



Business, Energy and Industrial Strategy Committee

Oral evidence: Decarbonising heat in homes, HC 851

Tuesday 20 April 2021

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[Watch the meeting](#)

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

Questions 99 - 156

Witness

I: Naomi Baker, Policy Officer, Energy Saving Trust; Emma Harvey, Programme Director, Coalition for the Energy Efficiency of Buildings, Green Finance Institute; Professor Mark Barrett, Professor of Energy and Environmental Systems Modelling, University College London; and Juliet Phillips, Senior Policy Adviser, E3G.

Written evidence from witnesses:

– [Energy Saving Trust ([DHH0066](#)); Coalition for the Energy Efficiency of Buildings, Green Finance Institute ([DHH0071](#)); E3G ([DHH0124](#))]



Examination of Witnesses

Witnesses: Naomi Baker, Emma Harvey, Professor Mark Barrett and Juliet Phillips.

Q99 **Chair:** Welcome to this morning's session of the Business, Energy and Industrial Strategy Select Committee for our third hearing on decarbonising heating in residential homes across the country. Today we are going to be considering some of the financial implications and costing assumptions around our decarbonising strategies in the UK. Before I begin, I should declare my interest: my wife works for the Association for Decentralised Energy.

Today we are delighted to welcome four witnesses to the Committee: Naomi Baker, who is the policy officer at the Energy Savings Trust; Emma Harvey, who is the programme director for the Coalition for the Energy Efficiency of Buildings at the Green Finance Institute; Juliet Phillips, who is a senior policy adviser at E3G; and Professor Mark Barrett, who is a professor of energy and environmental systems modelling at University College London. Good morning to all of you.

I am going to start with a few questions to each of you before I open it up to colleagues. Professor Barrett, I am going to come to you first. The Committee on Climate Change has estimated that it is going to cost us around £250 billion to decarbonise heat in homes in the UK. From your perspective, is that number right? Is it too low or too high? What are the key assumptions underlying it that we need to be aware of today?

Professor Barrett: It is of the right order. The difficulty is that you have to account for all the parts of the energy system that you need to deliver heat, all the way from your primary energy of, say, wind, solar and nuclear, right through to your gas boilers, your hydrogen boilers or your heat pumps. It is quite difficult to precisely account for the costs of heat out of the whole system. About £250 billion is about the right order for the capital costs of the system. When you annuitise the capital costs and the operational costs, it will be of the order of £50 billion to £80 billion per annum for the system.

Q100 **Chair:** In terms of the key assumptions underlying that, we have heard evidence about reducing cost to consumers as the market develops and other funding that is already going in to deal with some of the distribution networks. Is that right, or are there other key assumptions that are really important in underpinning that figure, where, if one of those goes wrong, it is going to cost more, for example?

Professor Barrett: There are some technologies that are quite well known, because they are installed in their millions around the world and in Europe. Heat pumps and district heating, particularly, are very widely used. For hydrogen, the knowledge is less precise because there are no current hydrogen networks of any scale and hydrogen boilers are difficult to come by and so on. There are major uncertainties there.



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The principal uncertainty for me is probably in the cost of the network. If you have a lot of electric consumer heat pumps, you have to upgrade the electricity distribution system particularly. If you have hydrogen, you need to repurpose the gas grid. There is rather little knowledge about how much that will cost, because it has not been done yet. It is also not just the distribution system; you also have to consider what changes might be needed in the internal gas pipes and so on within consumer premises. For district heating, the costs are pretty well known because it is extensively applied in other countries, but the costs in the UK context are more difficult to project. Those are the main uncertainties for me on networks.

In terms of your source of hydrogen, I believe it has to be electrolytic hydrogen—hydrogen made by electricity. You cannot use hydrogen made by natural gas to any extent because of its greenhouse gas emissions. If you do produce hydrogen from methane, using steam methane reforming with carbon capture, it is barely commercial. As far as I know, there are only three plants worldwide that are in the prototype phase of doing this.

Q101 Chair: Juliet Phillips, we have just touched on some of the uncertainties in the financing. I suppose the nature of an uncertainty is that it is uncertain, but are there things that you think Government could do to try to alleviate some of those uncertainties?

Juliet Phillips: It is a brilliant question. Yes, there is a lot that the Government can do to try to help bring down the costs associated with heat decarbonisation. The first one that is most important is probably around energy efficiency. This will be crucial for bringing down the costs by lowering the amount of energy we need to heat our homes. We have done some calculations that suggest that, without improving energy efficiency, the costs of heat decarbonisation will be £6.2 billion higher per year to 2050, so this could be a key way of bringing down costs.

Another point is around grid flexibility. An analysis done for the CCC suggests that the system-wide costs could be £16 billion less per year if we make full use of grid flexibility, which needs stronger planning co-ordination between electricity, gas and heating systems. In terms of reducing the upfront capital costs associated with the technologies themselves, we can focus on achieving economies of scale. This can help reduce the cost of heat pumps, installations and maintenance.

Research from OVO Energy suggests that we can reduce the cost of heat-pump technology through these economies of scale by focusing on the supply chain, manufacturing, wholesale and distribution. We can also reduce the costs associated with installations by focusing on the installer market and improvements in the installation process. The Government can do further support by taking examples from offshore wind, such as looking at a sector deal to help scale up heat supply chains and jobs across the country.



To pick up on the point that Mark raised, hydrogen is a potential risk and potential cost here. The forthcoming hydrogen strategy needs to set out a really strategic vision, identifying the places where hydrogen does and does not add value. It can have a really important role to play for certain sectors and regions where there are not currently other available decarbonisation pathways, but, on the whole, for most places in the UK at least, hydrogen for heating will not be the most cost-efficient way of decarbonising heat.

It could be up to six times less efficient than direct electrification, and the CCC has suggested that we could need 30 times as much offshore wind than currently to produce enough green hydrogen to replace all UK gas boilers. There is a clear need there for a Government signal to say that this is not the way forward.

Q102 Chair: That is great. We will come back to some of those things in more detail. Just to clarify, in your initial comment about energy efficiency you presumably meant a reduction in the yearly cost of heating if your home is more efficient as opposed to a reduction in cost in any of the capital infrastructure. Is that right?

Juliet Phillips: Yes, I am sorry. I should have clarified that I meant the ongoing cost.

Q103 Chair: That is great; thank you for that. Emma Harvey, we touched a little on unavoidable costs. Presumably if we all get electric vehicles we are going to need to upgrade the electricity grid anyway. Are there other unavoidable costs that we are just going to have to get on with irrespective of where we get to on heating?

Emma Harvey: That is a very interesting question. From the UK Committee on Climate Change's recommendations, we have seen that it feels the optimal path for decarbonising heating is predominantly through the electrification of heating. This will predominantly involve installing heat pumps, whether air-source or ground-source, and combining that with between 14% to 18% of heat generation coming from district heating networks and, to Juliet's point, generating a small amount from hydrogen, ideally located near industrial clusters.

There is going to be a significant amount of investment required in installing new technologies, in some places repurposing infrastructure such as pipelines, and then also new technology and new infrastructure such as the pipes that are required for district heating networks. Other elements will also need to be included to drive this change. We saw from the Committee on Climate Change that behavioural change among consumers is going to be very important for encouraging and having the uptake of technologies. Behavioural change does not happen by itself, so there may need to be public awareness and public campaigning done by both Government and industry, which may of course have associated costs.



As well as decarbonising the heat network—this is just to replicate and echo what Juliet said—there is a really strong need to combine this with a fabric-first approach. Investment in energy efficiency will be critical. There is a parallel track of investment that is required there. It is also quite important to understand which of these investments are supported by the public purse and which are supported by the private sector. We have to ensure that the costs are appropriately distributed and financed in an appropriate manner so that the households that are less able to pay or that are vulnerable are more able to tap into public financing while the able-to-pay market has suitable attractive financial propositions that can support the investment that is required.

I would be very happy to talk further around what some of those investment products and models look like, both in terms of what we have seen be successful on the international stage but also in terms of the innovations that are coming forward in the market today.

Q104 **Chair:** Thank you. We will definitely be coming back to those issues around consumer costs. I know colleagues will be following up with you and Naomi on that shortly.

Professor Barrett, very quickly before I hand over, there was quite a bit of discussion there and in previous hearings about assumptions on the reduction of cost as the market develops. Often people refer to offshore wind as a good example where Government intervention stimulated a very significant drop in costs. Presumably we are assuming that this will also happen for heat pumps, possibly hydrogen boilers and heat networks. What do Government need to do to help facilitate this in the heating sector as it did in offshore wind?

Professor Barrett: The same policy mechanisms can be applied. Essentially, a net-zero emissions system is going to be very capital-intensive with a very low fuel cost. We think the operation and maintenance costs may be 20% to 30% of the total annual system cost, so they are not negligible.

In terms of Government incentive mechanisms, an obvious one as used for offshore and balancing mechanisms is contracts for difference or capacity auctions. I believe the capacity mechanisms are going to become more important. You will say, “We want so many gigawatt hours of heat storage or district heating” and so on, and then you auction the capacity. That is a proven mechanism. It has been very successful for offshore wind, and I see no reason why it should not be applied to the system components upstream of the consumer’s premises.

