas boiler. The heat pump for my house was about £3,000. It is the installation cost and the associated bits of kit that really push it up. You are likely to need a new hot-water tank, a new controller, pipework and potentially new radiators. The total installation cost for my heat pump was £9,000. There is potential to drive that down significantly. With solar PV, part of the big cost reductions came with installation costs.

At the moment, my dad is having a heat pump fitted. Men are driving from Essex to fit it, although they have struggled today with the snow. It is a very immature market, and there is huge potential to bring these costs down. The actual heat pump unit itself is not very expensive. Even though I am very much an optimist, they are more complicated to install than a gas boiler, very much so. They need to be sized correctly; you need to make sure you have the right radiators and the right pipework; you need to make sure you have an experienced fitter.

We need to get to this extremely large number of heat pumps quickly to meet our carbon targets. By 2030 there is really nothing else than can do it apart from heat networks. I am concerned that if we really rush it we

potentially do it badly, which could cause long-lasting damage. Anything we do we need to be really careful and thorough about.

Q4 **Alan Brown:** How realistic is the 600,000 installation target set by the UK Government? Does that come anywhere close to putting us on the path to net zero?

***Dr Lowes:*** The Committee on Climate Change analysis pointed towards 900,000 heat pumps a year by 2028, so the Government target seems a little low. The 900,000 would probably put us on the pathway towards net zero, but 600,000 probably would not. Both of them are extremely stretching targets.

Q5 **Alan Brown:** Nick, is there anything you would want to add about technologies or other considerations?

***Professor Eyre:*** I would largely agree with Richard. Whether we mean big heat pumps in district heating systems or small heat pumps in individual homes, there is broad consensus that they will form the bulk of the low-carbon heating future. I doubt they will provide 100%, and that is because of the issue of how we heat our homes on days like today, when our heating needs are probably four times the average for the year. That is where there is probably some scope for technologies like hydrogen.

Q6 **Alan Brown:** Will affordability remain an issue? Even if the cost of installation comes down, it needs to come down majorly to be affordable unless there is Government subsidy, effectively. Is that not the case?

***Professor Eyre:*** Yes, in terms of the capital costs of this overall conversion, you can do the sums. Let us say we are talking about £5,000 a house. That is roughly the number that Richard was talking about. It could be higher for some other technologies, but it is about that for district heating as well. If we do some simple arithmetic, that is a £150 billion capital investment. It sounds a huge number, but we spend tens of billions each year on housing repair, maintenance and improvement. We just need to get a bigger fraction of that into getting our heating systems and building fabric right.

Q7 **Mark Pawsey:** In his opening remarks, Nick spoke about how the energy gets into our homes. That is the bit I want to focus on: the infrastructure to carry both gas and electricity. I am wondering whether one of our other witnesses might talk about how we are going to do that and the cost. The Chair spoke about a £250 billion total cost of decarbonising heat. How much of that will need to be spent on new infrastructure?

***Professor Webb:*** There is a political decision to be made about whether we are going to build new heat network infrastructure alongside gas and electricity infrastructure and what the balance of allocation of investment between those would need to be. We already have a highly developed electricity and gas infrastructure. We do not have any significant district heating networks, and yet all of the Government's own scenario planning,

the Committee on Climate Change and most research that one looks at all suggest that, to optimise the solution for low-carbon heating across Britain, we also need to develop heat networks as a means particularly of using all those waste heat sources that we currently simply emit into the environment in one form or another and that could be used effectively to heat homes and other buildings.

One thing we should say about heat networks is that, as with any major capital investment in infrastructure, they work best when you connect diverse buildings with very different and varied heat loads, including some buildings with intensive anchor loads, such as hospitals. Swimming pools are another popular one for heat networks as a heat sink.

We face that question of how you finance a third network infrastructure and what kind of planning is needed, given that, for instance, we had a very planned development of the gas network infrastructure. At the moment, costs for heat network infrastructure in Britain tend to be higher than they would be in mainland Europe, partly because we have not done this in the past and we do not yet have those skills, but that is arguably the case right across the low-carbon picture.

***Dr McDowall:*** I can say a couple of words about the cost profile for the hydrogen option, in which the infrastructure in terms of the distribution system is not the really big cost. If hydrogen is produced in a low-carbon way, it is zero-carbon at the point of use, and it can be used in boilers without change at the consumer end. It can use the existing distribution network. It is likely that widespread use of hydrogen would require new infrastructure in terms of gas transmission, but that is relatively low cost in terms of the overall system.

The really big cost is in the hydrogen supply, producing the hydrogen, whether that is through use of gas with carbon capture and storage, through electrolysis or through biomass gasification with carbon capture and storage. The really big costs are in the upstream end for hydrogen, rather than in the infrastructure or the end use.

Q8 **Mark Pawsey:** Is it simply a matter of putting hydrogen in the pipes that were previously used to transport gas around? How are we going to manage the transition? We are not going to suddenly go from methane one day to hydrogen the next day. What short-term investment will be necessary in that time?

***Dr McDowall:*** The transition path for a hydrogen option is actually pretty clear now. Government have been working quite carefully to build the stepping stones for that hydrogen transition. There are still big questions about how far you want to push it, given the efficiency benefits of heat pumps, but the transition path involves a sequence of stages to iron out and test some of the residual questions around the extent to which you can have blending. You can put 20% hydrogen into the existing gas grid with no change to appliances. There are deployments now doing that at Keele, and that appears to be working fine. That is an interim step aimed

at decarbonising gas to a small degree. If you put 20% hydrogen in, you get a 7% or 8% reduction in $CO_2$ emissions. That allows you to build up some hydrogen supply, and then you need to think about a full conversion to hydrogen.

To get there, we need to have demonstrations of 100% hydrogen use in small communities and then in larger communities to test the concept. We also need to mandate hydrogen-ready boilers. A hydrogen-ready boiler is simply a gas boiler that requires a very simple switch-out of the burner within the boiler. That enables the boiler to be switched from natural gas to hydrogen. You cannot burn hydrogen in a natural-gas boiler without making those adjustments, but we can mandate, from about 2025, hydrogen-ready boilers that will significantly reduce the costs of switching the system in the future.

That is the transition path, and then you would switch sections of the gas grid to 100% hydrogen. You would have to turn off the gas grid for a short period of time during the summer months when you do not need the heating, and go street by street to switch out the burners.

Q9 **Mark Pawsey:** If I can go back to Jan on her case for district heating, in many industrial processes there is heat going to waste. I understand that some of the problems are around the cost of getting the heat from its source to where it is needed. How are we going to bridge that gap? Secondly, is there not a case that district heating, particularly in the residential sector, is wasteful? People are not being charged for the heat. They are usually being charged a fixed amount regardless of the amount of heat that they use, which encourages waste and unfairness between users. Jan, could you address those issues on district heating?

***Professor Webb:*** First of all, yes, the cost of a district heating system in Britain at present would primarily be the upfront capital cost of investment in the network. We could reduce that cost significantly by creating some sort of guaranteed return on investment as we currently do for the regulated networks.

In other words, we would need to introduce a regulatory system of the kind, for instance, that is currently being proposed and is on the parliamentary books in the Scottish Parliament. That would introduce regulation, basic licensing for heat network operators, standards for technical performance and a kind of concession area licensing. One would treat this as a monopoly network just as the gas network is a monopoly network and the electricity network is, by and large, a monopoly network. We do not duplicate high-capital-cost infrastructure in the same area. We would have to decide which areas would be targeted, on an area-based competition, for one technology to be predominant over another for the supply of heat.

With heat networks, the optimal way to build the network and justify the upfront capital cost is to connect diverse and heat-dense loads. That includes domestic loads, but they are not necessarily the primary source

of heat uptake for a heat network. The primary sources would be the big heat loads. For example, the University of Edinburgh, my employer, has built a series of five combined heat and power systems. These are currently gas-fired. It uses those systems to heat all its rather diverse and dense buildings on a small estate. Those include domestic-scale buildings. It is very efficient, in terms of Nick Eyre's point about conversion. It is a very efficient conversion technology at present.

Do households waste heating if they are connected to a heat network? There are lots of debates about that one, but the Heat Network (Metering and Billing) Regulations already provide us with a framework to ensure that heat waste is minimised for those connected to heat networks, because you are metered and billed for the amount of heat that you are using. You get that kind of feedback from your metering system. You should be getting that kind of feedback from your heat supplier as well, to produce those sorts of checks and balances in the system.

A heat network often will work very effectively for buildings that are hard to insulate to the sort of standard that we need. In terms of that question about waste heat, we are already wasting an enormous amount of heat. We could capture that through heat-network pipes, which are also an energy-storage medium, and connect up nearby buildings so that you minimise the capital cost of the infrastructure. Again, it supplies for a very long time, when it is managed properly, of course, with all the technical and economic considerations of that.

Q10 **Mark Pawsey:** I just have a quick one for each of our witnesses. We know that low-carbon technologies will need to be run alongside improving the heat insulation of our homes. If you talk to people who sell homes, heat insulation quality ranks very low on people's list of priorities when they are choosing a new home, whether it is an existing building or a new building. How can we get issues of heat insulation higher up the profile for people who are looking to buy a new home? I do not just mean new homes but existing homes as well. How can we raise that level?

