OFFICIAL REPORT
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Net Zero, Energy and Transport Committee

Tuesday 2 September 2025

Session 6

The Scottish Parliament
Pàrlamaid na h-Alba

Tuesday 2 September 2025

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NET ZERO, ENERGY AND TRANSPORT COMMITTEE
25th Meeting 2025, Session 6

CONVENER

*Edward Mountain (Highlands and Islands) (Con)

DEPUTY CONVENER

*Michael Matheson (Falkirk West) (SNP)

COMMITTEE MEMBERS

*Bob Doris (Glasgow Maryhill and Springburn) (SNP)
*Monica Lennon (Central Scotland) (Lab)
*Douglas Lumsden (North East Scotland) (Con)
*Mark Ruskell (Mid Scotland and Fife) (Green)
*Kevin Stewart (Aberdeen Central) (SNP)

*attended

THE FOLLOWING ALSO PARTICIPATED:

Dr Eoin Devane (Climate Change Committee)
Dr James Richardson (Climate Change Committee)

CLERK TO THE COMMITTEE

Peter McGrath

LOCATION

The Mary Fairfax Somerville Room (CR2)

Scottish Parliament

Net Zero, Energy and Transport Committee

Tuesday 2 September 2025

[The Convener opened the meeting at 09:15]

Decision on Taking Business in Private

The Convener (Edward Mountain): Good morning, and welcome to the 25th meeting in 2025 of the Net Zero, Energy and Transport Committee. We have received apologies from Michael Matheson, and both Douglas Lumsden and Kevin Stewart are joining us online.

Agenda item 1 is a decision on taking items 3 and 4 in private. Item 3 is consideration of the evidence that the committee will have heard on the draft Climate Change (Scotland) Act 2009 (Scottish Carbon Budgets) Amendment Regulations 2025—I am sure that the titles of these things get longer every time I am given them to read. Item 4 is consideration of the committee's work programme. Does the committee agree to take those items in private?

Members *indicated agreement.*

Subordinate Legislation

Climate Change (Scotland) Act 2009 (Scottish Carbon Budgets) Amendment Regulations 2025 [Draft]

09:15

The Convener: Item 2 is an evidence-taking session on the draft Climate Change (Scotland) Act 2009 (Scottish Carbon Budgets) Amendment Regulations 2025. I will provide some context by saying that, last year, the Parliament agreed to adopt through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2024 a new system of carbon budgets to set limits on the total amount of greenhouse gases that Scotland can emit over a specific period. The Government must now, through regulations, establish four five-year carbon budgets to cover the period from 2026 to 2045—the year by which Scotland has committed to reach net zero.

The new system replaces the previous approach of interim and annual targets. As part of it, the four proposed budgets are set out in the draft regulations that are before us, which propose budget levels that are in line with the advice of the Climate Change Committee, the United Kingdom's independent advisory body on climate issues. In its advice, which was published in May, that committee set out what it described as a "balanced pathway" to meet both the carbon budgets and net zero targets by 2045. Alongside the regulations, the Scottish Government has published a policy statement that sets out in broad terms the policies and proposals that we can expect to see in the forthcoming draft climate change plan.

Today's evidence session is the first on the draft regulations, and we will begin by hearing from the Climate Change Committee. Next week, we will take evidence from a panel of academics, and we will finish with evidence from the Cabinet Secretary for Climate Action and Energy, before considering the motion on the regulations.

Before we go any further, I will make a declaration of interests. As members know, and as I have constantly made clear, I have an interest in a family farm in Moray. I am saying that because I believe that agriculture might come up this morning.

I welcome our witnesses from the Climate Change Committee: Dr James Richardson, chief analyst, and Dr Eoin Devane, head of carbon budgets. Thank you both for attending the meeting. We will move to questions, if we may.

The first questions will come from me, and I will leave it to James Richardson and Eoin Devane to

decide who wants to answer. I usually say to people who are giving evidence that, if everyone looks away, I will nominate somebody; however, you are both online, so don't you dare look away. If you want to answer, raise your hand and I will bring you in.

First, we talk about carbon budgets, but are they budgets that people will understand? Are they like normal budgets, which are estimates of income and expenditure? In other words, do they show what we will save in carbon and what that will cost? Is that how the people of Scotland should view them? Who would like to start?

Dr James Richardson (Climate Change Committee): I am happy to take that, convener. The answer to your question is: not entirely. In many ways, a carbon budget is a budget in the familiar sense—that is, it sets out the total amount of greenhouse gases that Scotland can emit over a five-year period. Within that, it allows trade-offs between different sources of emissions; if you have a bit more from one sector, you need a bit less from somewhere else. In that sense, it acts like a budget, as there are swings and roundabouts, but it all has to add up to a total. However, it is set in units of emissions, not in money; it is a budget for emissions, not a financial budget.

The Convener: Basically, the approach is all about horse trading among the various areas where carbon is emitted, to come up with an overall carbon budget. Does it give anyone in Scotland an idea of what the costs will be to the average household or the average individual, or does it just set out a figure for carbon with no costs set out for individuals and what they are going to have to buy into?

Dr Richardson: The budget shows a figure for carbon, but our advice to the Scottish Government sets out our estimates of the costs and financial benefits of our balanced pathway. We estimate an average cost of about 0.4 per cent of Scottish gross domestic product per year in the period between now and 2045. That is our estimate, but the Scottish Government will bring forward its own plans and might wish to make its own estimate, because its plans are likely to differ from the balanced pathway. We have tried to be as transparent as we can be about the costs and benefits, because many of the low-carbon technologies are cheaper than the high-carbon technologies that they will replace.