When it comes to the consumer, the cost of connection to district heating and the capital costs at the consumer’s premises will probably be about the same order as a gas boiler, and a hydrogen boiler would also be about the same order. They would perhaps be around £5,000, as a ballpark figure. A heat pump might be more of the order of £10,000. A



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possibility there is to use an incentive such as is used for electric vehicles, where you apply a grant to cover some of the additional cost.

One thing I would say is that we have modelled zero-emissions systems with all these different heating shares, with hydrogen, district heating and heat pumps, but we have also simulated them with climate change. The Met Office is projecting between 2° and 4° in the high-emissions scenario for 2060. Of course, one advantage of heat pumps is that they can be used for cooling as well as heating. One option that we think is worth having a very careful look at is reversible air-conditioning/heater-type heat pumps such as you often see in hotels and so on. These are mass-produced, rapidly installed and can have room-to-room heating so they are very well controlled.

From the consumer point of view, the additional cost of heat pumps is an issue. Otherwise, the costs will be paid through fixed and variable charges from public suppliers, whether that is electricity, heat or hydrogen. It should not present a greater financial barrier to most consumers than what there is now. One thing to say is that, of course, roughly 35% of dwellings are either privately rented or socially rented. The capital costs of the consumer gear will be borne by the landlord there, and then expressed through rent rather than having to meet a capital cost. As we have seen with the difficulties around retrofit efficiency programmes for buildings, it has been a real problem financing large capital sums for these purposes.

Q105 Alan Brown: Emma, I am just wondering whether you could elaborate somewhat. Professor Barrett gave a couple of examples of what he thinks might help bring down the costs of low-carbon heating technologies. From your perspective, what policy frameworks or conditions are needed to encourage the cost of low-carbon heating technologies to come down over time? What Government investment might be needed to unlock private investment as well?

Emma Harvey: That is a brilliant question. In terms of being able to drive down the costs of low-carbon heating over time, one of the strongest messages we hear back from the industry and the finance sector is about the need for long-term policy certainty. That allows investment in low-carbon heat technologies to become lower-risk, more certain and to have more certainty around returns.

For instance, what that could look like is a clear target on the phase-out of gas boilers being installed into new and existing buildings. We welcome the move in the future homes standard to phase out gas boilers by 2025, but that could happen sooner. That would provide clear investment opportunities both for property developers and for the industry. That would also help the industry scale up its skills base in heat pumps and start helping gas-boiler installers pivot towards heat-pump installation, for instance.



There is also a piece around helping to pump prime the market and drive consumer demand. The challenge at the moment is slightly chicken-and-egg. There are high upfront costs to heat pumps, which deter consumers and then stop the costs coming down, which further deters consumers.

One of the financing mechanisms that we have seen that can help to address that challenge—we have seen it be very successful in places such as the United States and Australia, and it is being trialled in Europe—is something called property-assessed clean energy finance. This is a financing mechanism that allows homeowners to pay for 100% of the installation costs of their heat pump and then repay the financing over an extended period of time—20 to 30 years.

Importantly, the finance is linked to the property rather than the property owner. If the homeowner decides to move home, they will not be taking £10,000 or £12,000 of financing with them that they then have to continue repaying. Whoever subsequently moves into the property is responsible for repaying the finance. Whoever is benefiting from that low-carbon heating technology is going to be repaying the finance. This is quite important, because it addresses and overcomes the key barrier to heat-pump adoption, which is the high upfront costs. It would be a very clear financing mechanism if supported by Government and the finance sector. It could help complement policy frameworks and decisions such as the phasing-in of heat pumps and other grants and policies.

Q106 Alan Brown: I know you said it is successful elsewhere, but in a way that is what the Green Deal tried to do: put finance against the property. That was not successful here. There is also an argument that you are paying for this technology over a 25-year period. Is that the most effective way of financing it, if you are effectively putting it against a mortgage?

Emma Harvey: I am really glad you brought up the Green Deal, because there are a number of differences between PACE finance and the Green Deal. Primarily, the Green Deal was unsecured finance while PACE finance is secured finance. What that means is it is secured against the property so it is lower-risk, which means it has lower interest rates and payments can be spread over a longer timeframe. It also means that lenders are more likely to go into this. The golden rule is also not associated with PACE. If you are familiar with the Green Deal, that was one of the key challenges to its adoption. We have seen over \$6 billion go into energy-efficiency retrofits in the US over just a handful of years. It really is starting to gain traction in a number of states where it has been launched.

Your question around the repayment timescales is very interesting. At the Green Finance Institute, we strongly believe that you need to have a mix of financing mechanisms that are appropriate to individuals and individuals' circumstances in order to help drive the transition. Some homeowners, maybe mortgaged homeowners, will use green mortgages and take further borrowing in a classic traditional mortgage approach.



Some homeowners or private renters will use heat-as-a-service business models, which are starting to emerge. Some may use PACE and various other mechanisms. It is a very good question. Ultimately, we need to have a smorgasbord of financial solutions that can match individual needs and desires.

Q107 **Alan Brown:** Naomi, can I ask whether you want to add anything to that? Do you have any different suggestions about policy frameworks and conditions?

Naomi Baker: I would very much echo everything Emma said about needing different financing situations for different households. The Government recently consulted on a new requirement for mortgage lenders that would require lenders to bring a certain scope of the homes under their lending up to an average of Energy Performance Certificate rating C by 2030.

The mechanism has the ability to improve up to 9 million or 10 million homes, but the impact assessment suggested that it would only improve 2.8 million. The reason for the gap is because it would not be affordable for all homeowners to take out additional lending and still meet mortgage affordability requirements. That suggests that we need alternative unconventional loans to go alongside that, such as the PACE financing that Emma highlighted, which could sit on the property rather than the lender. Ultimately, we need to improve all homes, not just those with householders who can afford it.

I have a couple more points on the importance of policy certainty in bringing the cost down. There is also something around aligning existing incentives in this area. For example, we currently spend about £4 billion on dealing with the consequences of fuel poverty, of people not being able to afford adequate heating. We spend £2.3 billion a year on helping people pay for their energy bills and then another £2 billion via the NHS on helping treat the impact of cold, damp homes. Against that, we spend £0.64 billion on retrofitting homes on a year-on-year basis. Clearly, we could align some of those costs.

Similarly—this will come up a lot—most of the energy-policy costs currently sit on electricity, even though electricity is the lowest-carbon heating source that we have at the moment. There is obviously scope to remove that disincentive. There is definitely an argument around aligning existing incentives to reduce costs overall.

Q108 **Alan Brown:** Juliet, can I ask a slightly different question? What should the Government's priorities be for minimising cost in the heat in buildings strategy when it comes forward? Given there is a trail that we are going to move to 85% emissions reduction by 2035, how critical is the heat in buildings strategy in terms of looking ahead and the roadmap?

Juliet Phillips: We see the heat in buildings strategy as essential for setting the roadmap to get on track to decarbonise our homes over the



next decade and further forward into the later years as well, working alongside other important decision making this year such as the hydrogen strategy, the spending review and the net-zero review. Together, these need to provide a comprehensive national strategy for getting on track. The essential role of the heat in buildings strategy will be to provide the governance to help support this transition, both at a national level, through setting out things like standards, regulations, the roadmap and targets ahead, but also at a local level. This is really important as well for getting to scale.

To dig into some of the things we need at a national level, this would include a fabric-first principle being embedded, which focuses on increasing energy efficiency and the performance of the fabric before installing heat technologies, which in most cases is the most cost-efficient way of decarbonising heat. Ensuring that there is action to tackle fuel poverty and support for low-income households will be another essential strand of this. We recognise that a significant chunk of households are already experiencing issues related to costs. Given the effects of the pandemic and the fact there are more people working from home, this could also increase. It will be essential to make sure we are focusing on support for those households.

We need more regulation at national level. This is picking up on things that other people have said already, but setting a phase-out date for fossil-fuel boilers will be really important for setting that direction. Related to the fact that we need to focus on energy efficiency and heat decarbonisation together, we also need to bring into place regulations around minimum energy-efficiency standards for all tenures. These are currently in place for the private-rented sector, but we think there is a strong case for introducing them for the owner-occupied sector as well.

I also have a few things on the local governance piece around zoning. This is the idea that local authorities can take more control over the different pathways towards place-based transitions at a local level. This will also support investor confidence, because they will be able to see the pathways forward in different areas, be it heat pumps or district heating networks, et cetera.

Q109 Alan Brown: I have one final question, Juliet. The Government have a target of 600,000 heat-pump installations by 2028. The Committee on Climate Change thinks it should ideally be 900,000. We are looking at circa 20,000 installations a year at the moment, and you have rightly said that there needs to be investment in energy efficiency. Is it a realistic proposition that we will be able to get to 600,000 installations in the next six or seven years? What would be your No. 1 ask of the heat in buildings strategy that would get us going in that direction?