***Professor Eyre:*** Ultimately, we are going to have to regulate. There are systems of incentives that can be used, but clearly we should be moving to zero-carbon new builds as soon as possible. It is crazy to build new housing that does not meet the standard we know it will ultimately need to reach. The bigger task is insulating existing buildings. That is also the more important task, because they are less efficient. We have tried various things.

Q11 **Mark Pawsey:** How are we going to change the occupier's attitude towards the importance of heat insulation?

***Professor Eyre:*** Ultimately, it will be by regulating. That is what we are already beginning to do for the private rented sector by setting minimum standards for properties that can be rented. I appreciate that it is politically likely to be more difficult to do that in the owner-occupier

sector, but, if there is sufficient warning, it could be done. It will need to be contemplated.

Q12 **Mark Pawsey:** Could we be educating people and making them understand the consequences more? We have managed to get people to think sensibly about switching their cars from internal combustion engines to electric. We know there has been quite high uptake there. Why can we not get people to think in the same way about the insulation properties of their home?

***Professor Eyre:*** We should not underestimate what we have done. Most houses with cavity walls have had those insulated, largely through subsidised programmes through the energy utilities over many years. We should not run away with the idea that we have done nothing to improve the housing stock, but we have not done enough. I am not arguing that we only need regulation. We need education; we need advice to be available to individual households about their individual property. It is not just a generic information problem. We probably need incentives to encourage people to do that in the run-up to making it a mandatory standard. The scale of the task, as we set out at the beginning, is so big that we will need to throw a whole bunch of policy instruments at the problem.

**Chair:** There is an interesting debate about whether mortgages should have incentives for homes that are better insulated and how you might change energy performance certificate regulations for homes so that it comes higher up the priority list and incentivises them to buy more insulated homes. Maybe we will come back to that at a later stage.

Q13 **Richard Fuller:** I was really interested in the conversation between my colleague Mr Pawsey and yourself, Professor Eyre, because it really gets to the nub here. We are working in this context where politicians have legislated that certain things have to happen, but a lot of people are just not prepared to fork out for it.

At the start, the Chair talked about the total cost of this overall initiative as being £250 billion. You all have a great amount of expertise in this area. I wonder whether each of you could tell me what your own estimates are. Do you do your own estimates of cost? Is that a cost number you would agree with? For the particular technologies you are asking for—Richard talked about how the current cost may go down—what is your estimated cost experience curve? For every doubling of production, what percentage reduction in the unit cost are you anticipating?

Crucially, and building on the point made by my colleague Mr Pawsey, who is going to pay for it? It is all very well to talk about how important it is and the different ways we can do it, but ultimately someone is going to pay. How much of that £250 billion will be taken by economic returns? How much will be left for the taxpayer or the billpayer? How would you allocate that amount between the two?

***Dr Lowes:*** It is a great question. On the cost point, this is going to cost something in terms of capital. We need to invest the money or net zero will not be met.

Q14 **Richard Fuller:** What is the amount? Do you accept it is £250 billion, or is it less or more than that?

***Dr Lowes:*** Based on the modelling and the whole-system analysis I have seen, it will be £200 billion to £300 billion in terms of total additional costs compared with business as usual by 2050.

Q15 **Richard Fuller:** To be clear, Richard, when you talk about the analysis you have seen—I am sorry to press on these points, but I will press everyone—are you just parroting the number, which is perfectly reasonable, by the way, from the CCC, or have you done your own analysis for your own technology?

***Dr Lowes:*** No, I have not added up the cost of my own heat pump and multiplied it by 23 million, if that is what you are suggesting. What I am talking about is a figure that has come out of various techno-economic analyses that have been carried out by colleagues at Strathclyde, UCL and the Committee on Climate Change and so on. They all broadly agree with that number of a few hundred billion. It is a very large number, but when you divide that by 30 years it looks less and less scary. In terms of investment we are talking about £10 billion a year of investment.

Q16 **Richard Fuller:** That is still a pretty scary amount of money for the Government to fund.

***Dr Lowes:*** Yes, it is a big amount of money, absolutely. There are two important things to bear in mind. The first one is that most of these investment costs only happen once. We will get to 2050, and then effectively all of that money is invested in the housing stock, and it is an investment.

That leads to the second point. Currently, we are in this situation where we have these huge energy imports that have a huge cost associated with them. We pay a lot of money to import gas and oil. By making these investments, as well as decarbonising the energy system, all of that investment can be put into the UK economy.

Q17 **Richard Fuller:** You are not disputing the £250 billion. You do not have any specific difference for your own heat pump technology that would reduce that amount. You are saying there may be some long-term return, but we have to pay the £250 billion. Who is going to pay for it?

***Dr Lowes:*** As with anything, it is either going to be the people who are using it or the taxpayer.

Q18 **Richard Fuller:** What is your recommendation? You are asking us to spend £250 billion, £10 billion a year, which you seem to indicate is a light amount and neither here nor there. A billion here and a billion there, eventually you have a large amount of money. Who is going to pay for it?

Is it the taxpayer? Is it the billpayer? Is your technology going to reduce that significantly?

***Dr Lowes:*** All three should come together.

Q19 **Richard Fuller:** Should they pay for a third each?

***Dr Lowes:*** I cannot be specific. In our current recommendations paper, which we are pulling together at the moment, you would provide a significant level of capital support on an ongoing basis. I do not know whether heat pumps will ever be cheaper than a gas boiler. You would stagger this: the cost is, say, £7,000 a year, and that drops by a couple of thousand pounds every two or three years. Alongside that you would have a wider market reshaping. I am afraid to say this would probably include something like tax increases and carbon taxes, which the Government are already talking about.

Alongside that, we would expect to see innovation that would reduce costs not just of the technologies themselves but also, potentially, in terms of how they can be used. One exciting area is time of use tariffs, so you can do things like charging off-peak rates for hot water. It is not a particularly modern approach, but it is something you can use to get a lot of value out of the system.

To start with, it needs to have Government support, and that support needs to be very strong and significant.

Q20 **Richard Fuller:** I am getting a hint from that. Professor McDowall, maybe you can help us on this.

***Dr McDowall:*** You asked about innovation and cost reductions. By the way, at UCL my colleagues do a lot of energy system modelling. I have not seen precise numbers on this specifically, but they do not disagree with the numbers produced by the CCC, Imperial and Element Energy.

**Richard Fuller:** It would be helpful if you could share the UCL modelling or estimates with us.

***Dr McDowall:*** I can talk to colleagues about that. With all of this modelling, there is huge uncertainty about the long-term technology costs. Our experience with both electric vehicles and renewables is that costs have fallen faster than had been anticipated. That is likely to happen again, but we do not know in which areas costs will fall faster than anticipated. Twenty years ago, we did not think solar PV would fall so quickly, but we did think some other technologies would become cheaper. When we are looking at these cost estimates, we need to remain aware that we do not really know quite which pathway will end up being cheapest. That is why we need to ensure there is continued innovation, competition and investment in R&D, which is happening. Those will drive cost reductions.

Q21 **Richard Fuller:** What are your own thoughts about how much of that £250 billion will be taken up by economic returns, with companies

investing and making a long-term return? How much will be left as a deadweight cost for taxpayers or billpayers?

***Dr McDowall:*** There is a large return for UK companies in the supply chain, in installation and in developing new technologies. We should put this in a broader context and think about the global transition as well. We have seen that countries that are successful in establishing domestic industries through a home market sometimes then capture significant export markets. They do not always.

Q22 **Richard Fuller:** I am sorry, Professor McDowall, but I am trying to get at how much of this bill the taxpayer is going to pay. How much is the taxpayer going to pay? How much is the billpayer paying? What are you saying? You are promoting options here. Being responsible, when you see the cost that is left, you ought to be saying, "I am afraid that is going to cost the taxpayer this much." As policymakers, that is a decision we are going to have to make. What is that amount and what is your recommendation?

***Dr McDowall:*** I do not have a specific recommendation. These are necessary actions to meet a target that has been legislated. It is the House that has legislated a zero-carbon target for 2050. This is the really expensive bit of it. Some of those costs to taxpayers generate returns for the economy more broadly through technology spillovers and the development of industries.

There is a big role for tax-funded support, particularly in the early stages, as we are starting to develop those supply chains and bring down technology costs. Clearly, there is plenty of private investment in some of these technologies. That is also critically important. Certainly, the taxpayer cannot pay for all of this. We need to get the policy framework right to induce private investment. As with things like regulation of the private rented sector where landlords are paying to upgrade their properties, we have examples of Government action inducing that private investment.

Q23 **Richard Fuller:** It is fair to say that we are struggling to try to understand how much this will cost and where we allocate this cost. It is the "oh gosh" moment. We have legislated this, but now it is going to cost households the equivalent of whatever £250 billion is divided by 20 years divided by 20 million households. I will have one more go at this. Who is going to pay and, being honest with people, how much is it going to cost?

***Professor Eyre:*** I will try. Ultimately, you are right that it is the policymakers who have to make—

Q24 **Richard Fuller:** You are trying to influence us. You have just told us that we have to do it. You told us just a few minutes ago that we ought to regulate. You cannot back off this, Professor Eyre. Who is going to pay?