The Convener: What does the percentage figure for GDP between two periods actually mean for a person in a house in Scotland? How much will it cost them to achieve the targets that you suggest that the Government should achieve?

Dr Richardson: I do not have an exact estimate of that. It will depend on the policies that the Scottish Government chooses to implement, and, indeed, on some UK Government policies. For example, our main recommendation to the UK Government, and one that we recommend that the Scottish Government should support, is to make electricity cheaper by changing some of what are in effect taxes on how our electricity is charged for. If that happened, it would bring down the costs for a household in Scotland.

Some of the costs that we allocate geographically to Scotland in our estimates are almost certainly not paid by Scottish people. For example, we think that Scotland has considerable capacity geographically for engineered removals—technologies that remove carbon dioxide from the atmosphere and store it away. That should be done on the polluter-pays basis, so it would be paid for by the people across the United Kingdom who are creating the residual emissions, although the activity would take place in Scotland. Again, that would not necessarily be a cost to Scottish households.

We would have to know what the full set of policies was to be able to say that something was a cost to a household. Until we see the climate change plan, we will not know what the Scottish Government is proposing. We are also still waiting for the UK Government's equivalent of that plan.

The Convener: People out there are facing a cost of living crisis, the prices of food and suchlike are rising exponentially and we are asking people to make fundamental changes to their lives, such as moving from using fossil fuels and oil boilers to air-source heat pumps and so on. There is a cost to all that, in the same way as there is if we follow the recommendation that we eat less meat, because that means that we can reduce the size of the herd, which means that the price of meat increases. To make people buy into that, which is what you and the Governments are encouraging people to do, surely they will have to know what they have to invest financially. Just saying that it is better for the world is too abstract if they do not know how many pounds they are going to have to take out of their pockets to pay for it.

Dr Richardson: I entirely agree. It is important that people understand that, which is why it is important that we have clear policies for support for the more expensive elements of all this. That is why we are pressing the UK Government so hard on electricity prices. It is important that people benefit from the economic gains that will come from these things, because low-carbon technologies are fundamentally more efficient than the technologies that they will replace.

The high-carbon technologies are extremely inefficient forms of energy conversion. Only about

a third of the petrol that you put in a petrol car actually gets you anywhere; the other two thirds are entirely wasted. With an electric motor, about 90 per cent of the energy that goes in translates into the motion that you want from the car, so such technologies are much more efficient than the ones that we are replacing.

If the prices are correct for people, there are savings to be had. That requires support from the Government. We need support on heat—we talked about the costs of converting from boilers to heat pumps. Support is available in Scotland. The electricity price comes into that calculation. We are waiting to see the final version of the heat in buildings plan.

We have also talked about agriculture—it is very important that there is support for farms. If they are to convert some of their land from supporting livestock to, say, growing trees, farmers need to know that it makes sense for them economically. Such things depend on the Government's policies, and you cannot say, in the abstract, "Well, there's definitely this cost for this kind of household."

The Convener: I am sure that we will come to agriculture later, but I make the observation in relation to moving from livestock to trees that I have yet to find a tree that is edible and worth eating—but we can have that conversation in a minute.

I am trying to drill down to whether you think that, when the Scottish Government produces its climate change plan, it will be in a position to allow the people of Scotland to understand what the cost is. You suggested moving to electric cars, but there is a huge cost to doing that. A lot of people who are using a fossil fuel car cannot find the additional money to move to an electric car—making that choice might be different for those who are paid as much as MSPs are, for example, but it is not for people who are on the minimum wage.

My question is whether people are going to understand the benefit to them. If they have to cough up £25,000 to £35,000 to put an air-source heat pump in their house—that is, by the time they have insulated it—and if they have to buy an electric car, which will probably add another £20,000 to that, are they going to understand that it might cost them £60,000 today but that in 20 years' time they might get the money back? Surely that is the sort of information that people want to know when you are doing a budget.

Dr Richardson: That kind of information is very important, partly to correct some of the figures that people put out there—I will challenge your figures on an electric car, because most people, and in particular people on low incomes, buy their cars second hand. Second-hand electric vehicles are already at price parity with internal combustion vehicles. We are rapidly approaching that point in the new car market, which is more—[*Inaudible*.] Most people do not buy their cars new.

The running costs of electric vehicles are considerably lower, particularly for people who can charge at home, and for those who are charging on the street with slower charging—rapid charging is more expensive. That represents big savings for households. They are not available to everybody right now, because the stock of second-hand electric vehicles is still quite small and obviously reflects the sales from some years ago. However, we are really beginning to see price falls coming through. That is the largest overall saving in our—[*Inaudible*.]—and it reflects much greater efficiency. Such technologies are fundamentally more efficient.

A heat pump is a bit different; there are big up-front, one-off costs of converting a property to fit a heat pump—not for the pump itself but for the pipes and so on. However, the running costs are then lower, because a heat pump is about three times as efficient as a gas boiler and more so compared with an oil boiler. Such technologies are much more efficient, and there are savings.

Yes, there are up-front costs, particularly around heat, and that is why it is very important that there is support from Government—and there is, to be fair. The Scottish Government makes available substantial grants and low-interest loans, so households are not left to bear the costs alone. That is a very important part of how we make this feasible for households.

09:30

The Convener: The subject is interesting. At the moment, I do not think that I understand enough about carbon budgets and the proposals that the Scottish Government has made to give me confidence about what I am being asked to invest in, which is what we are asking every single person in Scotland to invest in to reach net zero, or about what the basic costs are to those individuals.