Juliet Phillips: It is definitely ambitious, particularly when you look at the current low levels, but it is also completely necessary to decarbonise our building stock. We have seen equivalent rates being achieved in other countries such as Finland, which has seen a huge boost in heat-pump



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installations. With the right combination of regulation, mandates and, really importantly, financial support and incentives, I believe it is possible. We are seeing innovation across local authorities, the private sector and financial institutions. Bringing this all together in a carefully considered policy framework could make the ambitious achievable.

Q110 Mark Pawsey: I want to move on to how we are going to pay for this and how we are going to get investment into the system. In Professor Barrett's remarks to you, Chair, he agreed that the total cost of decarbonising heat might be £250 billion, but it could be as much as £50 billion to £80 billion per annum. I am interested in who is going to bear that cost and how we get private-sector investment. Emma, you said that a proportion of the cost would be borne by the public purse and a proportion would be borne by the private sector. What is the split between the public purse and the private sector picking up the costs of achieving our objectives in decarbonising heat?

Emma Harvey: As outlined at the start, the estimated investment into decarbonising homes comes in at £250 billion, but we have seen that small amounts of public investment targeted in the appropriate way can bring in up to five to 10 times that amount in private investment by crowding in. The OECD's estimates suggest that guarantee schemes, for instance, can bring in 10 times the amount of public investment.

Q111 Mark Pawsey: I will come on to how we do it, but I just want a broad assessment from you. Is 20% going to be picked up by the public purse and 80% by the private sector? Will it be 50:50? What are the ballpark figures?

Emma Harvey: I do not have a figure for what the split would be, but you could minimise the public investment and maximise the private investment by having mechanisms that are attractive to the private sector. I would be happy to find some information and share that with you in a letter.

Q112 Mark Pawsey: We heard from Juliet that one of the key issues is policy certainty. How certain would you say policy is right now?

Emma Harvey: Today's announcement of the decarbonisation target is a welcome move, but what we hear from the investment industry is that clearer guidance on the types of technology that will be invested into and where those different technologies will be deployed would support investment into the sector. For instance, the recent announcement on zoning, whereby you look at area-based plans for decarbonisation technologies, are strongly supported by investors, because they give them clarity on when and where investments are going to be required.

Q113 Mark Pawsey: If I were changing my heating system and I was intending to install a heat pump, how many lenders would know what I am talking about?



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Emma Harvey: The lending community, and in particular the high street banks and the retail banking community, is becoming increasingly aware of these types of technologies. That is very much driven by the recent consultation on how mortgage lenders can play a role in helping to decarbonise homes. There is further to go.

Q114 **Mark Pawsey:** They will not have as much choice. If I was going to buy a new car, there are many lenders who would want to lend me the money to buy a new car. If I want to buy a heat pump to change my heating system, how many lenders would confidently know what I am talking about? Would it be 10, 50 or hundreds?

Emma Harvey: There are more than a dozen finance providers who are offering green mortgages at the moment, and there are a number of specialist lenders who focus on renewable technologies. Since 2017, we have seen that finance lenders are increasingly bringing out these green products. They are becoming more au fait with heat-pump technologies driven by the Bank of England stress tests, but we are also developing, as the Green Finance Institute and our Coalition for the Energy Efficiency of Buildings, a guidebook that is targeted at lenders that gives them decision-useful information on these green-home technologies to get them, exactly as you say, fully up to speed on what these technologies are to help their consumers and customers.

Q115 **Mark Pawsey:** Juliet, is the investment community researching this sector adequately? Given the very substantial amount of lending that will be necessary, are they up to speed? Do they know what they are talking about? Are they lagging behind?

Juliet Phillips: There is more work to be done. There is an emphasis on Government to set that clear direction and to make it clear which areas will need more scaling up. I would point to the excellent work being done by the Coalition for the Energy Efficiency of Buildings and its various members in helping achieve that. There is still a way to go, but we need further Government intervention as well.

Q116 **Mark Pawsey:** What do you want the Government to do?

Juliet Phillips: I have picked up on a couple of points from the heat in buildings strategy around governance. There are also things that the Treasury can do to rebalance the operational costs, the ongoing costs of heating. As Naomi alluded to earlier, it is currently more expensive to heat your house with electricity rather than gas, despite that being a higher-carbon fuel.

Q117 **Mark Pawsey:** We need a radical rehaul of pricing strategy. Is that what you are saying?

Juliet Phillips: I am not sure whether "radical" is the word, but we definitely need a rebalancing to add an incentive for the consumer.

Q118 **Mark Pawsey:** How should Government do that? Should Government do



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it with financial incentives, by means of a carrot, or should it do it by regulating, by bringing out a big stick?

Juliet Phillips: I would say we need a mixture. There is no silver bullet here. We need a mixture of carrots, sticks and all the other kinds of motivational behaviours and drivers to get the scale needed. There will be a role for grants in the long run, particularly for low-income households, for whom even the cost of a boiler is too expensive. Continued support there will be needed as well as around the ongoing running costs. There is a role for low-interest loans, for instance through the new UK Infrastructure Bank. That could be a way of incentivising more homeowners to take on those additional costs.

Q119 **Mark Pawsey:** Of all the people who are replacing a boiler that has broken down this week, how many are really going to think about having one that is hydrogen-ready, for example, which is going to be more expensive than replacing it with the same old boiler they have always had?

Juliet Phillips: I totally agree. At the moment, consumer awareness is low. There is no denying it. We need Government-backed campaigns to drive awareness and bring more education around the different options available and the benefits associated with them. We need a consumer protection deal as well. As people are retrofitting their homes, we need to make sure it is of the highest quality and that people are getting good value for money in the transition.

Q120 **Mark Pawsey:** Naomi, would you say that somebody replacing a boiler right now should be thinking about a low-carbon alternative rather than just doing what is expedient? What incentive is there for them to do so as things stand?

Naomi Baker: There is not an adequate incentive at the moment. From the consumer perspective, we think there needs to be an attractive consumer proposition. Consumers need to know that, if they switch, their bills will be lower. At the moment, there is a problem with the levied cost on electricity. We think they also need to be able to get the low-carbon heating at the same price that it would cost to replace their boiler.

In terms of how the Government do that, if we zoom out, the really interesting insight from the Committee on Climate Change's modelling last year was that if we follow the most cost-effective and affordable pathway, which is their balanced pathway, by 2050 it will lead to lower energy bills. Not only that, but the total energy bill savings over the 30-year period will outweigh the total capital costs. If the Government were to look at homes as a long-term infrastructure programme rather than as a collection of private assets, we can see that on one hand there is a 30-year need for investment but on the other hand there is a revenue stream.

We think there is scope for the UK Infrastructure Bank to come up with some sort of long-term loan scheme, using private-sector capital, to help



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consumers with those upfront costs. If we grow the market now, we can bring down the costs in the future.

Q121 **Mark Pawsey:** You refer to the UK Infrastructure Bank. Should it have a formal role in ensuring we achieve these objectives?

Naomi Baker: Yes, very much so.

Q122 **Mark Pawsey:** Professor Barrett, I want to chat to you about the opportunities for businesses and what we might do to ensure that the £250 billion, or the £50 billion to £80 billion per year, is an opportunity for UK companies. What needs to happen for UK companies to get a share of that very substantial investment?

Professor Barrett: As I suggested, we can treat the issue of heating in the same way as we have treated the issue of decarbonising electricity supply. We have had feed-in tariffs right through to capacity markets and contracts for difference for low-carbon supply. I see no reason why the same mechanisms could not be applied to bidding for district heating schemes or for heat-pump manufacturing and installation capacity.

One thing I would say is that, given the huge reductions in renewable costs because of the success of these programmes, the energy consumption for heat will be much less than with gas. The energy cost of heat may very well be less than it is with gas, though that depends on which gas price you use. One important issue I would like to bring up is that the marginal cost of electricity supply will be very highly variable depending on whether the wind is blowing and so on.

A particularly important part of this is how the capital costs—for heating 80% or 90% of the cost of heat is upstream of the consumer—will be met through fixed and variable charges on their bills. This is a very important tariff question, which should be addressed. If poorer consumers particularly are exposed to very high variations in electricity price, this will cause problems. There is a big issue there around constructing an electricity market that recovers costs but does not expose people to too high fluctuations in costs.

Q123 **Mark Pawsey:** Professor Barrett, when you say it will cause problems, do you mean it will act as a disincentive for them to make the investment we need them to make to achieve our objectives?

Professor Barrett: Yes. Roughly speaking, in a zero-emissions system, it is going to be almost all capital costs and operation and maintenance costs, which are going to be incurred whether or not the wind is blowing. We need structures whereby we can recover the capital costs, which could be to private companies that have bid for the capacity. We need to be able to recover the costs and not expose consumers to too violent variations in electricity prices.

Q124 **Mark Pawsey:** Professor Barrett, are we not being prepared for very substantial variations in cost based on the time power is used? Smart



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meter technology provides us with the opportunity to provide very low-cost electricity at night for people to charge their electric cars. A variation in price is something we are going to have to get used to, is it not?

Professor Barrett: We want a variation in price so that people are encouraged to use energy more efficiently and invest in storage and so forth. What I am saying is that some of the capacity in the system, for example energy storage, may be used only rarely. When it is used, that will load the costs on to those particular limited periods. It is not just day or night; longer-term variations in wind and solar generation cause large variations in the marginal costs of the system. This is an issue that will need addressing to obviate fuel poverty, but you also need to incentivise people to charge their vehicles at night rather than in the day or when the wind is blowing.