***Professor Eyre:*** No, I am not attempting to back off. If we regulate, that forces the investment—it is an investment, not just a dead weight—to be made by the building owner. In that case, at the point you regulate, you force those costs on to the building owner. If, for political reasons, there is no will to regulate, if the targets are going to be reached there will have to be greater incentives. Those incentives either have to come from the taxpayer or they have to come from the billpayer through levies. That is the choice that is faced.

My personal view is that it would be better to regulate in the medium term and give people warning that it is coming. That will force those costs on to building owners. It is a big number, but remember that households pay £30 billion a year in fuel bills at the moment. That could come down with some of these measures. The bulk of the investment will go into installation and making things; it will go into jobs. This is not a lose-lose agenda.

**Chair:** We are conscious that the Treasury is doing its net-zero review at the moment. We will all be looking at that as a Committee, and no doubt we will do further work on this financing question, because we will need to bring consumers with us if we are going to reach this target on the deadline of 2050.

Q25 **Paul Howell:** Could I direct this question to Professor Webb in the first instance? We can have other contributions afterwards, if necessary. What I would like to do is change the direction of the discussion slightly. In terms of putting these different technologies in, is there an argument for different technologies being much more appropriate in different parts of the United Kingdom? I am an MP up in Sedgefield. We have loads of mines around here. There is a lot of talk about using, for example, geothermal energy. Clearly you could not do that in a different part of the world where those mines do not exist.

Whether it is policy, the direction of travel or how we achieve this, it comes down to the combination of cost, feasibility and practicalities. There is also the potential for speed in terms of getting things done. Is there a view about the UK on a macro level that says, "You should do this here and this there; you should do this for urban and this for rural"? Is there any sort of conversation around that?

***Professor Webb:*** Yes. There is considerable argument between centres, regions and localities around where the division of responsibility should sit, particularly in relation to decarbonising heat. It has been accepted by the UK Government, certainly since I have been involved in research on decarbonising heat, which is over 10 years now, that there are good economic and technical reasons to think there are different solutions that are going to work best and most cost-effectively in different areas. There is understandable political concern about the risks of decentralising responsibility. Arguably, you would have to decentralise the powers and resources in order, for example, for Greater Manchester or for the

Newcastle and Tyneside area to develop their own distinctive plans and to advance.

I have heard arguments, for instance, that the blame would fall back on a UK Minister, who might not therefore be willing to allow that more regionalised planning. I have also heard and would take note of counterarguments. On balance, I would argue that we can move forward faster with a more regionalised set of solutions as long as there is, as always in any circumstance or system, adequate co-ordinated governance between central, regional and local government and those with lead responsibility.

I do not want to talk particularly about the Scottish example, but at present there is a series of proposals in Scotland. We do not know how well those will work, but the aim there is to do systematic local heat and energy efficiency strategies on a comprehensive area-by-area basis and to decide the most competitive solutions for the future of heating at that area level and then advance on that basis. It might be heat pumps in one area; it might be district heating connected to geothermal or mine water sources, for instance, in another. It might be large heat pumps connected to district heating networks somewhere else, et cetera.

Based on the work we have done, I would argue that it really needs planning, careful governance and direction. It needs decisions that will then be acted on. At present, the research we have done, which is broadly socioeconomic as opposed to technical-economic, would show there is not a responsible problem-owner, in many instances, who is going to take the lead responsibility and carry the can, effectively, with shares of costs as appropriate.

Q26 **Paul Howell:** We are looking at how you get it done with different things in different parts of the UK, whether that is demographic or geographic, but, in terms of actually achieving the end goal of getting there, it seems to make sense to me that, if we can, we should prioritise the urban areas because that is where there is going to be more heat consumed. Is that the case? Would you be doing that? For all I know, it might be so much easier to do the towns and villages and go step by step as opposed to dealing with the big problem of central Manchester or something. Is there a theoretical approach in terms of where the priority should be, in terms of getting the numbers moving down as quickly as possible?

***Professor Webb:*** The theoretical approach would be to do the really heat-intensive areas first, because they are the centre of emissions. They tend to be dense inner-urban areas. They are also, for other reasons, politically sensitive and hard to do in that sense.

***Professor Eyre:*** We know from analysis something about the geography of the problem. As Jan said, heat networks probably look like the core of the solution in dense urban areas. Off the gas grid, it is pretty clear that we will need to move largely to some combination of biomass and

probably ground-sourced heat pumps. The economics are often better there, because people are reliant on expensive fuels at the moment.

The bulk of urban Britain outside urban centres is where the debate between individual heat pumps and hydrogen is still, to some extent, unresolved. Most of us now live in areas where the local council has declared a climate emergency, and increasingly they are looking to do roadmaps for how to deliver on that. I speak from experience of trying to help Oxford City Council do exactly that.

Local government is not going to be able to do that without some clarity about the choice between electricity and hydrogen for their area, not generically across the country. It is a very specific thing. That can only be done by central Government working with local government and the infrastructure providers to develop plans in each area.

Q27 **Chair:** Very quickly, because I am conscious of the time, this point is important because the Department for Business could do a zoning consultation on where technologies might work best and build business models, but presumably MHCLG needs to do the planning framework. From your work, Richard, have you seen co-ordination across Government Departments on this? Is this one of the tasks Government need to pick up?

***Dr Lowes:*** It seems to be getting better. The sign of this is around the Future Homes Standard, which is the proposal for new homes from 2025. It has always been a total anomaly that building standards are totally separate from BEIS. While they are now talking to each other much more than they were, there is still no official governance relationship between the two, and there is certainly talk of historical battles between Ministers over these situations, particularly in the coalition Government.

With building regulations and all the associated documents—we talk about part L, which is the thing planners and carpenters look at when they are doing insulation—it does seem quite odd that those two things are not very closely connected. What this points to more broadly is the need for wholesale governance reform around energy system issues. We put some ideas around this into our submission, of course, but it does seem to be a bit of an outlier, particularly around buildings.

Q28 **Alan Brown:** Jan, you mentioned decentralisation and you slightly touched on the Scottish context. I am aware that on Friday the Scottish Government put their heat in buildings strategy out for consultation. Clearly, a lot of the policy decisions still rely on the UK. The Scottish Government have also published a hydrogen strategy. We are still waiting for one from the UK Government. The BEIS Committee in a previous inquiry found that both Scotland and Wales invested better and more money per capita in energy efficiency. Clearly, both Governments work with a fixed budget. I am just wondering whether that in itself makes the argument for the need for changes to the consideration of the regulatory framework and the policy decision making, to allow the devolved nations

to move on with their strategies.

***Professor Webb:*** There is an interesting debate around heat itself. In the past, for instance, I have had a UK official say that heat is devolved by default, because under the devolution settlement any area that is not explicitly reserved to the UK Parliament is treated as devolved. Heat becomes this rather ambiguous object, around which there is some fuzziness about where the powers lie. The regulation of the gas network and the decisions about that are reserved to the UK Parliament, and therefore there are central decisions required. One would hope those are in full consultation with our devolved Governments right across the UK, or certainly GB.

There is an argument that, if we want to move forward as we should and move as rapidly as possible to decarbonise heating, those devolved processes need to be strengthened, not weakened. There is a perfectly good economic case for doing that and proceeding with more devolved regulatory powers. I know Ofgem has begun discussions about how that could be managed and how best to respond to the different net-zero planning of the devolved national Governments.

Yes, it is there. There is much more awareness and live debate. It is certainly live in relation to the ED2 electricity distribution network price-control planning that is now taking place, around the extent to which future energy scenarios for the electricity networks should be centralised or decentralised to respond to the different carbon targets of the different Governments in the UK.

Q29 **Alan Brown:** Could I turn to Professor McDowall, please? If we look at the UK-wide context, again we know the UK has been wedded to the natural gas network, which, as has been said, has slowed down any thinking in terms of heat decarbonisation. Are there any other countries with similarly extensive gas networks that the UK should be learning from in terms of how to decarbonise?

***Dr McDowall:*** The UK is unusual in the degree to which its heating system is dependent on gas and individual gas boilers. The closest comparator is the Netherlands, which is the other European country with a similar degree of gas penetration. Germany also has quite large penetration, but not at the same scale.

In the Netherlands, they are and have been pushing heat pumps a bit more aggressively than we have been in the UK. They are looking at phasing out connections of new buildings to the gas network in order to build the market for non-gas low-carbon heating technologies. Like the UK, though, they have also been looking at the hydrogen option and conducting trials on blending and the full use of hydrogen in gas networks.

We can learn a lot from the Netherlands. I know less about it, I am sorry to say, in terms of how they have been driving the adoption of heat

pumps more successfully than we have. In terms of what they are doing on hydrogen for heating, we are in a fairly similar place. Perhaps the UK is a bit ahead in terms of keeping that option on the table.

Q30 **Mark Jenkinson:** I would like to concentrate on the lessons we can learn from past UK Government policy to deliver low-carbon heating, for example the renewable heat incentive, and how effective the green homes grant has been to date in incentivising the installation of zero-carbon heating.