I heard what you said about reducing the price of electricity; well, we have not seen a reduction in its price, which seems to be going up continually. As far as cars are concerned, I look forward to having a car that can get me home without my needing to stop to charge it, which delays me in the process of getting there.

To turn to some of the generalities, there is a complex mix of what is devolved and what is not devolved with climate policy responsibilities, is there not? Which devolved responsibilities are the really important ones that the Scottish Government should focus on first in the climate

change plan? What does the Scottish Government have responsibility for now and what should be its focus of attention? I do not know who wants to answer that.

Dr Richardson: Why don't I have a go at that? It is an important point that this is a complex area. A great deal of progress has been made, in particular in energy supply, which is mostly reserved. The areas that are the most important for progress over the next 10 years or so are mostly, but not exclusively, devolved. We have talked about heat in buildings, which is substantially devolved to the Scottish Government. Transport is a bit of a mix; things such as the electric car grant are provided at a UK level, but charging provision and public transport are very much with the Scottish Government. Agriculture and land are devolved; they are important areas that are within the Scottish Government's gift.

There are areas in which both Governments need to work together. We talked about that with regard to electricity pricing—that is for the UK Government, but it would support action by the Scottish Government, particularly on heat and on industry, which is another area in which we really need the Governments to work together. There is a lot that is devolved, and there is a series of areas in which we need both Governments to work together, but a lot of progress has already been made on things that are purely reserved.

The Convener: Moving on slightly, I think, James, that you will understand the process that has been gone through: emergency legislation was passed last year to change the original legislation and bring in carbon budgets. We were expecting carbon budgets in May and, based on your advice, there was a delay. There was some talk within the Scottish Government and, having received your advice, it decided to reject some of it.

I would say that, for the committee, the whole process has been fairly torturously slow, and as convener, I am absolutely concerned that we will be dealing with the final part of the climate change plan in the rump of the parliamentary session, probably in the last month and the last weeks before the Parliament goes into recess in the run-up to the election. I am concerned about that, and I have to wonder whether a climate change plan will be approved by the Parliament and put in place.

Can you explain to me what interactions you have had with the Scottish Government and whether those interactions have justifiably led to the delays that the committee has faced in considering the carbon budget and, eventually, the climate change plan, when we get it?

Dr Richardson: Obviously, we talk to the Scottish Government at official level and, from time to time, at ministerial level, and we discuss the timing of our advice. That is partly tied to the timing of our advice to the UK Government and the Governments of Wales and Northern Ireland, because it is all integrated and our capacity is finitely spread across them.

We discussed the timetable and tried to produce our advice as early as we could; inevitably, the Scottish Government needed some time to consider it. As far as I am aware, we have not had discussions with it about timings subsequent to the provision of our advice about when it would bring forward its draft regulations, and so on—that is a matter for the Scottish Government and yourselves.

Clearly, we want to see the climate change plan, but what matters is that it is a good plan and that it has the content. The targets are important but, ultimately, it is actions, not targets, that will drive progress.

The Convener: I am still slightly concerned. I am not sure that I will get the exact date right, but it was something like 22 May when you gave your advice—or perhaps that was when we were expecting the budgets. There was then a delay of about three weeks in getting the Scottish Government's response to your advice and the draft budgets. That suggests that there had not been much liaison before you produced your advice to the Scottish Government, because it was thrown into disarray by it. Is that an unfair characterisation of what happened?

Dr Richardson: That is certainly not my understanding. We had discussions with the Scottish Government throughout the process, so it had a pretty good idea of what was coming. However, I am not surprised that it wished to consider the advice once it had received it. It is quite a substantial piece of work of more than 100 pages, and there is also a very substantial methodological document that—[*Inaudible*.]

I am not aware that the Scottish Government was in any way in disarray as a result of receiving our advice. Obviously, we are not involved in the discussions that it has or its response to the advice—that is a matter for it. We received technical inquiries, as you would expect, with regard to exactly how had we achieved a particular number, but no one was phoning us up and saying, "What on earth are you doing—why is it this and not that?"

The description of disarray is not something that I recognise, but, as I say, we are not part of that process, so it is probably a question that you should ask the Scottish Government.

The Convener: So, you are confident that your interaction with the Scottish Government has not caused any delay in the production of the draft carbon budgets.

Dr Richardson: I cannot see any reason why our interactions with the Scottish Government would have caused delay. Of course, it is fair to say that the Scottish Government might have asked for our advice earlier, if that had been possible, but we produced it at the earliest date that was technically feasible for us.

The Convener: Thank you. I am going to move on to questions from Kevin Stewart.

Kevin Stewart (Aberdeen Central) (SNP): Thank you, convener, and good morning to the witnesses. I want to look at transport in more depth. The Scottish Government has pledged to review its target to reduce car kilometres by 20 per cent by 2030. Given that you conclude that reduction from today's levels is unlikely, is some form of car kilometre reduction target still worth while? Maybe you would like to comment on why it is so difficult to shift to public transport and active travel. Will schemes such as the Scottish Government's scrapping of peak rail fares from this week help in that regard?

Dr Eoin Devane (Climate Change Committee): I will take that question. In summary, we assume in our modelling and our pathway a 6 per cent reduction in car kilometres, with a shift from car to active travel and public transport. However, given the growth that you might otherwise expect to see as the population grows, gross domestic product increases and so on, you are right to say that it kind of evens out. Over time, therefore, that shift does not lead to a reduction in absolute car kilometres. However, action is still required to deliver that 6 per cent shift; otherwise, you would, according to our modelling, see an increase.