Q125 **Mark Pawsey:** Emma, where do you see the opportunity for British manufacturers and British companies to take advantage of the business opportunities that will come their way through decarbonisation of heat? Is there institutional funding ready to support the investment that will be necessary to manufacture the heat pumps and hydrogen-ready boilers that we will need?

Professor Barrett: Yes, because, after all, we have an industry that installs so many millions of gas boilers already. We have an industry that is installing gigawatts of wind and solar year by year. The technological expertise is there. There can be a commitment through Government policy to say, "We want 10 gigawatts of offshore wind, 5 gigawatts of heat pumps and district heating schemes, and 10 terawatt hours of storage in district heating schemes", and they can put those out to auction.

Mark Pawsey: Professor Barrett, my question was to Emma Harvey. I am hoping Emma can tell me whether or not the investment institutions are ready to make money available for that to happen.

Emma Harvey: We recently convened a roundtable to look into just this challenge. There is appetite among financial institutions to invest in this space; the challenge is that the demand is not there from the manufacturers and the installers, because there is not the certainty of demand from consumers and installations. There are some interesting financing mechanisms out there. Sustainability-linked loans, for instance, are a real opportunity to drive this sector, but, as I say, the demand and the need for those organisations to pivot into this sector is not coming through loud and clear just yet.

Q126 **Mark Pawsey:** Government need to set the framework and manufacturers will come forward to meet the consumer demand. Is that right?

Emma Harvey: Yes.

Q127 **Mark Jenkinson:** We have spoken at length about the kinds of



incentives that Government can use in terms of carrots and sticks: carbon taxes, tax reliefs, subsidies, grants and low-interest loans. We heard about property finance from Emma. I am keen to explore what that mixture of carrot and stick should look like, but also what we can learn from international comparators in terms of their incentives to encourage uptake of low-carbon heating. What policy models have been most effective, and to what extent can they work in the UK?

Emma Harvey: We have seen real best practice be demonstrated in Scandinavian countries, where they have implemented a combination of carbon taxes and a levelling out of the imbalances between gas and electricity. In the UK, we have a significant favouring of gas at the moment. There is a need for building regulations, potentially starting with new builds first, requiring and mandating them to have gas boilers and high energy efficiency, and then expanding that more broadly to the wider sector. Technical standards and public awareness campaigns are also important.

One area where we can learn from UK best practice is how we delivered the offshore wind industry. There is an opportunity, potentially, for a Government-backed, market-led delivery authority. We saw this being recommended by the Construction Leadership Council last year. You would see a centrally co-ordinated strategy for decarbonising heating, covering all elements from finance to quality assurance to training, et cetera. With full Government backing, that could be a very powerful vehicle for ensuring that there is national consistency. It is also important—this is something we have seen internationally as well—that these transitions are delivered at local level by trusted local authorities and trusted local people.

Q128 **Mark Jenkinson:** The Environmental Audit Committee has suggested a reversion to 5% VAT on energy-efficient materials. How much of an impact did that have previously? What might the impact be if we were to revert?

Emma Harvey: Reducing VAT will be a key driver or a very important factor in helping to encourage energy-efficiency uptake. It not only reduces the costs for people retrofitting properties; property developers purchase significant volumes of equipment, and reducing the VAT on that equipment will give a clear incentive for building properties to increase energy-efficiency standards. That would be a very positive decision.

As I mentioned before, there is another very important policy piece around levelling the playing field between gas and electricity, which would support the existing property sector.

Naomi Baker: I completely agree with what Emma has said. It is also important to address the non-financial barriers from the consumer perspective. Even if consumers are offered heating that is going to save them money and cost them the same, there are going to be some reservations about changing to a heating system they are not familiar



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with. Heat pumps, for example, work in a very different way. It is quite an ask of consumers to make that change. We need to address the non-financial barriers, we need to make it easy for consumers and we need to make it secure.

We think we need the kind of advice service that is currently running in Scotland, funded by the Scottish Government, Home Energy Scotland. That is impartial and Government-backed advice. People can phone up and say, "This is what I have been recommended. These are my concerns. Could you help me with them? This is the price. I have had two different quotes from installers. What about this? I have a concern about that." It is really just to put them at ease.

The second thing is that it is really important that, if a consumer is taking this step and is potentially funding it themselves, they need to know that, if anything goes wrong, it will get put right quickly. That is about strong quality standards and adequate redress. We do not have time to have any poor performance hindering this route.

Juliet Phillips: I would just reiterate Emma's points about the need for a real strong mixture of drivers around incentives, regulations and governance. There is no silver bullet here.

We can look to other countries. The Netherlands is an interesting example, because it also has a really high current dependency on fossil gas, so it is facing some of the same challenges as the UK. They have taken forward a suite of measures to support the transition, including a tariff on gas bills and reductions around electricity bills. They have a subsidy that supports the rollout of heat pumps; they have a ban on new gas connections for new builds, which means that more than 50% are now using heat pumps, which is double the rate from 2016. They have social housing renovation targets, which is another really important aspect that is a good way of scaling up supply chains and skills as well as decarbonising social housing, which is a really important sector.

They have high standards for new builds, the nearly zero-energy standards. We have seen in the UK that the future homes standard has been pushed back to 2025. This means that thousands of new homes are going to be installed with gas boilers, which will have to be retrofitted later down the line, which is an added expense for the customer. We think that is an oversight, and we would push for it to be brought forward to 2023 or earlier.

Finally, in the Netherlands, they are encouraging a local-led approach with municipalities taking a lead in identifying the appropriate steps for their communities. Again, this is something the UK can learn from. There is the new zoning proposal, which Emma mentioned. That is currently just focused on heat networks. We would encourage the UK to look at zoning for all sorts of different elements of decarbonising the built environment.



Q129 **Mark Jenkinson:** Do you have a view on the VAT reduction?

Juliet Phillips: It definitely has a role to play, for the reasons that Emma picked out, but there is no silver bullet here. It will need to be backed by a good communications campaign to hammer home those benefits to consumers.

Q130 **Mark Jenkinson:** We heard in oral evidence that the cost of installing heat networks could be brought down by creating some form of guaranteed return on investment. Juliet, what are the pros and cons of that particular funding model for heat networks? How does it compare to other potential funding models such as the renewable heat incentive or contracts for difference? Are there any international comparators on heat networks for delivering at scale that can bring those costs down?

Juliet Phillips: I might defer to Emma or one of the other people to answer that one. I do not claim to be an expert on heat networks.

Naomi Baker: It is the same for me. I am sorry.

Professor Barrett: Heat networks do not have to be very large, by the way. District heating can cover everything from communal blocks to city-wide systems. The obvious thing to follow on this are the Scandinavian policies, where there is a lot of municipal involvement in these systems. They offer integrated services. For example, in Gothenburg you can be offered either a ground-source heat pump or a connection to district heating, and you can be offered different tariff structures. You can pay high capital costs and low running costs or the other way around.

The other thing to say is that, in general, there are particular segments of the housing stock that are a softer entrance for this low-carbon heating, particularly off-gas grid, for example. In high-rise blocks, there is a problem using gas anyway, particularly after Grenfell. These might serve as nuclei for wider district and communal heating schemes.

Emma Harvey: We have seen that the Heat Networks Investment Project, HNIP, has really helped to drive the sector. Some estimates suggest that, for £3 billion of public investment in heat networks, you can crowd in £22 billion of private investment. This is partly because the infrastructure project finance sector is very well aware of how to manage high-risk projects. It is just that we need to get a track record of investing into some of these projects.

Another model that we have seen or we have started to explore is something that we call community improvement district financing. This is where specific zones are designated as community improvement districts, and they support the building of new district heating networks. The upfront investment in developing and connecting to these networks is provided by institutional investors and is then repaid through a levy that is charged to buildings that are connected to the network. There is a small payment from the householders, but that is spread out over



economies of scale, because it is spread over an improvement district. This plays in quite nicely with some of the zoning work that Juliet and I have mentioned already.

Professor Barrett: I would just mention another option for implementation. Perhaps you could replace gas boilers when they die with individual heat pumps. I would suggest that you think about reversible heat pumps to prepare for climate change. As the district heat networks extend, you could replace the heat pumps with a connection to district heating and cooling systems. There is a flexible implementation programme there, which might give you some rapidity.

With an average gas-boiler lifetime of, say, 15 years, in principle you might replace them all with heat pumps within 15 or 20 years. Then it will take longer for district heat networks to be built area by area, but they could plug into the internal systems used by the heat pumps. One reason for district heating is a rather wider one: it is a very important way of managing variable renewables and variable demands on the electricity system.

Q131 **Paul Howell:** I would like to move the discussion on a little to the distribution of costs, whether we are talking about the different regions of the UK or relative impacts on the fuel poor, et cetera. Juliet, earlier in the discussion you made a comment about how hydrogen is relatively okay if you are in a certain zone. You can use my situation as an example. I am in the Sedgefield constituency. I am not very far from where things are going to happen in Teesside with hydrogen. I am sat on old mine workings, with the opportunity for geothermal-type heat systems to come there. At the same time, we are in a relatively low house-price area, which could have other impacts on how things work out.