I also want to go back to a point Will made earlier, that we did not expect the price of solar PV, for example, to fall as sharply as it did. We hear a lot about the investment that Government should make. We made an investment in offshore wind and solar PV. When we removed the subsidy, we found that the cost came down, suggesting that we had probably artificially kept the costs of those technologies high while they were subsidised. There is a sweet spot that we need to try to find in regard to Government subsidy and cost. What are your thoughts on that?

***Dr McDowall:*** I can speak to that question about subsidy and cost reduction. In the early stage of the maturity of the new energy technology, it is difficult for it to access the market, but we have pretty clear evidence that publicly supported deployment programmes have enabled the innovation and cost reductions that then led to those subsequent declines.

There may be periods where the delivered cost of a technology is artificially propped up by a subsidy, but that is not the main picture. The main picture that has emerged—this is from significant analysis globally—shows that the deployment of these technologies like PV and wind has then driven the cost reductions both through learning by doing but, more importantly, through economies of scale and the private R&D that is then induced by the creation of a new market for the technology. When you start to support a new technology in a convincing way, you start to get much more private investment into it. That R&D then drives down the cost, and that then becomes a self-sustaining market. That is the dynamic we saw happen with PV.

With heating technologies in the UK, particularly the RHI, we did not quite get that right. To come back to Richard Fuller's point, we had a system in which the taxpayer was paying for relatively expensive installations in the homes of the relatively wealthy, and that does not seem like quite the right way to do it. We did not put enough effort into thinking about the supply chain and thinking about how to support the innovation and cost reductions that would go alongside it.

Most people would agree that the RHI was very much focused on meeting the targets in the renewable energy directive. It had a very tight renewable energy deployment target, and it did not really do enough to focus on the building supply chain and ensuring technology development.

We need to learn from that experience, because that is a key thing we did not get right with the design of the RHI.

***Dr Lowes:*** I have spent quite a bit of time investigating the lack of performance of the RHI. A few years ago, I also worked with Nick and the National Audit Office on the review of the RHI. The RHI has been the policy to deploy domestic heat pumps in the UK, apart from the green homes grant more recently. We were expected to have around 500,000 heat pumps installed in homes by 2020 under the scheme. That was the total number expected to have been installed. It is way less than that; it is less than a fifth of that total number.

The RHI was expected to lead towards a mature market that led to learning. Unfortunately, we do not have that. There has been a lot of lost time. From a policy perspective, there is a lesson about making agile policy decisions. It felt like it was trying to steer a huge cruise liner that could not quite get into the port.

I would just say one thing about cost inflation, which policy sometimes causes. I know installers who are offering heat pumps cheaper if you do not take the renewable heat incentive or the green homes grant. You can see it pushing up the cost already.

***Professor Eyre:*** I have a couple of quick points, though I have nothing to add to what Will and Richard have said on the RHI. On the point about learning, we should be very clear that the reason photovoltaics came down in cost was not because of learning in this country; it was because of learning globally. Where you have a product that can move globally, it is the international market you should be looking at. For installation costs, you are looking much more at a national market. Those are more able to be influenced by national Government policy than the price of PV panels, for example.

On the green homes grant, I am tempted to say that it is too early to tell. I probably do not know much more than you will have seen in the media. We already knew at the outset that a one-year programme was not the right way to construct this. I understand why it was tempting, given the need to have an economic recovery package, to have a very large one-year stimulus, but, as we have been talking about, this is a 30-year problem, not a one-year problem. We need to build supply chains, and you will not build them in a year. We need to be thinking much longer term than that.

***Professor Webb:*** The RHI has not really worked to support other network infrastructure like district heating networks terribly well, other than with some small biomass heat networks in some instances. I am probably not as knowledgeable as some of the others here, but, as far as I understand, it has been a rather expensive incentive to administer. There are some lessons there for how to devise incentive schemes that are administratively straightforward, not to underestimate the costs entailed in managing the admin side.

Q31 **Richard Fuller:** With the energy White Paper, there is a lot that the Government would like to see happen. I wonder whether our panellists might help us. When it comes to the decarbonisation of domestic heat, what would you urge is the most important policy uncertainty the Government ought to seek to address? Where should they point their fire?

***Dr Lowes:*** Certainly in the short term, as we talked about earlier, the key thing is grants. We are going to have to have grants for the foreseeable future. I agree with Nick: on the green homes grant, we can only really say what we have seen in the media and in the Public Accounts Committee report yesterday.

There needs to be long-term certainty for the market that those grants will exist for some time. I am aware that manufacturers of gas boilers are considering deploying heat pump production lines in the UK, but they will not do that based on one or even two years of green homes grant policy. Having a clear grant payment framework for the longer term, I would suggest, is the most important thing for heat pumps.

***Dr McDowall:*** A really big uncertainty is how successfully we can get deployment of deep-efficiency heat pumps over the next few years. If it turns out that we can deploy heat pumps much more successfully than we had anticipated, it makes a huge difference, because you need so much less energy. We really need to work that out. We need to go quite hard quite quickly to resolve that.

***Professor Webb:*** My key policy uncertainty would be the future of the gas grid. We need clarity in the reasonably short term, in the mid-2020s at the latest. That would help to unlock a lot of those investments.

Q32 **Richard Fuller:** Could you just explain precisely what you mean about clarity on the gas grid? What is the policy clarity you are looking for precisely?

***Professor Webb:*** We need policy clarity on whether areas of the gas grid, as it currently exists, will be decommissioned or repurposed. We need some indication of how those decisions will then be implemented. What are the funding systems and funding streams for that? We currently have some embryonic hydrogen demonstrators under way; we have some experience with varying kinds of heat pumps; we have little bits of district heating networks. All of these are effectively dependent on what happens to the gas grid, and that is under the control of the UK Government.

**Chair:** Thank you to our witnesses on the first panel for their contributions.

## Examination of Witnesses

Witnesses: Craig Dyke, Graham Halladay, Gus McIntosh and Ian Rippin.

Q33 **Chair:** We are now going on to our second panel. We are delighted to welcome Craig Dyke, who is the head of strategy and regulation at the National Grid Electricity System Operator; Gus McIntosh, director of energy futures at SGN; Ian Rippin, who is the CEO of the Microgeneration Certification Scheme; and Graham Halladay, who is the operations director at Western Power Distribution. Welcome to all four of you this morning.

We have just heard in the first panel about some of the challenges and barriers to decarbonising heat in our country. My first question is to all of you. From your particular part of the system, what is the most significant challenge or barrier that policymakers need to unlock to allow you to be able to move as quickly as possible to lower-carbon sources of heat distribution in our country?.

***Craig Dyke:*** With regards to how we would want to take this forward, there are a couple of clear areas. Clearly, we are talking about decarbonising heat and moving across to renewable sources of heat. I do not think anyone disagrees with that. The direction that the energy White Paper sets out is great, but we still need the building heat strategy to provide a solid framework that gives clarity on what the pathways are by which industry needs to move forward.

The main bit is recognising that the way we have tackled energy efficiency so far is the right way, but there is still a lot to look at in terms of energy efficiency in homes and buildings. We need to move to a more energy-efficient world in order to realise the full benefits of moving to decarbonised sources of heat.

Fundamental to all these three things is the consumer. Whichever road we take will be invasive. We are going to need to go into people's homes. It is all about changing what people take for granted with regards to gas boilers, for example. At least having an understanding of the impact on consumers right from the outset is really key. The main bit for us is recognising that right from the very start, so, as we are making decisions around policy and policy direction, the consumer has to be very much at the heart of that. That is what we see as how you are really going to unlock decarbonised heat.

Q34 **Chair:** The main challenge for National Grid is how we get into everyone's homes and get them to agree to our doing that. Gus from SGN, what is the most significant barrier from your perspective as a gas network operator in terms of moving to low-carbon heating?

***Gus McIntosh:*** Craig touched on a key point. What was striking to me listening to the conversation earlier is that there is a lack of focus on the consumer. The consumer is so important in this. People do not buy the cheapest car and they do not buy the most expensive car. They buy the car that suits their needs and wants. This is about ensuring that we have a reliable, secure supply of responsive heat and hot water, for example.

The critical thing at the moment is bringing the consumer with you, providing the options, and making sure that we are delivering what they want.

Things like heat pumps, theoretically, can add benefit, albeit I would question some of the efficiency figures that were promoted, particularly when you are looking at the resilience of the whole system. However, evidence suggests that customers are not picking them up. They are not wanting those solutions. Hydrogen offers the system transformation that allows the cost to be socialised right across all of society, so that you can bring every part of it with you, rather than focusing on specific customers or higher-value customers. It is a whole end-to-end solution.

The biggest thing, without a doubt, is the customer. There are a number of barriers for a gas network operator that we would like to see moved. For example, the Gas Safety (Management) Regulations currently restrict us from being able to put any hydrogen in the system. We would like that to change, and we are working hard. I chair the UK Gas Quality Working Group, which is seeking to make that amendment. It is now sitting with the DWP at consultation.

There are other things that were mentioned earlier by Will, like mandating hydrogen-ready boilers. That is a really important thing, because we will have finished all our research and development in the hydrogen space and be ready to do mass deployment, doing it wherever, whenever, by 2025, but mandating hydrogen-ready boilers, with a turnover of around 1.6 million boilers a year in the UK, would give us a really good start on minimising disruption in the homes. Conversion of these would take but half an hour to an hour.