The 6 per cent figure is based on evidence of shifts to active travel and to bus and rail travel that we have seen in the past in areas of the UK, including areas of Scotland—Dundee is a strong example in that respect. The removal of peak fares is one example of a scheme that can deliver increases in the use of trains, as we saw in the pilot schemes, so we are supportive of such schemes. Of course, the challenge is to ensure that you do that sort of thing fairly and that people have travel options.

We are aware that the Scottish Government had a 20 per cent reduction target, but that is under review. Our pathway assumes 6 per cent, based on the evidence of what has been achieved in comparable areas, but that is not to say that that is the only type of scheme or the only level of production that should be looked at. As you will be aware, there are wider benefits to reducing car travel beyond reducing carbon. It is not for us to say that there would be no value in going further than that for congestion benefits, air quality benefits and so on; those should be considered when determining whether a new target was appropriate.

Kevin Stewart: Would you say that schemes such as scrapping peak rail fares and free bus travel for young people and older people are beneficial to making that shift?

Dr Devane: I would say so, yes. One of the clear messages from a citizens panel that we conducted as part of a UK-wide survey earlier this year was that people want low-carbon choices to be easy for them to choose and affordable. Schemes that make access to public transport, for example, easier and cheaper are likely to play into people's needs and wishes.

Kevin Stewart: In your evidence, you conclude that battery electric vehicles will be the dominant low-carbon option as opposed to hydrogen or other low-carbon options, even including the decarbonisation of heavy goods vehicles. What led you to that conclusion?

Dr Devane: We can see that quite marked progress has been made in the electric and light-duty vehicle sectors in recent years. In 2023, battery electric vehicles reached 12 per cent of car sales in Scotland, so they are entering the mass market. Moreover, battery prices have fallen quite steeply which, as James Richardson mentioned earlier, has led to electric vehicles now being priced competitively in the used vehicles sector. Based on evidence from the sector, we think that, by around 2026 to 2028, new battery electric vehicles will reach price parity with new internal combustion engine vehicles. That means that people will be saving both when buying a vehicle and while running it; as James has pointed out, electric vehicles are more efficient to run, because of the cost of the energy that they take in.

On the heavy goods vehicles side, we recognise that the market is at a much earlier stage, but there is read-across from the light-duty vehicle market. Progress in batteries has been impressive, even with the heavy-duty batteries that are required for heavy goods vehicles. We see most of the major manufacturers bringing electric options to market, and many of the big fleets are beginning to adopt them.

That is not to say that we are anywhere near as far on as we are with cars. More progress will need to be made on, for example, making sure that depots can connect to the grid when they need to, and the roll-out of public charging that works for heavy-duty vehicles. However, we have a lot more confidence than we did five years ago

that that is the direction in which the market is going—with the caveat that it is at an early stage and there is potential for things to go in a different direction. We are therefore not ruling out hydrogen entirely in certain use cases, but, in most cases, we expect electric to be the dominant choice.

Kevin Stewart: You have said that you have caveats on some of that. You have talked about a reduction in the price of batteries but, of course, the contents that make up those batteries come from elsewhere, and certain parts of the world control the markets in lithium, for example. Does the Climate Change Committee take into account security and changes in international relations when it looks at all the evidence? You have said that battery prices are coming down, but they could go up with international relations as they are and the trade wars that we are seeing. If China puts up the price of lithium, we are scuppered, are we not?

09:45

Dr Devane: We absolutely do consider trade implications. I would point you again to the advice on the UK seventh carbon budget, on which Scotland's modelling was based, and in which we looked in depth at the supply constraints and the supply chains that we would need in order to scale up. We have not done our own analysis on that, but we have reviewed analysis from organisations such as the UK Critical Minerals Intelligence Centre, the Energy Transitions Commission and the International Energy Agency, all of which have looked at the pace at which global supplies of lithium and other key minerals need to grow. All of them have confidence that that growth is being seen and, moreover, that new markets are opening up, with different battery chemistries being developed that might avoid some of the more problematic minerals that are required in traditional chemistries. There is growing innovation in the industry, which gives us confidence that there should not be the bottlenecks and price dependencies that create those risks.

The other aspect of energy security is our dependence on imported fossil fuels. In fact, we already have that level of dependency, as we have seen from the energy price shocks over the past three years. Increases in gas prices can have profound effects on people's cost of living and ability to heat their homes, so moving away from imported gas and oil has big benefits from that perspective, too.

Kevin Stewart: I am sitting in the great city of Aberdeen today. One of the dangers in our move to net zero is in relation to shutting down North Sea production too quickly, losing skilled workers and, in so doing, making it much more difficult to achieve a just transition. You just said that we do not want to rely on imported oil and gas. Is there a logic to the UK Government policies that are having an impact on North Sea production?

Dr Richardson: It is important to start from the big picture. As you said, it is critical that there is a just transition for the workforce in that industry. We need a clear plan to bring new industries into the areas of Scotland that are particularly dependent on oil and gas—especially Aberdeen, as well as other places that would be affected, such as Shetland.

Regardless of Government policy on net zero, the industry is going to wind down because of the geology. When we look at the figures that we have reviewed from the North Sea Transition Authority, the difference between new licensing and not new licensing is the difference between a 90 per cent reduction in production and an 85 per cent reduction. Either way, there will be a substantial impact on the industry. The critical issue is to bring in new industry that will create new jobs for people in that area. Those might be green jobs, perhaps from floating offshore wind, or they could be jobs in some other industry entirely, as long as it creates alternatives.