There are other people who are a long way from a hydrogen source or a long way from mine workings. How do we get equity and fairness of transition for different people in different parts of the UK, depending on how they sit in terms of the accessibility of alternatives?

Juliet Phillips: That is a great question. There are a few big issues there, which I will try to unpack, starting with hydrogen.

Paul Howell: Do not worry, as I will go to your colleagues to build on it afterwards.

Juliet Phillips: The Committee on Climate Change's analysis finds that, if we went for a hydrogen strategy for the whole country, it would be the highest-cost pathway. Although sometimes it is suggested that it would be cheaper compared to, say, heat pumps, because it might be less expensive to households, there are actually significant costs associated with the transformation of the gas network for hydrogen distribution, which are thought to be around £22 billion.

As well as the upfront costs, there are also the ongoing operational costs. In terms of blue hydrogen, which is produced from fossil fuels, so it is not



actually zero-emissions, you would also need to factor in the costs of scaling up carbon capture and storage, which has never been achieved at scale, and the elimination of methane emissions in the supply chain in order to reduce the carbon footprint.

If we go for a green hydrogen route, which is the one we would prefer because it is based on renewables, there are huge costs associated with scaling it up. That is not necessarily a bad thing, but there is a growing body of research that suggests that this is not the most cost-efficient way of decarbonising heat. It could be six times less efficient and would require 30 times more offshore wind than we currently have, if we were to replace every single gas boiler in the UK with a green-hydrogen boiler.

We really need to focus the use of hydrogen for heating in those industrial clusters where there might be surplus green hydrogen. Therefore, there needs to be a strong signal from Government to say they are not going to roll out hydrogen-ready boilers across the UK, where it is unlikely that hydrogen is going to have prospects. Also around blending, which is the word used to describe blending natural gas and hydrogen together in the gas grid, we need to make sure that is not scaled out across the country, because it will increase the costs overall.

Professor Barrett: Electrolytic hydrogen uses four times as electricity per unit of heat. We think it will cost about 70% more than heat-pump heat, either from consumer heat pumps or from district heating heat pumps, because of this inefficiency. It would mean you have to build an awful lot more wind turbines or solar panels to generate the electricity. There is a problem around the speed of transition there, because it is not just a target of zero emissions in 2050; it is the cumulative emissions to that date that are important for global warming.

When you are looking at district heating, that will be lower-cost in high heat-load density areas in general. In rural areas, we are definitely looking at heat pumps. It will be some mix of the two that will produce the lowest cost. I do not see any particular reasons for high regional variations in the deployment of these technologies, because they will work all across the UK. We do not have huge climate differences like, say, North America.

In terms of the electricity system, we are going to have wind farms all around the coast feeding inland at different points. I do not see big differences from area to area. There are some places where you may have coalmines. Southampton uses geothermal, for example. You might use seawater as a source for your district heating heat pumps, as they do in Stockholm. I do not see a big change in the potential for the different pathways across the UK.

Q132 **Paul Howell:** That is the crux of the question. I will go back to Juliet and the other witnesses in terms of whether they agree or otherwise about that non-difference across the UK. It feels to me as though, if you have supply options in different parts of the UK, be it because of where the



hydrogen is sourced, where the mine workings are available or wherever the other examples are, there would necessarily be economic supply opportunities that would put a different cost into it. I just wanted to challenge that assertion that there is no differential across the UK.

Professor Barrett: If I could just address that particular point, if you are using electrolytic hydrogen you can have your electrolyser pretty much anywhere, although you will generally want it near fairly high-voltage transmission lines for efficiency. If you are generating hydrogen for industrial purposes—for example, the reduction of iron ore for steelmaking purposes is one obvious use of hydrogen—I am not sure why you would be producing surplus hydrogen. You can if you like, and you can use it as a form of energy storage or you can use it to power ships directly or to make ammonia for powering ships, but I do not see why there are going to be particular surpluses of hydrogen in one place as opposed to another.

Q133 **Paul Howell:** Just moving back to heat pumps for a second, in terms of heat pumps or district heating, is that not impacted regionally by geothermal opportunities?

Professor Barrett: It is to a degree. Ground-source individual heat pumps are pretty expensive, but that is a possibility. For district heat pumps, you have the availability of a range of low-temperature heat sources. It could be sea water; it could be river water. There are a lot of ground-source heat pumps in district heating schemes. In terms of resources, we are a maritime nation, so seawater is available close to most cities for district heating. Most of the costs of district heating, for example, are not for the heat pumps and so on; they are for the district heat network. I do not see that the costs of any of these technologies will change significantly. In Scotland it is a bit colder, so air-source heat pumps will be a bit less efficient than in Cornwall, but there will be pretty marginal differences.

Juliet Phillips: There are just a few additional points from me. As a rule of thumb, we believe the Government should look to minimise the total systems cost. There can be a role for central planning and organisation to make sure we are not going after the more expensive routes that could lead to increased costs for consumers while also undertaking local zoning to ensure that locally appropriate measures are being carried out.

In addition, we think it is really important to recognise that there are costs, but there are also huge benefits in terms of jobs, reduced fuel bills for customers, skills and a reduced dependency on fossil-gas imports. That needs to be factored into the overall picture as well. We need to recognise that these costs are a political choice, at the end of the day. The Energy Efficiency Infrastructure Group estimates that £13.7 billion is needed from this spending review for energy efficiency and heat pumps, but the Government have committed £27 billion for roadbuilding. There are political choices to be made around how we distribute the costs more generally in terms of infrastructure priorities.



Recognising that there will be some differences across the nation, we really need to make sure there is strong protection for fuel-poor, low-income and vulnerable households. The new fuel poverty strategy recognises that we should go for a worst-first approach, which first targets the least energy-efficient homes to make sure they are getting up to standard first. We also have to look more broadly at vulnerability to consider health considerations and the impacts on elderly people, et cetera, to make sure those people are being protected in the transition.

Q134 Paul Howell: One of the things we have heard or discussed is the big challenge on the fuel poor. If you take the metaphor of electric cars, the people who have transitioned to electric cars are typically the people with the most money who can afford to buy a new car. At the moment, there is not yet a used electric car market of any substance. It will take time for those sorts of things to evolve. In terms of this transition, is there a risk that we will end up with a division between people who can afford heat pumps or hydrogen-ready boilers for the transition—they will buy things in and get themselves set up that way—and the fuel poor, who have not been able to do the transition? They will also be in the residual end of a market where supply is decreasing and therefore the price goes up because of natural supply-demand mechanics. We could end up putting the fuel poor in an even worse situation. Are there things that we need to do either to pre-empt and stop that happening or to put policy in place to challenge it?

Juliet Phillips: I totally agree. This is probably one of the most important pieces. It needs to be central to the heat in buildings strategy. We need to make sure that none of the steps being taken has these unintended consequences, particularly taking on board the impacts of the pandemic and the fact that more people are working from home so will have higher costs associated with staying in their houses.

There needs to be continued support for the upfront costs associated with buying low-carbon technologies. We have seen the green homes grant being scrapped, and we need a replacement for that. There also needs to be support with the ongoing costs associated with the different technologies, which could be done through rebalancing bills but also potentially through other ways of making sure that people have the funds needed to afford electricity systems.

Naomi Baker: I would agree. We think there should be grants for the fuel poor, and there should be a suitable range of finance options—a smorgasbord, if you like—so that everyone can upgrade their heating as and when they need to replace it and pay for it in whichever way is most suitable and most attractive for them.

The other point I would really like to make is that the way we funded low-carbon policy in the past was via an energy bill levy. The issue with that is that it is regressive, in that the poorest households pay the largest proportion of their household income on energy bills. It accounts for 10% of the income of the poorest, whereas it accounts for 1.5% of the income



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of the most well-off households. That means the poorest households are contributing the highest relative amount. We have done it for low-carbon electricity and there has been an impact, but the impact would be much greater if we were to follow the same approach for heating.

To give an example, the current levy package has some measures for low-income households, but most of the policy spend is for electricity. If we take the example of a household, for example, they might not have benefited from any insulation work through the scheme, but they might get about £150 through the warm home discount scheme to help them pay their bills each year. They would be paying levy costs, as part of their electricity bill, of about £150. The help on the energy bill is wiped out by the policy costs they are paying on top of their electricity bill. If the levy package was instead funded through general taxation, so funded on the basis of ability to pay, that household would be contributing £50 to that levy cost. That means they would end up £100 better off by the time they receive their warm home discount to help them pay their bill. That illustrates that it would be the least best route to go down if we were to fund the low-carbon heat transition. That is why we think upfront grants and loans would be a better approach.

Q135 Paul Howell: Thank you, Naomi. You have answered my next question; I wanted to develop exactly the things you have just picked up on in terms of the balance of the electric tariffs, et cetera, and how those things are for electricity rather than gas, and how we need to move that forward. What you are looking for there is how the policy mechanisms move to try to put it in a better place.