All in all, there are a few barriers to getting the thing going, but the biggest one, for sure, is getting it right for the customer.

Q35 **Chair:** Ian Rippin, from your perspective, representing the installation of this kit, presumably you would agree with Gus and Craig that consumer buy-in is your top priority, or is it something else?

***Ian Rippin:*** Yes, it absolutely is. It is about the consumer making a journey into low carbon, in the same way they may be embracing electric vehicles now. We need to get into the psyche. You get there by providing independent advice and support for consumers who want to make the change to zero carbon.

We know from our research that one of the biggest influences on consumers is their installers. If your installer comes to your home when you are thinking about changing your heating system and they say, "There might be another way of doing this, and it is through heat pumps in particular," that can convince consumers to make that step.

It is about the supply chain. As we are currently seeing with the green homes grant, installers need to be engaged in a policy initiative that is for

the long term, so that they can invest in their businesses and their apprentices, so that they can support this consumer transition over to heat pumps. Hydrogen feels to me like a long way off. It does have a role to play, but right now the scalable, proven technology is heat pumps. That is what we should be focusing on.

Q36 **Chair:** Graham Halladay from Western Power Distribution, what is the most significant priority from the perspective of a distribution network operator?

***Graham Halladay:*** I agree with the previous three witnesses. Consumers are key here, as is making sure that consumers understand the options of the different solutions they can use to heat their homes. We are doing a lot of work at the moment through our stakeholder engagement and various publications and webinars to help the understanding of consumers, local authorities and installers on the heat pump solution.

There also needs to be clear and decisive policy on not only new homes but also changing insulation values on older homes. That will drive a lot more certainty into the market on the direction of travel. We are talking very high-level numbers at the moment, and the 10-point plan has done that. What we now need is the detail that gives certainty, both for consumers and for the industry.

**Chair:** I was expecting you to say, among you, the amount of power generation, flexibility, storage on the system, copper pipes and skills. You all said consumers, which is quite telling.

Q37 **Mark Pawsey:** My colleagues and I are going to look at different solutions. I want to focus on heat pumps. We heard quite a bit about that in the first evidence session, and we have heard each of our witnesses today say how important consumers are. Everybody knows what a gas boiler is. We have all got them in our homes. It heats hot water; the water then goes into the radiator and it heats our homes. I do not think people understand what a heat pump is, whether it is an air-source or ground-source heat pump. Because people do not know what they are or understand how they operate, there is little demand for uptake. By contrast, you can see an electric vehicle on the road and you can see that there are more and more of them.

What are you doing, as an industry and a sector, to make it easy for people to understand exactly what a heat pump is, how it works, and make it something to be considered as an alternative method of heating one's home? Craig spoke about changing what people take for granted. Craig, how are we going to change what they take for granted?

***Craig Dyke:*** It is understanding what the consumer really wants. The consumer really wants heat, and they want heat at an affordable price. Traditionally, for the vast majority of the housing stock in the UK—

Q38 **Mark Pawsey:** With the greatest respect, the consumer is not buying

heat. The consumer is usually paying for a boiler, and that is different.

***Craig Dyke:*** I do not disagree, but ultimately it is heat. It is about thinking of heat as a product, because ultimately you are buying gas for cooking or heating. That is what the consumer is generally using the main source for. With regards to heat pumps, it is recognising that it is a different technology and therefore it has to be cost-effective. It has to be cost-effective for somebody to move from a gas boiler on to a heat pump.

Q39 **Mark Pawsey:** Our evidence session so far has been based around how much more expensive a heat pump is than a boiler; it is a factor of three or four times the price. An investment basis of persuading people is not really going to happen, is it? We have to persuade them on a hearts-and-minds basis that it is the right thing to be doing, not that it is going to save them money.

***Craig Dyke:*** It is all about looking at lower-carbon sources of heat, is it not? That is why you would move across to a heat pump from a gas boiler. Ultimately, it is about that consumer piece. It is about understanding. As a consumer myself, I am on oil. Why would I move across to a heat pump and electricity? It ultimately will come down to economics for me. It is making the economics work for consumers. That goes back to the original point: getting consumers in at the very outset is key.

Q40 **Mark Pawsey:** Is the problem not that we are a long way away from it being an economic choice, unless Government bring in very substantial carbon taxes or other kinds of incentives?

***Craig Dyke:*** Currently, today, we are, but that does not mean it is going to be like that forever.

Q41 **Mark Pawsey:** How do we get the customer to understand what we are talking about? Most of the people engaging and listening to this will not understand what a heat pump is.

***Graham Halladay:*** I totally agree with the comment you made at the start. The transition to electric vehicles is one that is happening and people see them out on the streets. We do see electric vehicles on the streets. We have seen a huge uptake of solar PV on people's roofs. Again, you can see it. Heat is a boiler in somebody's home; you do not see it. I absolutely agree that there need to be campaigns, both locally, through companies such as Western Power Distribution, but also nationally, to make people aware that there is a choice to have a low-carbon solution to heating within your home. That will spark the initial uptake of low-carbon heating within homes.

It is not the case that economics is always the only choice. Electric vehicles tend to be more expensive than their petrol or diesel equivalents, yet people still choose to buy them because they recognise that it is a low-carbon choice for them and they choose to make that

decision. I would agree that there needs to be far more publicity about the choices that people have to change to low-carbon heating.

Q42 **Mark Pawsey:** Sticking with you as a company that provides infrastructure, if we are successful in persuading people to adopt heat pumps in volume, what will be the impact on the demand for electricity through your systems?

***Graham Halladay:*** Demand on our network will certainly go up. We manage that in several ways.

Q43 **Mark Pawsey:** Is it able to cope right now? Could you cope right now, or are reinforcements necessary?

***Graham Halladay:*** We are absolutely coping right now. We do distribution future energy scenario work, predicting what is likely to happen on the network and the uptake of those. We use that information to do detailed studies of the network to identify where those constraints will be, and then plan to invest in those areas.

Q44 **Mark Pawsey:** At what point do you see investment being necessary?

***Graham Halladay:*** Investment is happening now and will continue to happen through the rest of this price control period that ends in March 2023. It will then continue in the new price control period that ends in March 2028.

Q45 **Mark Pawsey:** Are you suggesting that adoption of heat pumps will not have a significant impact on any plans you already have? If there is widespread adoption of heat pumps in 10 years' time, will you have to make a reinforcement specifically because of that action? I suppose it is going to be very difficult to uncouple that from the additional demand as a consequence of a switch to electric vehicles.

***Graham Halladay:*** We will absolutely need to invest in the network with the uptake of heat pumps. Our prediction of the number of heat pumps on our network is that, by 2028, around 150,000 heat pumps a year will need to be installed. In our business plan for ED2, which is the period from 2023 to 2028, we are predicting that 36% of the load growth will be due to heat pumps on our network.

Q46 **Mark Pawsey:** To pick up Mr Fuller's questions from the previous session, who is going to pay for that?

***Graham Halladay:*** That is a very good question. I was interested to see that the previous witnesses were unable to answer it. From my perspective, we are a heavily regulated industry. Our funding is determined by the regulator, Ofgem. It is not really a decision that we make; we put forward our business plans for the investment that we believe will need to be on the network, and then it is for Ofgem to determine how that is funded.

Q47 **Mark Pawsey:** Craig, if we get widespread adoption of heat pumps, what

will be the impact for National Grid? What will be the additional costs of preparing for it?

***Craig Dyke:*** Recognising that we are the system operator part of the business, so we do not own the wires, we are already thinking about this. We are not just looking at heat pumps but also heat networks and the role of hydrogen heating, so we are also starting to understand what that means for us from a system operator perspective.

One of our ambitions is to ensure that we can operate that system carbon free for 2025. Part of that will also be understanding what impact heat pumps will have. We will look at heat pumps and peak load on the system. We are also working with suppliers to understand what their tariffs mean for us as well, so when they will incentivise customers and consumers to heat their homes and use that renewable energy at the right time. You have already started to see that today through some of the tariffs that are offered out there in the market.

Q48 **Paul Howell:** I want to move on to talk a bit about hydrogen and try to understand the relative advantages of electrolysis versus steam methane reforming for producing hydrogen in the first place. How do the costs compare? Will these technologies become commercially viable at the same time? Do they have a dependency on other technologies, whether it is carbon capture and storage or whatever? Could you talk around that part of the subject, just to educate me a little, please, Mr McIntosh?

***Gus McIntosh:*** First of all, we are seeking to construct the first 100% hydrogen distribution network in Fife, which will be a glimpse at what the future looks like. It is from turbine tip to burner, so that is a green hydrogen solution. That is where we are advocating that we need to move to in the longer term. Clearly, in the short term, you have a significant issue with scaling of renewable technology to increase this very significant demand. That is where blue hydrogen comes into its own with its ability to scale; you can get deep decarbonisation very quickly, you can maximise existing supply chains of natural gas, both indigenous and from abroad, and you can pair that with carbon capture and storage.

You also have to remember that hydrogen is potentially a global commodity. This is not a UK-only challenge in term of net zero; this is a global challenge. Hydrogen has the opportunity for shipping in the forms of ammonia or other derivatives that can quickly get you deep decarbonisation.