We provided some advice to the then-Secretary of State for Business, Energy and Industrial Strategy, Kwasi Kwarteng, back in 2022, on the various factors. However, we must take into account the fact that, whatever happens, we have got to start with, and build on, the assumption that the current industry is going to shrink.

Kevin Stewart: You said that you have provided advice. In some regards, people who are looking at this logically feel that the UK Government has failed to come up with the strategy required to balance the environmental aspects of all this with the energy security aspects—it needs to come up with a logical balance to stop the greater import of oil and gas in future, which will actually be more damaging to our environment.

Would you advise UK secretaries of state that the best thing that they could do would be to come up with a comprehensive strategy to balance all those aspects out and to make sure that we do not shut down North Sea production only to see greater import of oil and gas from elsewhere? In seeking to ensure that we maintain jobs, surely it is essential that we make sure that the experienced workforce that we have can slot into the new jobs that appear. Basically, does the UK Government have the right strategy and are you going to advise it to get that strategy in place?

Dr Richardson: This is a matter for both the UK Government and the Scottish Government, and the strategy is needed between the two. You are absolutely right to emphasise the importance of

the workforce and of bringing in new industries—that can be done only through co-operation between the two Governments. Of course, it also requires the private sector to come forward. Conversations are needed with investors to bring investment in that area.

You are right that these matters need a consideration of all the factors, including things like energy security, but it is important to say that oil in particular is mostly for export, so the impact of more licensing for oil will not affect our import dependence on oil products—it would affect our exports. The only thing that we can do as a country to manage our energy security is to get off our dependence on fossil fuels, because whatever you do, in a world that cannot get off fossil fuels, the North Sea is going to decline below any level of demand. So, the route to energy security is through domestically produced renewable electricity—much of it, of course, in Scotland. That can then power our homes, industries and transport without the kind of reliance on fossil fuel producers that we currently have and will increasingly have, regardless of whether we are licensing the production.

Kevin Stewart: I have one final brief question. Going back to electricity versus other options, such as hydrogen, it has been suggested to me that the Climate Change Committee is anti-hydrogen. Is that the case?

Dr Richardson: That is certainly not the case. We see a role for hydrogen. It plays a key role in certain parts of industrial decarbonisation. It is very important within the electricity system as one of the ways in which you can power electricity on those days when it is neither windy nor sunny. However, in many applications, the economics of electricity are much stronger than the economics of hydrogen, particularly when making green hydrogen using electricity. That is the only way to do it that does not have any emissions. There are significant losses across that chain of converting electricity into hydrogen and then using hydrogen to create usable energy. It is much more efficient in almost all applications to use electricity directly for that process, so hydrogen tends to play a role in things that electricity cannot do, for example, in very high temperatures—it is possible but very hard to do that with electricity—or in chemical processes and so on.

It is however a substantial expansion in our model—[*Inaudible*.] Some of that could well be placed in Scotland, because, of course, the renewable energy resources that you have could make Scotland a sensible place to locate green hydrogen production, provided you could source the necessary renewable resources.

Kevin Stewart: Thank you, convener.

The Convener: Thank you, Kevin, and thank you for not missing a beat when I came to you when I should have gone to Douglas Lumsden first. Apologies to you and to Douglas. I will come to you in a minute, Douglas, but Monica Lennon has a follow-up question, and I also have one.

Monica Lennon (Central Scotland) (Lab): Thank you, convener, and good morning to our witnesses. I return to the issue of surface transport because it is our highest emitting sector. We have had some important questions from Kevin Stewart, but, if I may, I will dig in a little further. Some good schemes have been highlighted, such as the scrapping of peak rail fares and the concessionary travel schemes for under-22s and older people in Scotland. When I speak to constituents and other people around Scotland, however, they want public transport to be more integrated, to be easier to use and to be more reliable. Affordability is an issue, but people want to be able to get around as quickly as possible and to avoid congestion.

How can we make the bus more attractive to people? I had a quick look at the figures, and I think that it is still the case that bus patronage in Scotland is declining. That has been a trend for the past decade, notwithstanding the period of Covid lockdowns. In contrast, in Greater Manchester, where there is an ambitious bus strategy, there has been a recovery in bus patronage.

Are there examples elsewhere in the UK or internationally that you would like to bring to our attention and to the attention of the Scottish Government? How do we achieve the balance between carrot and stick? I am quite concerned that Glasgow City Council is proposing road charging for people who visit the city at a time when public transport is still not as good as it needs to be.

Dr Devane: What Greater Manchester has done, fundamentally, is make its public transport system more joined up. It has brought it into one umbrella network so that it fits together better.

What you are hearing from your constituents very much lines up with what we heard from our citizens' panel. People want public transport to be more affordable but, more than that, they want public transport that works for them by being aligned with when and where they need to travel and, importantly, is joined up so that they do not have an hour-long wait at the train station because the bus does not come in until an hour after the train has left. Those sorts of joined-up modes can work quite well.

On road charging in cities, London's congestion charge has reduced car usage largely because it has a well joined-up public transport system. You are right to say that there needs to be an effective

alternative, and that very much aligns with what we heard from people as part of the process. People want choices. They want the ability to make the low-carbon choice because it is as easy and attractive as just taking their car.

The Convener: While you are there, Dr Devane, could you just answer a simple question for me? As a more balanced pathway to net zero, the Climate Change Committee suggested a 6 per cent shift from car use to public transport use. What does that mean per car user in the UK? How many kilometres will they have to shift? Six per cent does not mean very much to me, and I doubt that it means very much to the car user.