Naomi Baker: I had another quick point. At the moment, the levy cost adds about 23% on to the unit price for electricity. In terms of what we do with that, rather than rebalancing the cost across the two fuels, across electricity and gas, the Committee on Climate Change thinks there is scope to meet the cost from existing Exchequer spending in this area. If we rebalanced it on to gas, it would cause difficulty for some low-income households in terms of heating their homes, so we would not recommend that. The CCC approach seems very sensible to us. It would not involve additional taxation; it could be funded by reprioritising existing costs.

Q136 Paul Howell: Going back to an earlier point, in terms of identifying where the costs go for different households, the term that was used was making the fabric of buildings more energy-efficient. Clearly, there are radically different challenges there, depending on whether you are in a city centre, whether you are in a relatively new property or whether it has cavity-wall insulation capabilities. An obvious example, again coming back to my patch, is the rural poor. It is very difficult to improve the energy ratings of some of the houses they are living in. How do we get a balanced policy across those differential spaces that people are living in at the moment?

Naomi Baker: The PACE loans that Emma mentioned earlier would really help here. While the average investment per home would be £10,000



over the 30-year period, it could range from £5,000 for some households up to £30,000 for other households, for example the rural poor. Often, the person commissioning the work would not see that benefit. They would see some benefit through bill reductions and some benefit when they sell their home, but they probably would not realise the whole investment. We do not think it is reasonable for them to foot the risk and the bill for that. PACE funding would allow that investment to be spread between different owners, which seems fairer.

There is also a need for public funding. Some of the measures, for example solid-wall insulation, would not just be justifiable in terms of bill savings. They would be needed because they would increase the capacity of the network in that area. It would have a social or system benefit. Given that the benefit would be a social or public one, we think it would be reasonable for there to be some way to subsidise some of that cost. There needs to be a mix in terms of where that investment comes from.

Q137 Paul Howell: Emma, if you would like to build on that, but I have another point for you to cover at the same time. You talked earlier about how some of the costs would be borne by landlords, for example. I am going to declare an interest here as a private landlord, but, clearly, a landlord in my part of the world could quite easily have a portfolio of properties that are valued at only £50,000, £60,000 or £70,000 each. The investment cost to change the heating system will be a dramatically different proportion of the cost of the property and the cost of investment or return that the landlord is working to than it will be for somebody based in central London, which would be the obvious extreme. There would be differentials in how you get paid back and all that sort of thing. Is there some sort of need for a regional strategy in that space?

Emma Harvey: You took the words right out of my mouth. I was going to follow up on the first question around cost. The absolute cost of the technology is the same, but the relative cost of a poor rural area versus, as you say, London is huge. That really does play into the finance that those different households can access. If you have a £1 million house and you are putting in a £10,000 heat pump, it is probably quite easy to add that finance on to your mortgage. If you have, as you say, a £50,000 house, that is a significant investment.

That leads me into something else I wanted to say. Earlier we talked about minimum energy-efficiency standards. We know those are in place in the private-rented sector, and they are going to become increasingly stringent over time. There is also talk about minimum energy-efficiency standards in the owner-occupied sector. While that would give a clear policy signal and a clear signal for investors and homeowners, it would need to be introduced in a very careful manner to avoid creating a two-tier market where you have households in homes with very low energy efficiency, who have very low income and are therefore unable to access private finance to improve their properties in order that they can mortgage or sell them.



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That brings us back to this point. If the cost of a retrofit is relatively high versus either the household income or the value of a property, that is where there should be the opportunity to tap into public finance, whether that is grants or subsidised loans. A perfect model for that has been KfW in Germany.

As you are on the private-rented sector, one of the other pieces here is that the Coalition for the Energy Efficiency of Buildings has been developing a green rental agreement, which we are hoping to launch in the next couple of months. There are two models for the green rental agreement. One is a warm-rent agreement, which we think is the best long-term strategy for the rental sector, where rents actually include heating bills. The reason for this is that it incentivises landlords to retrofit a property and reduce the operating costs of that property to the greatest extent possible. We have also included provisions on how the tenant behaves, so people do not have the heating on and the window open, for instance.

There is also a cold-rent example where heating bills are not included in the rent but the energy bill savings due to a retrofit are evenly distributed between the landlord and the tenant. At the moment, all those energy bill savings go to the tenant. If you fairly distribute them between the landlord and the tenant, the tenant still sees a reduction in their energy bills but the landlord starts to get a return on their investment or starts to recoup some of their investment. We have seen that there is a barrier to introducing that model in the UK due to the Tenant Fees Act 2019, and we are happy to share further details on that afterwards. Those are two models that could help to nudge the private-rented sector towards retrofitting and decarbonising heat.

Q138 Paul Howell: It would be interesting to see that information as a follow up. I have one final question to each of you. This comes down to regulation. Electricity and gas are both regulated by Ofgem, but heat is not regulated in that sense. Is something required in that space to get proper protection for consumers?

Professor Barrett: The short answer is yes. It should be regulated like any other energy distribution company. That is certainly the case if you look at Denmark and Sweden, for example. They have very carefully defined regulations on this. I believe Ofgem are looking into how it might regulate district heating.

Q139 Paul Howell: As a final question, does this lack of regulation impact on the position of fair distribution of costs? How should we change the regulation or the monitoring of this to make sure we get that fair distribution?

Professor Barrett: Whereas for electricity and gas you have national systems and national price regulation, the same is not true for district heating. It depends on the particular scheme type and which heat sources it uses.



Juliet Phillips: This could be something that is, in part, addressed through the heat in buildings strategy. We are calling for a new deal for consumers to achieve the kind of proactive support that we need for the heat transition. It will be achieved through identifying installing measures, the service experience and making sure customers can recognise the benefits that are being delivered. It should be easy and convenient for consumers to take the actions. They should be provided excellent service through the installation process and afterwards.

It should be clear that retrofitting homes and buildings represents the way forward for creating modern and more comfortable living conditions. That is not just necessarily focusing on the climate aspects but looking more broadly at the different triggers in the behaviour of households. Finally, it needs to come to be seen as a fair price representing good value compared to the alternatives. Addressing some of those areas should be central tenets of that approach.

Q140 **Paul Howell:** Just picking up on your last few words, this almost goes back to what you said earlier about needing to motivate and educate people as to the importance of the heat system transition. It seems to be very well acknowledged. People see there is a benefit, in the long term at least, in changing to an electric vehicle, but the communication is not there yet in terms of people understanding the real impact of their house's heating system on the whole net-zero agenda.

Juliet Phillips: Absolutely, yes. The electric vehicle example is quite a good one, because you can see a package of measures that has helped spur action. To be fair, the target to ban fossil-fuelled vehicles was a real driver of change for industry, Government and the whole supply chain. Something similar signalling the phase out of fossil-gas boilers could have an instrumental role in this sector as well.

Q141 **Richard Fuller:** Is it true that whichever way we allocate the costs, to achieve this goal of decarbonising heat, we are asking households to accept a reduction in their standard of living for a prolonged period of time? That is inevitable isn't it?

Emma Harvey: What we see is that, if there is a combination of energy-efficiency measures and heating, the standard of living for a household should be improved. They should have greater comfort. We have seen that about £2 billion a year is spent by the NHS on managing household-related challenges and those kinds of things, so there are health benefits as well as the obvious environmental benefits. The challenge comes, though, in the operating costs of heat pumps in the current energy and levy landscape. A lot of what Naomi was saying about how you can redistribute those costs can help to bring down the cost to consumers.

Q142 **Richard Fuller:** You are making a valiant effort, Emma, but I do not think you really dispute that there would be a reduction in economic wellbeing or living standards to pay for this. It is £250 billion. That is a lot



of money, and someone has to pay for it.

Professor Barrett: If I could just come in there, given the projected reductions in the costs of primary energy supply in wind, solar and so forth, the total annual bill may not be terribly different from what it is now. The energy cost of providing heat from a heat pump from renewable energy sources is already getting quite close to the cost of gas heat, excluding the capital cost. In the long term, over maybe 20 years or something like that, the energy part of your living costs will not be terribly different from what it is now.

Q143 **Richard Fuller:** I understand that. That is 20 years. My point is about the next 20 years. We should be honest about this, should we not? There is a trade-off here, and it is going to mean that families have less money and taxes will be higher. It is a policy choice that you are recommending, maybe for good reasons, but the consequence is that households will be worse off. It might be for 20 years until Mark's equivalence is achieved. If you would like to dispute that, I am happy.

Professor Barrett: Here is an argument. The decarbonisation of heating will be accompanied by significant reductions in air pollution, which prematurely kills thousands of people and commits them to long-term ill health. I have not done the sums on this one, but such benefits will substantially balance the costs of decarbonisation.

Juliet Phillips: I would also back that up. I strongly disagree that it is going to have negative impacts. Quite the opposite is true. We have research that suggests that, by increasing the energy efficiency of homes, we can reduce energy expenditure by £7.5 billion per year. That money could be reinvested into local economies. We have done research that finds that, through a long-term retrofit programme for energy efficiency in heat, we can create 190,000 green jobs across the country, which in turn could support the levelling-up agenda, given the areas where energy efficiency is most needed.