In terms of the cost differences, clearly electrolysis has a very steep cost reduction curve planned. It is analogous to some of the costs in offshore wind. Nel, for example, have announced, just in the last week, a major reduction in the cost of electrolysis, where they are targeting a price of £1.50 per kilogram for hydrogen, which is very competitive when you consider that diesel is about £6 per kilogram. There is a technology reduction pathway that you need to recognise, but at the moment electrolysis is more expensive at scale.

When you start looking at the long-term future of the whole energy system, you actually need fewer turbines to be generating hydrogen than you do if you have an electrification scenario. That is because you want to sweat these assets and be generating energy all the time, which you would need to meet the significant variation in your demand versus your intermittency in supply. This is a really key point, particularly about heat load. The heat load is very skewed. You have a peak right in the winter period, and we design that peak, from a gas system perspective, for a one-in-50 condition. It is a very high resilience that the electricity network does not design to at the moment, and there is very good reason for that, which is that warmth is one of Maslow's hierarchy of needs. It is right up there. You have to ensure that reliability, resilience and security of supply.

Electrolysis costs will definitely come down. There have been a number of studies, including from the Offshore Renewable Energy Catapult and under the Dolphyn project led by ERM. You will see this transition between blue and green in the 2040s and 2050s at scale, but it could come down earlier, subject to some of the technology developments that we are seeing, particularly in offshore wind.

Q49 **Paul Howell:** You say it could come down earlier. Is that one year earlier, or substantially earlier? What sort of timescale will it be?

***Gus McIntosh:*** What you have to do here to really drive that change is demonstrate the market, and that is what we are trying to do by doing the first demonstration. We have got the supply chain going. Almost every manufacturer that is involved in the demonstration is a UK manufacturer—great companies such as Bosch, Baxi, fire manufacturers such as Stovax and Charlton & Jenrick, and Enertech. You have to prove that market, and then it is about how that market is going to be serviced and how that drives down costs.

Getting the blue hydrogen in there gets your hydrogen economy stimulated. The blending that was mentioned earlier gives you enough to stimulate some of the industrial clusters, particularly in the UK, but those costs will come down. It is about creating that market and getting the technology moving.

If you look, for example, at the Dolphyn project off the north coast of Scotland, you are talking about major scale-up of hydrogen production kit. They have a 10-megawatt turbine targeted for 2024 connection, where we are seeking to accommodate that hydrogen into the gas grid. The scale is increasing all the time. There is other work on stacking, such as the Gigastack project, which is about how big these electrolysers can go. Can they get up to 40 megawatts? As soon as they do, the economies of scale become very significant. It is going to be driven by the volume of the market, of course.

Q50 **Paul Howell:** Is any other stimulus required? Is it just about the pace at which technology can develop, or is some other stimulus required to

make things happen even quicker?.

***Gus McIntosh:*** UK Government and Scottish Government are doing the right things in stimulating the research and development. For example, we want to accelerate the gas networks being ready. We have 280,000 kilometres of distribution pipe, in every street in every city in Britain. That asset has already been paid for, to some extent. We continue our mains replacement programme, which is providing that hydrogen readiness. It is a very efficient system. That needs to continue. The research and development costs, particularly in production and on the supply side, are really important for, first, getting an early position for the supply chain and our ability to lead the market globally, and, secondly, getting that cost down.

Q51 **Paul Howell:** Coming back to something I said at the start, is there any need for a push or a prod on things like carbon capture and storage, or is that keeping pace with where it needs to be to support the industry?

***Gus McIntosh:*** The plan is to do two by 2025 and two by 2030. That can be revisited within the industrial clusters within the UK; there are around eight or nine clusters, as I would call them, not all totally industry. That should be accelerated. Carbon capture is going to be essential in any scenario, whether it is hydrogen or electrification, as is hydrogen storage. As you heard this morning, you are going to need storage of energy, and the only low-carbon or zero-carbon option you have is hydrogen. These need to move quicker than they are. There is good work going on in stimulating hydrogen production, and it is about getting it to that point where it can compete in the market.

Picking up on some of the points earlier, yes, there is a timing issue in making sure that you have just enough to get that market going but not to skew it.

Q52 **Alexander Stafford:** This question is mainly for Gus, but, Craig, if you want to jump in, please do. How would the widespread adoption of electrolysis and steam methane reforming affect the demand for electricity and natural gas? With those changes, what infrastructure is needed for large-scale production of clean hydrogen using these technologies?

***Gus McIntosh:*** This is really important. Essentially, this is a complex match of supply and demand. You have significant variability in demand, not at the moment on the power grid, but you are already seeing significant curtailment of offshore wind, for example, or onshore wind, because you need somebody to be using the demand for that energy to be realised. What we are trying to say is that, if you look at this across the piece, the maximum recovery of energy is in a form that is storable and can be distributed to customers at point of use in a way that means they can use it wherever and whenever they want it. Critical to that is the storage aspect of it, in terms of infrastructure, whether that is anticlines or within network storage around how we manage things like line pack,

which, without going into the detail, is a storage benefit that comes from pipeline technology.

Q53 **Alexander Stafford:** In order to get the transportation of hydrogen into homes, what costs are we looking for? How quickly can your organisation deal with that? I am also looking at Graham and Craig. How quickly can you get this going?

***Gus McIntosh:*** Production costs are where the majority of the costs are going to be. That is about pairing with offshore wind but also in the reforming of natural gas. To meet the five-gigawatt target you would need about eight 600 or 650-megawatt reformers, which could be built within a five-year period. We would need to ensure that the network is able to accommodate them and that the carbon capture facilities are there. That would also require some storage. In the short term, if you do not have the storage you can just increase the number of reformers and carbon capture that you are undertaking.

In terms of deliverability, we converted the natural gas network, back in the 1960s, to natural gas from town gas; that took about 10 years. We could potentially do this quicker by mandating hydrogen-ready boilers and taking steps such as the mains replacement programme that we are undertaking. All of that helps to make sure that we can move quickly and with minimum disruption to customers.

Q54 **Alexander Stafford:** Are the proposed provisions in the network price controls sufficient to get these changes?

***Gus McIntosh:*** We need to be careful about a price control, because you have to look at that in the round. I would leave my director of regulation to give you the wider view of our GD2 settlement. However, specific to net zero and what we are trying to do, you need to ensure that you have mechanisms that are flexible to meet the future demands of the system. At the end of the day, we are a network operator that accepts energy that people want to put into our system in a form that customers want to use, so we need to be able to respond quickly to that. At the moment that is built into uncertainty mechanisms within the price controls that we have. We do not have a certain path, but the structure is broadly there. We need to ensure that the final design of those mechanisms is appropriate and ready for us to be able to facilitate this deep decarbonisation option.

***Graham Halladay:*** From an electricity perspective, this is not something new. We are not trying to transform our network to operate with a different medium or generate that energy in a different way. Today we deliver energy to our customers, and we build and reinforce our network to meet that demand. Over the last few years we have developed a significant amount of learning, from producing our distribution future energy scenarios, to understand what likely impact various technologies will have on our network, and then delivering our plans to ensure that our network will be ready for that. From an electricity perspective we are

ready now, and we will continue to be ready, using the distribution future energy scenarios to ensure that our understanding of what will happen in the future builds into our plans for the future.

***Craig Dyke:*** It also depends on what we mean by getting hydrogen into homes. There are two ways of looking at it. One is whether you are using hydrogen as an additional source of heat. Back to Gus's point, is it about repurposing the networks? In that case, they need a clear pathway from Government and those hydrogen-ready boilers and appliances ready for that future world.

The other bit is thinking about hydrogen as a storage vessel for excess renewable energy, in which case you would be converting excess renewable energy into hydrogen and therefore converting it back when there is additional demand for electricity later in the day or later in the year.

It is also understanding what and how you are going to use hydrogen, and also recognising that, from a siting perspective—certainly from an electrolysis perspective—you are better off siting close to where that renewable energy actually is in the first place, if we are minimising that need for additional infrastructure.

***Ian Rippin:*** From the Microgeneration Certification Scheme perspective, I am going to talk about heat pumps. The truth is we are going to need all these technologies. We would say hydrogen has a great role to play in decarbonising sectors such as heavy transport and aviation as a priority. It takes a lot of green energy to create hydrogen. It is something like 500% to 600% greater than the amount needed to power an equivalent number of heat pumps. Heat pump technology is available now. We need to get away from the question about not understanding the technology. We have all got heat pumps in our homes in fridges keeping our milk cold this afternoon, so the technology is not new. We need both solutions to hit anything close to net-zero carbon emissions.

Q55 **Alexander Stafford:** I know the answer to this already, and I am sure you all do, but this is just to reassure the public. Hydrogen is more flammable than natural gas. What safety concerns does this pose for having hydrogen in our homes, and what steps have been taken to mitigate that and to reassure the public that hydrogen is a safe fuel in our homes?