Dr Devane: I think that the average car user drives a bit more than 10,000km in a year, so to do some quick maths, that 6 per cent would mean 600km in a year, which is a bit under 2km a day. However, that varies quite a bit. It is worth saying that our analysis looks not just at averages but at what works in different places in the country. Most modal shift takes place in urban areas, so the percentage share in cities would be higher than 6 per cent because, as we said on the previous question, those are the places where we can build more integrated public transport systems and alternative modes of travel, whereas we have quite a low assumed reduction in more rural communities where dependence on the car is a bit more integrated.

10:00

The Convener: This is where I get confused by the headline figures: as you rightly say, 6 per cent might mean something completely different to somebody who lives in Edinburgh who does not need to take public transport compared with someone who lives in the Highlands. Somebody in Edinburgh may have one car whereas, in the Highlands, most families may have to rely on two cars because they have to get around the place. We are talking about a huge reduction in car use and there is no sight line in the future to having more bus or train transport. In fact, bus services and train transport are reducing. What will the effect be on people who live in rural areas? How many miles or kilometres do you think that they will have to shift: 100km a year? Would it be reasonable for the burden to fall on everyone in Edinburgh and Glasgow, as they have access to public transport?

Dr Devane: I do not have that figure to hand. I think that it is in our detailed methodological annex, which is on our website. As I said, the percentages are much more skewed towards more urban areas. Most of our reduction has not taken place in rural communities. We would not be assuming that reduction would be as high in rural areas.

The Convener: I am intrigued about how that will be achieved, because you cannot increase road tax or fuel prices in rural areas without penalising them for it, and you cannot provide them with public transport because there is not the capacity for it, nor is there a wish to have public transport at the moment. How will the Government deliver that wonderful 6 per cent figure for people who live in rural communities?

Dr Devane: The 6 per cent figure is not for people who live in rural communities—that figure would be smaller in those areas. Most of the 6 per cent reduction will be delivered by those who live in urban communities. You can look at what has happened in Dundee, for instance, or across certain cities in the UK. We have looked at schemes that have been introduced in the Netherlands, Switzerland and Germany to incentivise the use of rail and bus travel for certain journeys. Again, we are not assuming that those schemes are applicable to everyone or that they are appropriate for all types of journeys. However, the 6 per cent figure is based on real-world evidence of schemes that have delivered those types of reductions.

The Convener: I am sure that that gives absolute confidence to people in rural areas who rely on private transport to get them to places because there is no public transport. I must also say that people in rural areas often have to travel to cities such as Edinburgh and Glasgow for treatment, because there is no treatment in rural areas. They will be penalised for doing that if there are congestion charges. I think that a lot of work needs to be done in order to explain what the effects of the proposals would mean for individual households.

Mark Ruskell (Mid Scotland and Fife) (Green): I perhaps take a different view, convener. To me, the 6 per cent figure sounds pretty pitiful, to be honest. As someone who lives in a rural area, I could quite easily reduce my mileage by 6 per cent just by organising my day a little bit better, by joining up with other families when taking my kids to activities, for example.

I think that Eoin Devane is making a point about the real reduction coming from urban areas, but in the CCC's advice, I do not see what the game changer could be if we are to significantly reduce vehicle mileage. For example, some cities in Europe have completely free public transport systems. If that is put in place and funded through congestion charges, could that result in a much greater reduction—say, 30 per cent—in vehicle mileage in urban areas? It could mean that there simply would be no point in driving any more if people are charged to drive but had a completely free, well-funded public transport system.

I feel that we are in a climate emergency. What is the game changer here? Many projects have been tried across Europe, and you have collated some of the best practice on that. However, none of this feels like the big, big shift that is needed. If we are sitting here debating a 6 per cent reduction—or one journey in every 20—that does not really feel to me like a shift in behaviour. I know that I am being provocative, but I am interested in finding out what the big ideas are that could really shift things fairly and in a way that actually benefits people.

Dr Devane: I think that I would challenge the notion that 6 per cent is very small. Since 2019, which is the baseline that the old 20 per cent reduction target was based on, car travel in Scotland has come down 3.5 per cent, and most, if not all, of that reduction is due to structural shifts following the pandemic, with more people working from home during parts of the week et cetera. That shows that we have not really moved the needle on reducing car kilometres, despite having quite an ambitious target and bringing in various schemes such as those that have been mentioned.

Moreover, if you look further back, you will see that emissions from surface transport have not changed at all in Scotland since 1990; indeed, before the pandemic, they were actually up. People were driving more, not less. Therefore, delivering a 6 per cent reduction is, in my view, quite ambitious in some ways.

I am not saying that it is the most ambitious approach, and you have set out a number of approaches that could go further. As you have said, we have looked at schemes that have been brought in across Europe, and we have based our assumption on interventions that have delivered a measurable reduction in car kilometres. We have not pitched our reduction at the very top end; you are right to say there are places—Tallinn in Estonia, for one—where there have been interventions, such as making public transport free for all residents, that provide evidence of the potential to go further.

To be honest, though, I would just say that, as with all areas of our analysis, we have tried to base this approach on evidence of what is feasible and deliverable. The clue is in the name—it is a balanced pathway, so there is a balance of measures. In most areas of our analysis, there is scope to go further and to be more ambitious if you choose to be, and there might be reasons to go beyond the carbon pathway that justify such an approach, as I mentioned earlier.