To build on Emma's point, there are also savings for the NHS through avoidable winter deaths. We are also going to be reducing our dependency on gas imports, which again has benefits around taxes.

Q144 **Richard Fuller:** I can get my head around the maths of energy-efficiency programmes. That I can understand. We have done that in the past. That is not decarbonising heat. That is a separate issue. It is connected, but it is not the same as decarbonising heat, is it?

Juliet Phillips: You can significantly reduce the amount of heat that you need for an energy-efficient home, so they go hand in hand. To go back to a point I made earlier, this is a political choice about where we are choosing to invest in infrastructure priorities across the countries. If we choose to prioritise this, which makes the most sense for climate, jobs and levelling up, it would be a more sensible investment than some other infrastructure priorities.



Q145 **Richard Fuller:** That is my point. If it is a policy choice, politicians should be clear on what the cost of the policy is. To assume that it will have no impact on the living standards of households for the next 10 or 20 years seems to me to be, from what I have heard so far, unlikely. Therefore, we ought to be clear that it is going to cost people money.

Professor Barrett: You do not want to deny the benefits.

Richard Fuller: No, of course not.

Professor Barrett: Juliet brought up the issue of gas imports. We already import about half of our gas. Ten years ago we had a very steep gas price rise, which put a lot of people, particularly old people and people on low and fixed incomes, in great jeopardy of not being able to heat themselves properly. This is another benefit of energy efficiency and having renewable energy that is not subject to international gas prices.

Q146 **Alan Brown:** Naomi, we know the green homes grant and the domestic renewable heat incentive programmes have been unsuccessful in encouraging a significant take up of low-carbon heating. These are demand-led policies. Is it the fact they are demand-led that is the issue? What do we need to do to make these policies work on a large scale? Can this be rectified in time for the delivery of the clean heat grant, which is due to launch next year?

Naomi Baker: Just to unpack that, starting off with whether we can do it just through demand-led policies, no, we cannot. We have less than 30 years to change 29 million homes. We need a strong regulatory path to do that. What we want the regulation to do, if designed properly, is shape markets and bring the investment in. The regulation will be there as a backstop, so the markets will be doing the work rather than the regulation. We can see how that worked really effectively with the coal-fired generation phase out, for example. In 2015, when the Government set the target that by 2025 it did not want any more coal-fired generation, there were 14 coal-fired plants in operation. It is likely that by 2024 there will be just one left. There are only three left now. As soon as the Government set that target, investment crowded into the space, almost removing the need for the regulation by the time that date is reached.

That is the same thing we want to happen with regulation in this sector. We think we need minimum energy-efficiency standards for all tenures. We think we need phase-out dates for fossil-fuel heating. As Juliet and Emma said earlier, it is a shame that it was not decided to bring the standards for new homes forward to 2033. For replacement oil, coal and LPG for off-grid homes, the CCC are recommending 2027 or 2028. For homes on the gas grid, it is also recommending 2033. We need that clear timeframe so that both institutional investors and homeowners know where to put their money. That is the point about the demand-led schemes.



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In terms of the sector responding, that is very much linked. We know there is money waiting to go into the supply chain, but until there is a clear pathway that investment will not go in.

In terms of the green homes grant specifically, it was a very short-lived programme and it was not feasible for the supply chain to scale up to that scale in the timeframe. The market was largely used to dealing with a subsidy programme, the ECO programme, which is £0.64 billion a year. Asking it to scale up to deal with £2 billion over six months was not going to happen. What it did manage to do, in terms of £300 million on top of the ECO market, was good.

Another thing to say is that, rightly, the Government required quite strong quality standards for the green homes grant. That is very positive, given some of the issues we have had in the past, but it is mainly small and medium-sized enterprises that work in this sector. For them to get accredited is fairly arduous. It involves investment. It is around five days of time off work and off earning. There is interest, but the sector needs to know that the grant programme, for example, with those requirements is going to last for more than six months. For example, they need to know that it is a five-year programme.

Q147 Alan Brown: The Government seem to be saying, "This is not working. We hoped it would be successful in six months. It is not working." They would have been better to keep that money in place rather than withdrawing it.

Naomi Baker: Yes, start-stop funding programmes are not helpful for the sector and are not helpful for consumers.

Q148 Alan Brown: I am trying to get my head around scaling up and what needs to be done if we are looking at massive heat-pump installation. You are saying that this was not possible with the green homes grant. Correct me if I get any of this wrong, but I am thinking about the process of converting to an air-source heat pump in the property I stay in at the moment. I am going to have to have a gas fitter and a plumber come in and disconnect my existing gas boiler. There needs to be an electrician to fit the air-source heat pump. I am assuming there needs to be a concrete foundation slab for the air-source heat pump to sit on. Then I need a plumber to do internal modifications to the heating system.

Naomi Baker: I completely agree with what you are saying. It is much too hard for the consumer at the moment.

Alan Brown: I would also need to install a hot-water tank. I am trying to get through what will need to be done. There is such complexity to the work. Does that not make it more difficult to get consumer buy in and to get to the place we want to be with such large-scale installs? You have so many tradesmen and so much work to be done. You have to make sure the quality is still there.



Naomi Baker: If there were targets in this area, the supply chain could scale up and those things would become easier. There would be more of an integrated consumer offering.

I would like to pick up on a point that was made earlier about how this whole area of decarbonising heating is going to lead to increasing cost for consumers. That does not need to be the case at all. In terms of getting to 2050, the CCC thinks it will involve around 21 million heat pumps out of 29 million homes. That is largely a capital cost and a capital problem. Once we solve that capital problem of who pays and how we finance that cost, the bills for consumers will go down. Once Government use the levers they have at their disposal, bill costs could go down again.

We spoke earlier about the levy costs. Juliet spoke about energy efficiency. If consumers are also supported to insulate their homes, their bills will go down. If homes are reasonably insulated, heat pumps can also do what is called pre-heating. That means they can heat their homes during cheaper off-peak periods rather than when electricity prices are at their highest. That could save money both for the consumer and for the network. There are different estimates about what that could save, but it ranges from about 20% to 40% in terms of the saving on consumer bills. I just wanted to emphasise how important that could be.

Professor Barrett: You raise an important point about the training to build up the capacity. It is one thing to finance it, but it is another thing to have the integrated skills—as you mentioned, there are the plumbers, electricians, gas fitters and so on—to increase the capacity for installation to rates of 3 million or 4 million units a year in order to decarbonise in, say, 20 years.

Q149 **Alan Brown:** Has any assessment been done of how many people to date have thought about air-source pumps? Do we know how many consumers have thought about it and then thought, “That is way too much trouble for me. I am not modifying my house to that extent. It is just not worth it”? Obviously, we have to get consumers on board. They have to understand what is required and then be willing to do it.

Professor Barrett: Most of the people who are doing it at the moment are wealthy and green, if you like, to be able to afford it. That will have to change. As I say, heat pumps are different things. If, for example, your heat pump is providing cooling as well as heating, it might become, just as electric vehicles have become, a prestige thing, even for middle-income people.

Emma Harvey: Your initial point was that it is a very complicated journey. We support the role of retrofit co-ordinators that came out under PAS 2035, which can really help take some of the burden off consumers. Another recommendation that has come out of a number of organisations, including the Committee on Climate Change and the Coalition for the Energy Efficiency of Buildings, is the role of building renovation passports in helping inform consumers on how their property



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is performing today and also providing a decision-useful roadmap of actions they can take to renovate their property. That is critical.

On your question on what we have seen on uptake, some BEIS research identified that 66% of consumers are in favour of gas-boiler bans and nine out of 10 consumers felt they wanted to take action to reduce the climate impact of their building, but very low percentages—we are talking less than 30%—were aware that their home was one of the major contributors. There is a knowledge gap that needs to be bridged.

In terms of actual uptake, I do not have any statistics on that to hand, but there was one point that I wanted to mention on the green homes grant scheme. Not only did it catalyse demand for retrofitting, even though the supply chain could not meet that demand. It also catalysed a wave of green-financing products. The green homes grant scheme was launched in September, and since September we have seen 11 new green mortgage products come to market from small lenders up to major lenders. The reason for bringing these products forward and accelerating their launch was because there was the green homes grant scheme and a view that there was going to be significant demand. That suggests there should be long-term stimulus activities by Government. If they are long term, the finance sector and the investment community will feel more comfortable and confident to come into the gap.

Juliet Phillips: I have a couple of points on the green homes grant and the skills and supply-chain piece. We have been working with the Energy Efficiency Infrastructure Group, which is an industry group, to identify some key lessons that should be learned from the green homes grant and should be taken forward into a successor scheme and also into the clean heat incentive, which you mentioned.

A good point around this is the fact that local authorities can deliver, given the time and the resources. The voucher scheme, which was contracted to IFC, which is a big US contractor, had lots of administrative problems associated with it. That resulted in delays to households and installers getting paid, which could even have resulted in some job losses. That was a terrible mistake. On the other hand, the local authority dimension of the scheme, where local authorities were in charge of providing support for households, was a success. It has already delivered action on the ground. They successfully managed to get the money they were provided by Government out of the door. That is a really important learning.