***Gus McIntosh:*** Safety is sacrosanct. That is what we live and breathe in our industry day to day. In Fife we will be undertaking a safe trial, not a trial for safety. It is useful to say that it is only in recent years, since conversion, that we have not been distributing hydrogen. For the first 150 years of the 200-year-old gas infrastructure network, we were transporting 50% hydrogen as part of that mix. We have ensured and will ensure, through all the research and development we have done over the last decade in preparation for this, that this is absolutely safe, and we

have all the right design and features to maintain the excellent safety record that we have now with the delivery of natural gas.

Q56 **Chair:** Can I ask for two very brief clarifications? Gus, my understanding was that we are waiting for the outcome of some research projects to understand how much hydrogen our copper pipes can manage, and how it reacts with those copper pipes in terms of our existing housing stock. In the first panel, one of our witnesses said something about mixing hydrogen up to 20% with the natural gas that we have. Could you clarify where we are with that? What are we waiting to understand, and what do we currently not understand?

***Gus McIntosh:*** We understand that, in terms of the plastic pipe that we use currently, which you will see the networks replacing in every street, that pipework is absolutely fit for purpose. The existing metallic system that is in the process of replacement used to deliver hydrogen, but it is a function of its age and its suitability. We need to determine what level of intervention we would need to make on that existing, remaining metallic asset base. However, by 2032, with the natural completion of our programme, that does not leave a very significant amount, cost-wise. It is likely to be pretty much cost-neutral going forward, if that makes sense.

In terms of in the home, the good work led by UK Government, under the Hy4Heat programme, has looked at the pipework within the home. The initial thoughts on that, subject to an inspection, are that it would be fit for purpose. The important thing is that if something is gas-tight on natural gas, it is going to be gas-tight on hydrogen, but you need to make sure that there are no leaks. We will be doing that in a number of ways, through additional safety devices, for example.

The one other area where work is still ongoing is on the transmission system itself, when we are distributing the gas at higher pressures. We have a local transmission system, which is actually the majority, and it is owned by the distribution networks. Without going into the detail, it is a type of steel, X52, that is absolutely appropriate for hydrogen. It is actually the specification for new hydrogen pipelines, so that is about 90% of the pipe that is in the ground. However, we still have some final validation work to do. We are planning to do a demonstration in the next couple of years to prove that local transmission.

National transmission is slightly more complicated, because it is higher pressure, higher stress and higher-grade steel. All these things are a little more susceptible to things like hydrogen embrittlement. However, there is a project ongoing at the moment, which National Grid is leading, called FutureGrid, which is seeking to evidence that. The vast majority of the national transmission assets tend to be X60, which is the next specification up from the local transmission, rather than the really high grade, which would be more of an issue. Again, we seek to have all this research and development fully concluded for a "wherever, whenever" approach by 2025.

Q57 **Chair:** We understand there is going to be a higher demand for power on the network in order to do electrolysis for hydrogen, as well as for the heat pumps that are plugged in. From a National Grid perspective, are you able to scale up to meet that extra supply of power on your systems, or are there infrastructure problems from your perspective?

***Craig Dyke:*** From the ESO perspective, we would be looking to use that excess. We would expect a market drive on excess renewable energy to maximise the use of that surplus to drive the electrolysis of hydrogen. That is how we would be looking at that.

Q58 **Chair:** It will not go on the grid; it will just go straight in?

***Craig Dyke:*** That is the expectation. If, strategically, you site the electrolysis in the right location, yes.

Q59 **Paul Howell:** I want to go back and touch on different systems again; this time it is district heating and the heat networks. I will come to Mr Dyke first. I want to talk about the challenges in developing the infrastructure to support low-carbon district heating. We all hear how successful it has been in some Scandinavian countries, but it has not yet gathered much interest here. What are the challenges? Why are we not seeing that?

***Craig Dyke:*** From a GB perspective, it is familiarity of heating. It is not necessarily a new technology, but most of our heating stock is from gas applied through the main, followed by electricity. It feels relatively new for the UK. Where we anticipate you are likely to see this would be in new developments, be it a new industrial development or local housing. That is where you are likely to see the benefits. It is not a new technology; around the world it is used loads.

It is also recognising that it can be a limitation of choice for customers. Once you are in that place where district heating is heating your home or your business, you are pretty much locked in and you are paying for that capital infrastructure for 10 or 20 years. There is a balance at play between giving the customer choice versus what might be the right decision and locking them out of future choice.

***Gus McIntosh:*** One of the challenges for district heating is obviously finding that primary heat source. Some 90% of the installations are supplied by natural gas at the moment; quite often those that are not supplied by natural gas have a natural gas supply backup, if it is coming from a significant biomass plant. We have an issue with how we are going to supply district heating going forward. There will be hydrogen-compatible solutions for that as part of the system. Of course, you also have the alternative, which would really need to be ground-source heat.

**Paul Howell:** It goes back to one of the questions I raised in the earlier session, when you talk about the geographic opportunities. The opportunity for district heating in areas of old mine workings, for example, would be much more than in other places.

Q60 **Richard Fuller:** I had to step off briefly for a constituency matter, so apologies if this has been covered. I would like to ask witnesses whether they have what they need to go to the markets to raise financing to go big and go fast on decarbonising heat in the UK. Can you make a credible case to raise substantial amounts of capital now? If not, is it because the technology is not ready? Is it because the production supply chains are not ready? Is it because the policy framework is not ready, or are you at the market right now trying to raise capital?

***Ian Rippin:*** That is a great question. Representing, by definition, smaller installers who are looking to make an investment in their business, they tell us that if the policy landscape were set for the long term, they would feel confident about making investments in their businesses, whether it is equipment or new recruits. We have seen them take some of these steps under the green homes grant. There are difficulties with that scheme, but they welcomed the scheme, initially at least, as a step in the right direction.

In terms of the growing number of SMEs that are fitting heat pumps around the UK today—it is growing every day—they are looking for a policy that has longevity. If they think the market is turning in the way we hope, and we are seeing a massive increase in interest in heat pumps, you are going to see many more businesses wanting to get into fitting renewables.

Q61 **Richard Fuller:** In terms of the long term, do you want the Government to say, "We are going in this direction in terms of tech, and we are going to give loads of grants"? Is it subsidies that are needed for that long term, or, in the absence of subsidies, just a decision of which way we are going?

***Ian Rippin:*** The decision is the first bit. The Government's 10-point plan, which includes an aim to fit 600,000 heat pumps a year from 2028, has been very welcome. It needs to be underpinned by a policy that is operationally viable and that works for the sector. Those are the challenges we have with the green homes grant right now. We need no more stop-and-start. We have had many false dawns. Certainly, the heat pump sector feels like that, as does the sector around educating new entrants. We need the long-term policy.

Q62 **Richard Fuller:** What about for the other businesses here? Are you able to raise capital now? Can you go big and fast on this?

***Gus McIntosh:*** From a hydrogen network perspective, we have to complete the research and development. We have to demonstrate that market. There is very significant interest in the success of that market, not just in the UK but globally, because we are world leading in this space of hydrogen for heat, including our supply chain.

Q63 **Richard Fuller:** You say we are world leading, but you cannot raise capital because it is too early. What does it mean that we are world leading? Is it because you are investing as a private company to push

your knowledge forward?

***Gus McIntosh:*** No. It is in terms of the demonstration of that market. It is always very difficult to demonstrate the market in accordance with the scientific method of technology-readiness level, and then there is the commercial-readiness level that goes beyond that. It is not a bankable asset stage in terms of investment. These two things run in parallel; you have to do the demonstration through the technology readiness, which then informs what your commercial readiness will be.

Q64 **Richard Fuller:** Essentially, it is using the UK as a test bed to demonstrate that these things can work.

***Gus McIntosh:*** Yes, with the advantages of developing the technology here and all of the potential leverage that you can get from having that supply chain ready to service much wider than just the UK.

There are a couple of things that are impacting on investment. For hydrogen production, whether it is from green sources or blue sources of hydrogen, the Gas Safety (Management) Regulations at the moment have the restriction of not allowing hydrogen into the gas grid. That is preventing some of that investment from coming in, because clearly the legislation prohibits it. We have navigated that through the process of exemptions, but you do not make multi-million or multi-billion-pound investments based on an exemption from legislation rather than on a piece of legislation that would facilitate it. The other component is getting that research and development ready so that we can bring it in.

Q65 **Richard Fuller:** It sounds like there is quite a laundry list of things that need to be done to get to a commercially viable rate of return where you can go to capital markets, go big and go fast. That is what we heard from the other session. I will return to this question of who is going to pay for it. Clearly, there is a gap here between what the private sector can do right now and the cost that we need to get to that phase MPs have, in their wisdom, legislated for. Where do you guys think we ought to be laying that £250 billion cost? Should it be to the billpayer or to the general taxpayer, or should we just tax you guys more?

***Gus McIntosh:*** Ultimately, there is a cost to decarbonisation. What you have to remember is that there is also a cost to doing nothing. We cannot forget that. There is a very significant cost to doing nothing in terms of the climate, and that is arguably priceless. What you want to make sure is that customers are getting something they want, so that it is an acceptable cost, rather than forcing something upon them. There is sometimes a danger that we understand the price of everything but the value of nothing, to use that old adage.