Mark Ruskell: But is that not the fundamental problem with the balanced pathway? It assumes the status quo and that we have a way of working within our society. We have a structural dependence on car use; car use is much cheaper than public transport use; and there is nothing that fundamentally alters that balance. At the end of the day, the question is: what will actually convince people to leave the car keys at home and to get on a bus or a train? The policy on peak fares and all the other measures are fantastic—indeed, my party has been pushing for them in this Parliament—but where is the fundamental shift that is needed? When I look at the balanced pathway, I do not really see much hope of getting big reductions in carbon emissions from different sectors, unless that fundamental change happens. It just feels as though we are managing some carbon reductions within the status quo, instead of thinking outside the box and saying, "Well, these are the really big options for change that have to be fair, but which could ultimately benefit people."

Dr Devane: I come back to the three words that I mentioned earlier: easy, attractive and affordable. Those are the things that people need to see if they are to make choices that divert them from their own lived status quo. We saw in the pilot programmes to remove peak fares evidence of train travel increasing, and we have seen across Europe evidence of interventions that have been made to reduce car usage in cities by making public transport not only more integrated—with timetables more aligned, as I have said—but cheaper, too.

The other thing to say is that we have constructed the balanced pathway by looking at multiple different approaches. We are looking to reduce car kilometres, but we are also delivering reductions through a shift to electric vehicles. I suppose that the people of Scotland can be reassured that when they need to use a car, they can still do so, and that a large share of the reductions in emissions that they themselves can deliver will come through getting an electric car instead of a petrol and diesel car, and still being able to use it.

Mark Ruskell: Convener, can I move on to ask about heat?

The Convener: No, because I am going to come back to Douglas Lumsden, because I cut him off without even introducing him.

Back to you, Douglas. I apologise again; off you go.

Douglas Lumsden (North East Scotland) (Con): I will go back to the issue of electricity prices, which we touched on earlier, because it is so important.

Electrification is key to meeting our future targets. James Richardson, you said that electricity must be more affordable. How confident are you that electricity prices will start coming

down in the future and what factors will mean that those prices do come down?

Dr Richardson: There are two dimensions to that, which are short and medium term, if I can put it like that.

The short-term question is about the term "levies". You can think of levies as being a bit like taxes. They are added to the cost of electricity but, by and large, are not added to the cost of gas, which skews the relative price of electricity and makes the electricity that you buy more expensive than the cost of making extra electricity. If you get a heat pump or an electric car, you need more electricity and are actually paying over the odds for that extra electricity. That is a market distortion that we think the Government should remove, which would mean that people would pay something far closer to the true cost of electricity and would create far better incentives, in particular for heat pumps. That policy choice to put those costs on electricity was made a long time ago, but it is under the control of the UK Government, which could act relatively quickly.

As we replace fossil fuels in electricity generation and move to a predominantly renewable system, there will be longer-term questions about what that will do to the cost of electricity over time. We think that that will also bring down the cost of electricity. As everyone knows, the cost of electricity is very high at the moment because it is driven by the market cost of gas. The wholesale price of electricity is almost always determined by the cost of gas, which is very expensive because the market is being manipulated by Vladimir Putin. As you use less gas to generate electricity and push gas off the system by using more renewables, the cost will fall, but that will be a gradual process and we will have to pay the cost of building more renewable facilities and transmission infrastructure, so there will be costs as well as savings. We will see the cost per unit of electricity gradually reducing over time as we cut out expensive gas and replace it with lower-carbon technologies, but that will not offer the sort of overnight gain that you could have simply from having a better policy about where to put levy costs.

Douglas Lumsden: I need to pick up on a couple of those points. You said that market distortion—I think that was how you described it—is making electricity more expensive. What are the factors that make it more expensive? Are there levies or other things in people's bills that make the cost higher than how much it actually costs to make that energy? What are those things?

Dr Richardson: They are termed as "levies" and there is a range of different things. Some of those are essentially social policies and pay for things such as reducing bills for people on lower incomes or insulating properties. They produce a genuine benefit, but the cost is borne, in part, by electricity bills.

Some of the levies reflect the cost of the early intervention low-carbon technologies. When the first wind farms were being built, those were, of course, very expensive, just as the first mobile phones cost about £9,000 in today's money. The first examples of any technology are expensive and the costs of those technologies are reflected in electricity bills, but that is not the cost of generating the additional units of electricity that I need if I buy an electric car or install a heat pump. That extra electricity is going on to the market at a much lower cost.

If that much lower cost is not passed on to the people who are buying the extra electricity, those people essentially end up paying costs that would otherwise fall to other consumers and systems. In a way, they are being taxed for using the electricity. That distorts the price of making the switch away from gas—gas bears a little bit of the cost there, but far less of it—and it distorts the choices to move out of gas and into electricity, which means that households do not get the benefits of those lower-carbon technologies and their greater efficiency.

10:15

Douglas Lumsden: In that list of levies, there were contracts for difference, renewables obligation certificates, network costs and balancing—all those things have to be factored in and they make our electricity bills more expensive. I am trying to think about how, in the future, that effect would disappear.

Dr Richardson: Because those are legacy costs, they will roll off automatically over time. The Government could make policy choices that could immediately take them off the price of electricity. However, the costs of the initially expensive things that we did 10 or 15 years ago are starting to come out of the system over time—they are not costs for ever.

We see things such as balancing costs and network costs as part of the whole-system cost of generating electricity, so we are not arguing that those are misallocated. You are building a much bigger electricity system because you are using those lower-cost, low-carbon technologies. Even though you have to invest in more transmission balancing costs, we think that, overall, the unit cost of the underlying electricity system will fall. That will be the long-term effect—it will fall gradually, because you have to pay for all the things such as transmission balancing.

Douglas Lumsden: Looking at the next CFD round, we see that the prices are still on the

increase. You say that it is a legacy cost, but it is still going to be with us for a long time.