Another learning is around the need to work with industry and local bodies in the design set up to make sure we can avoid the problems with the green homes grant scheme. Building on what Naomi said, the schemes need time to work and deliver at scale. You cannot have a six-month boom and bust and then expect to see the results that you want.



Moving on to skills and supply chains, again this should be a really important part of the heat in buildings strategy. We see a need for a skills package. The Heat Pump Association has estimated that by 2035 the UK will need 40,000 qualified heat-pump installers, which is up from 1,800 in 2020. This is a huge gap but also a huge opportunity. We talk about a green recovery, and here is a great opportunity to build green skills and green jobs through upskilling and training.

We also want to see a heat pump sector deal, which can help build those skills and supply chains. If it is routed in an anchor location outside of London and the south-east, it can also support the levelling-up agenda. It could be useful for the Government's goals more broadly as well. There is also a piece around innovation to support technological breakthrough, which again could help reduce the costs but also provide the UK with a competitive commercial manufacturing offer as other countries around the world also look to develop heat pumps.

Finally, we think it is really important that SMEs have the opportunity to participate in Government-supported schemes such as the local authority delivery aspect of the green homes grant and the public sector buildings fund. Again, that will help build up the skills in those supply chains, which will be essential for getting on track to decarbonise our homes.

Q150 Alan Brown: I would like to come back to the ban on the sale of fossil-fuel heating systems. You have already said that you want the future homes standard to be brought forward in terms of connections to the gas grid. I take it that you also agree there should be a similar ban on the sale of fossil-fuel heating systems across all homes. In terms of setting a date for a ban, that would need to go in line with other policies.

Juliet Phillips: Yes, I completely agree. It is not a silver-bullet solution, but it can send one of the clearest signals to consumers and industry about the direction of travel. We would support a phase-out date of 2030 for existing households and as soon as possible, really, for new builds, with the future homes standard now expected to come in from 2025. It is not the silver-bullet solution, and we have discussed at length how we need continued support for households, particularly with the upfront costs and the operational costs associated with heating. Similar to what we have seen with fossil-fuel passenger vehicles, the ban has really galvanised action across the whole sector and supply chain. Something similar will add to the salience and attraction of the consumer engagement piece, but it will also help create training programmes for those supply chains that currently rely on fossil heating.

There is also a suggestion from OVO Energy that we could introduce obligations on fossil-fuel manufacturers to manufacture and sell a certain percentage of heat pumps, which could be another good way for the Government to steer industry to get on track for the future of decarbonised heat.

Q151 Alan Brown: Would it be two stages, with a ban on the sale of new



installs and then a complete ban on use? Given the lifespan of boilers and systems, if somebody puts in a boiler they might get 20 years out of it. Would it need to be a two-phased approach?

Juliet Phillips: Yes. We are not advocating for people to have boilers ripped out of their houses at the moment. New boiler installations in new builds seems like the obvious place to start. Further down the line, you would probably have to consider further actions.

Q152 **Chair:** I have a couple of wrap-up questions before we bring the session to an end. First, Naomi, there has been a bit of discussion today and in previous sessions about the levies and tariffs on electricity and how we balance that out better with gas to make electricity consumption cheaper compared to gas for heating in our homes.

Clearly, we have a concern about how you might phase in that policy initiative so you do not hit people on lower incomes in the early stages when their gas bill suddenly goes up and you lose public goodwill around the net-zero transition. Do you have any observations or thoughts about how, if you were to provide a level playing field between electricity and gas in levies and taxes, you would structure that kind of change?

Naomi Baker: Yes. From our perspective we would not recommend rebalancing the costs between electricity and gas. We would follow the suggestion made by the Committee on Climate Change, which is that the existing levy costs can be funded through reprioritising Exchequer funding in this area. Then we can take the whole levy cost off energy bills.

Q153 **Chair:** You would take it off electricity as well?

Naomi Baker: Yes. We have a similar concern in terms of carbon pricing. While we think that will be a valuable mechanism in the future, at the moment we think the heating market is just too unequal. Carbon pricing could help in the future if there is work done to bring all homes up to a minimum energy-efficiency standard or, for example, there is a package of measures that means any household can choose to retrofit their home or switch to low-carbon heating. If it were only affordable for people who can afford it, we do not think it would be a fair option.

Q154 **Chair:** That is useful, because there may be some carbon-pricing announcements later in the year that we would need to consider in that context. Juliet, you said earlier that we would want to avoid the proposal around blending hydrogen with gas, which other witnesses have suggested to us. I think what you were saying is that, if you sink the capital costs into being able to do that either in distribution or in the home, when you know hydrogen heating is going to be more expensive than heat pumps or heat networks, it is then kind of lost investment. Have I understood your point correctly?

Juliet Phillips: Yes, that is correct. In the Government's 10-point plan last year, there was a commitment to work with industry to reach 20% blending, which we do not see as the most cost-efficient or necessarily



climate-aligned solution for most of the country. We need to be very careful, if we are doing blending, that it is just in very specific areas. Modelling suggests that the most cost-efficient way to develop and deploy hydrogen is in industrial clusters, where there is good access to renewables. For example, in the UK it might be making the most of offshore wind in the North Sea. In those particular areas there might be a role for blending.

There is a saying about mixing cheap wine with champagne. We have this really expensive hydrogen that is going to cost billions to get online. Mixing it with fossil gas does not really make sense. Rather than starting with the question of how we retrofit existing gas infrastructure, we need to think, "Where is the secure supply and demand going to be?" and then retrofit our pipework based on the answer to that question instead of the existing interests in the infrastructure.

Q155 **Chair:** That is understood. Professor Barrett, you have talked about cooling as well as heating. I have to confess that I have not seen very much policy in the UK on cooling our buildings as opposed to heating our buildings. Have I missed something? Do the Government need to have a policy on cooling as well as heating? Is that your submission today?

Professor Barrett: There are quite a few research programmes building up within academia and other sectors. When you are insulating buildings, you have to take care not to exacerbate possible cooling problems. That needs careful design, which is sometimes difficult to achieve in retrofits. Essentially, the Met Office is projecting that it will be between 2° and 4° warmer, on average, across the year, with heatwaves maybe 6° or 7° higher than they are now. This is the point at which it become dangerous. This will be coupled with an increasing ageing population. Old people are not only worse at dealing with the cold; they are worse at dealing with high temperatures, too.

As is done in the millions in China, Australia and all across the world, people should have reversible air conditioner-heater heat pumps so you can cool in the summer and heat in the winter. To install these devices in a typical house would cost about £10,000. They are very accurately controlled, so you can heat and cool rooms room by room, which has considerable savings. They are mass produced and quickly installed, and they are installed in far greater numbers already in the UK than the typical air-source heat pump going through radiators, because they are in hotels, hospitals and all over in non-domestic buildings.

To me, that seems to set up a resilient option for the future where you can do both. Given that you are going to have significant generation from solar photovoltaic, that is well correlated with cooling loads. It seems to me a resilient option, whereas hydrogen boilers do not cool.

Q156 **Chair:** Thank you, that is very helpful. I just want to summarise our conversation today while we have you, so you can correct me or tell me if I have missed anything. There are four key areas that we need to be



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thinking about. There is the overall policy direction, where we need some strong coherent policy and regulatory announcements from Government, which is going to set the direction of travel. We have seen a bit of that in the 10-point plan and the energy White Paper, but we are waiting for the heat in buildings strategy. We hope that will come and fill the gap.

We have the infrastructure costs, and that seems to be the big thing here about capital costs, whether it is around distribution or in-home capital costs. We have had some discussion today around the role of the capacity market, contracts for difference and potentially some of the community shared-costing schemes that we have seen with district heating networks.

Thirdly, we have the manufacturing, supply and installation costs for whichever technology we are talking about in people's homes. That is a discussion around grants and potentially some new funding products linked to the building and not the individual in the home, but there is probably a broader conversation here with lenders around lending products, presumably once they have had the policy direction clarified.

We then have the ongoing cost issue, which is that the structure of your bill will change and some of your tariffs will change. You may see some differences in how you are paying for things. If this is well coupled with things like energy-efficiency policy and a reduction in generation costs, you might see the bottom line decrease over time, but there will be a difference in the way we pay for and structure our bills. There may also be some changes around levies and carbon pricing from Government that we need to factor in as well.

Have I properly understood those four headline themes? Is there anything glaringly obvious that I have missed from the submissions today?

Professor Barrett: I would just like to add to the market aspect. With district heating, because it is not a national system, there is a point about how the operation of district heating is regulated and the apportioning of costs to different consumers. We should try to bring that into a more regulated market.

Chair: Thank you for that. We have Ofgem in our next session, so that is a perfect point to end on today. We will pick that up with them. That is the end of the session today. Thank you so much for all of your contributions over the last nearly two hours. It was a slightly long run for you guys with only one panel today, but we are very grateful for your insights. Thank you to Naomi Baker from the Energy Savings Trust, Emma Harvey from the Green Finance Institute, Juliet Phillips from E3G and Professor Mark Barrett from UCL for your contributions. Thank you to my colleagues on the Committee.