You must absolutely get to a model where the polluter is paying for this stuff. There have already been some moves for a green gas levy, with the replacement for the RHI for biomethane, for example. There is an opportunity to expand that for the early hydrogen deployment, perhaps with the clusters. Beyond that, ultimately, some of the additional costs in

decarbonisation will be a mixture of both private sector funding and taxation.

Q66 **Richard Fuller:** I will bring in Graham as a distribution guy. I guess what "polluter pays" means is that we are going to have to start charging everyone who uses gas an extra levy to try to persuade them to change. What is that, £20 a month extra on people's gas bills?

***Graham Halladay:*** From an electricity perspective, as you are probably aware, there is currently a significant amount of levy on the electricity bill to pay for green energy and subsidies for renewable energy. It is not for me to say whether that should happen on the gas network. I would repeat what I said earlier: the industry is heavily regulated. Our income is fixed. We have to put a business plan in. It is for regulators and policymakers to make the decision about how and who pays, but whatever happens it needs to be fair and reasonable, nobody should be left behind and the vulnerable should be considered.

Q67 **Chair:** It has been reported that there is some debate alongside the carbon pricing discussion in Government around whether some of the additional charges on the power network should apply to gas, to make it easier for people to transition to electric-powered heat pumps or whatever it might be. Presumably you disagree with that.

***Gus McIntosh:*** What has actually been pretty successful in power is that the move or shift to decarbonisation has been supported through the bills. You could mirror that on the gas side. It is important to recognise who the beneficiary is of that decarbonisation. If the gas customers are paying for it as the polluter, they would then get the benefit of that decarbonisation through the gas system. That is quite a good model.

The other point to recognise is that regulatory models are a great way of attributing costs between current and future customers over a significant period of time. Regulatory asset-based models are something that should be considered as to how to apportion those costs going forward.

Q68 **Chair:** Ian, we heard from the first panel that one of our witnesses installed a heat pump and had to replace his radiators and some other bits and bobs, and it came to £9,000. The Environmental Audit Committee estimated it would cost, on average, £15,000 for a house to convert to a heat pump. Many households just cannot afford that, can they? How are we going to bring them with us?

***Ian Rippin:*** That is the cost of installation. That is why the Future Homes Standard is critical. We have to shut the stable door; the horse has bolted. It is possible to install heat pumps in the majority of homes if they are designed correctly, but there are some systems out there that require the heating pipes and the radiators to be changed. That is where the costs add up. We heard in the earlier session that it is not actually the cost of the heat pump itself, which might be one or two times more expensive than a replacement gas boiler; it is all the other bits and pieces that go with it.

This is a planned purchase, which is why I and MTS favour a combination of the consumer paying but also some grant to help them make that transition. We have to stop installing new homes with fossil-fuel-based heating. At the very least, we have to make sure the pipes and the heat emitters are ready for a heat pump future.

Q69 **Chair:** I agree with you on new homes, but, as I said at the beginning, our evidence is that much of our housing stock at 2050 is still thought to be the same housing stock we have had for a very long time. The retrofit question is really important, and replacing pipes and radiators is a big old job in people's houses. Evidently we are going to need to find a way to finance that and do it. If you have any ideas, let us know.

***Ian Rippin:*** We have seen a lot of interest in the green homes grant. It is not fulfilling its potential, but it has stimulated discussion. We talked about consumer understanding of the technology and their awareness of it as part of a low-carbon lifestyle. Your heating is a critical part, like taking the option to choose an electric vehicle. It is stimulating interest, as I say, when people make planned changes to their heating. It is possible.

**Chair:** It has to be. We just have to find a way to do it.

Q70 **Alan Brown:** Ian, building on what we are talking about in terms of the different work that needs to be undertaken for a heat pump, we have spoken before about an offset in costs in terms of the number of new jobs that can be created. Are you able to estimate what the possible job creation total could be through the transition to low carbon? Importantly, what is the skills gap and how is it going to be addressed?

***Ian Rippin:*** There are a few things in there. During National Apprenticeship Week we are talking about a low-carbon heating technician apprenticeship as a specialist route into the market. That is needed. This sector has come of age now and deserves its own apprenticeship model to complement the current plumbing and heating apprenticeships. The two things can sit alongside each other.

There is a supply chain issue in terms of installers. We are seeing many more wanted to become MCS-certified and comply with our standards, which is great, but the rate of adoption is not fast enough. A lot have been deterred by the operation of the green homes grant, but there are still a great many. For example, with the green homes grant skills competition, I know of one particular scheme that is offering training and qualifications in heat pump installation and MCS certification; that has over 570 applicants already. That is against a base that this morning was 970 certified installer companies; there are more actual installers. The sector is responding and will respond. There is a great deal of interest from fossil fuel installers who want to convert over. There are now qualifications becoming available for them, with all the knowledge they already possess, to convert to be a heat pump installer.

Q71 **Alan Brown:** Is there an estimate of how many new jobs could be

created and how many jobs will be recycled? Some conventional plumbers and gas fitters might be moving over, so do we know how many new jobs could be created?

***Ian Rippin:*** Our estimates are between 30,000 and 40,000 installer companies. That is more installers, but you have one-man bands all the way through to larger, multi-site, multinational organisations. In the sector today, it is mainly SMEs with three or four installers acting in teams, working for an MCS-certified company. That is taking it from around 1,000 today to 30,000. That is the opportunity, and most of that will come from existing fossil fuel installers who are converting over to fit heat pumps.

Q72 **Alan Brown:** You have called for Government certainty in terms of the green homes grant lasting longer and longer-term visibility. Would that in itself be enough for companies to do the training and start to bridge the skills gap, or is there still going to be more required, either from industry or from Government?

***Ian Rippin:*** The priority is absolutely that businesses see the opportunity in their area. For example, MCS is working with OFTEC, the oil-fired heating sector. In the next few weeks, we are going to be talking to their members about a renewable energy future for their businesses. Yes, going green is important, but so is the sustainability of their businesses. That is about the policy intent, the 10-point plan, and operation improvements to things like the green homes grant.

Yes, it helps to have voucher schemes to support people going through training, but it is not the be all and end all. It is about understanding that there is a business here for me, setting up as an installer in my area for the long term. That is the key. Vouchers are great but they are not the main thing.

Q73 **Alan Brown:** Gus, do you have any estimates of what large-scale hydrogen deployment could mean in terms of new jobs, and how many jobs will not necessarily be new but will be part of a transition?

***Gus McIntosh:*** There are estimates of 221,000 new jobs by 2050 through the Hydrogen Taskforce. By 2035 they are talking about £8 billion GVA added with significant jobs, depending on how it is secured across the different supply chains.

In terms of skills and training, the conversion of existing gas-safe registered engineers that are out and about doing the fitting of boilers is pretty straightforward. You would retain around 100,000 plumbers and fitters who are out there now. There is a huge opportunity for redeployment, particularly with CCS and production activities and some of the offshore pipelines and connections for the hydrogen production systems. For former oil and gas workers, that is a great opportunity. From a network perspective there will not be a massive increase in network-type roles other than for some of the additional pipeline

activities, but yes, very significant job opportunities and not too difficult a reskilling activity.

Q74 **Alan Brown:** You said 220,000 jobs. What would the bulk of these jobs be?

***Gus McIntosh:*** The bulk of them will be in offshore production, but also in the supply chain in terms of manufacturing. I mentioned earlier all of the manufacturers that are supplying the project, such as Bosch, Baxi, Stovax and all these UK manufacturers within the supply chain. A lot of it would be around pipeline technology, electrolysers, offshore wind connections, making sure all of that goes in, and storage as well.

Q75 **Alan Brown:** Craig, we have heard how there is going to be increased demand for electricity generation, whether it is heat pumps or hydrogen production. Is it the case that the National Grid charging system for electricity needs to be revisited? It seems to me that a lot of offshore deployment is going to be off the coast of Scotland, but at the moment for offshore deployment you have to pay to connect to the grid, whereas in the south of England you get paid to connect to the grid because of the previous generation system that the charging system was built on. Does that need to be revisited in order to make this transition?

***Craig Dyke:*** Yes, there is a significant charging review being undertaken by Ofgem. Clearly, the ESO will play a role in that. You are right that traditional charging methodologies have been driven by location of supply and demand. With the big ambition of 40 gigawatts of offshore wind by 2030, it means that shift of power transfer across the networks will change.

It is also about ensuring that we make best use of existing capacity today, so using smart technology and smart tariffs to make sure that, where there is headroom in the capacity of existing infrastructure, we shift that load, supply and demand to meet. Whereas traditionally it was all about getting supply to meet demand, in the future it will be about shifting demand loads to meet supply, so we have our excess renewable energy. It will be about us and the market ensuring that we can shift that demand to meet that excess supply.

Back to your original question, it will be folded back into the transition charging review that Ofgem is undertaking.

**Chair:** That brings our session to an end. It has been a very useful session. We have heard from both panels about some very significant, difficult and expensive challenges ahead to decarbonise heat. On the other hand, we have heard about the statutory responsibility we have as a country to reach net zero, as well as our decarbonising targets and the opportunity of very significant job creation in every part of the country. We have to do it and we want to do it. We just have to figure out how best to do it. Thank you to our witnesses on both panels. We will be digging into these issues in more detail in future evidence sessions, but

for today I call this session to an end.