Dr Richardson: We do not know what the price will be in the next auction round. The estimates that I have seen are pretty similar to the wholesale price that people are paying today for gas. They are still much lower than the costs that I am talking about of things such as ROCs—those were coming in at prices that were considerably higher than any of the estimates that I have seen for the auction.

It is important to say that, yes, at the moment we are in a period in which prices have gone up. We have seen that before when there have been these kinds of shocks. The shock was driven by the price of gas and it has pushed up the costs of things such as capital and steel. Those shocks are rarely permanent—we would not expect to see a permanent increase in the cost of wind.

In other parts of the technology, costs have continued to fall. For example, solar and battery prices have continued to fall. However, the sector relies on a lot of steel, and the price of steel has gone up because the prices of capital and of the inputs to steel production have gone up. So, yes, those prices are relatively high now, but they are much cheaper than they were with the costs that I am talking about.

Douglas Lumsden: I want to pick up on the fact that gas always seems to get the blame for increased electricity bills. Last night, I looked at my own utility bill. The gas price was 6.3p per kilowatt hour. The electricity price was 24.7p per kilowatt hour—almost four times the price of gas. How come gas is making such a big impact on electricity prices when, when I look at my own bill, it appears that electricity is four times the cost of gas?

Dr Richardson: There are several things going on there. The first is that, if I take gas and convert it into electricity, I only get about half as much in electricity as I put in in gas. You would have to roughly double that 6.3p's worth for it to result in the same amount in electricity, because of the losses involved in burning fossil fuels to make electricity. You do not get anything like a unit of electricity from a unit of gas that you put in.

The second thing is that the way that the wholesale electricity market works is that the price of the most expensive generator that the system operator calls on at any one time sets the wholesale price. That does not affect the price for CFDs, but it affects the price for the rest of the market. That wholesale price is nearly always determined by the price of gas, which means that cheaper generators who are on the system—say, nuclear—are being paid the price of gas, and are being overpaid because of the way that the market works. Therefore, that gas price is not only driving the cost of the electricity that is generated from gas, but driving the cost of electricity that is generated in other ways. It therefore pushes up the cost of all electricity, other than the CFDs.

The other thing that I will say on this, which I do not think has been fully understood in the debate, is that, although we tend to think of CFD prices as having fallen quite a lot—we have had some very low-cost auctions for a few years—actually, most of that supply comes on to the system only over the next few years. Most of the CFDs that are on the system today are the more expensive ones from quite some time ago. There is a lag between awarding a CFD and then constructing a wind farm in the North Sea. Those are not things that can happen overnight. Therefore, a lot of the lower-cost CFDs will start to come on between now and 2030, as those wind farms get completed and connected. We have not yet seen the benefit from that.

Douglas Lumsden: So that I can try to understand, for every pound of my electricity bill, for example, how much is down to the wholesale cost and how much is other things? I want to know whether, if wholesale prices double, my electricity price would double, or is that only, say, 50 per cent of the bill?

Dr Richardson: It is about 50 per cent. I am just trying to see if I can get the information here. We produced an annex on this to our UK progress report. We can send that over to the committee. That sets out all the various components, and what has happened to those over recent years. It is certainly true that there are other elements in the cost that are not purely the wholesale cost. There is a network cost, which we have talked about, and there are levies for things like social policy. There are also some costs from CFDs and so on. All of that is set out in our latest UK monitoring report, so maybe we should send that over.

Douglas Lumsden: Okay, thank you. I have a final question on electricity. Your modelling suggests no new gas plants, even with carbon capture and storage in Scotland going ahead. Will you say a bit about why you have come up with that? Nuclear will be dropping off in the next three years in Scotland, so what will our baseload be and how will we achieve it when the sun is not shining and the wind is not blowing?

Dr Richardson: It is important to remodel the Great Britain grid and its connections to the wider European grid. Across that, we see a need for gas with CCS and for hydrogen—for those technologies that provide a back-up source of generation on those days when it is neither windy nor sunny. That includes nuclear as well—there is Sizewell C, as well as equipment for one

additional large and several small plants on the grid as a whole.

There are modelling assumptions about the location of the plant, but regardless of whether those are situated in Scotland or south of the border, the electricity will be available to people in Scotland on those days. It is just a question of which way it flows.

It will ultimately be a market decision. SSE is interested in converting Peterhead to CCS—that is a choice for SSE in the market. The model does not pick that, but that does not mean that it will not happen. We are not making recommendations about where those sites should be located. It is just about function. It is probably driven by the ground transmission infrastructure, but other choices are available.

Douglas Lumsden: I guess from your answer that the baseload would come from imported electricity, because we would not be able to provide the baseload ourselves in that instance.

Dr Richardson: If it were the case that there were insufficient wind and solar resources across the whole of Scottish generation to meet Scottish demand, which is a relatively unlikely situation because Scotland will have far more generation than Scotland demands, and, in our model, Scotland is a vast net exporter of electricity to the rest of Great Britain—you would have to have really extreme conditions for Scotland to be unable to meet its needs from renewables—electricity would flow back the other way on the transmission lines that would normally take it from north to south; it would go from south to north.

Dr Devane: We have grid storage in our pathway in Scotland as well.

Douglas Lumsden: How much battery storage do you have in that pathway, then?

Dr Devane: I think that we have around 100 gigawatt hours by 2045, which is just about—[*Inaudible*.] That is not only battery storage but all grid storage, including things such as pumped—[*Inaudible*.]—as well.

Douglas Lumsden: How much do we have at present? I am just trying to understand how much that figure would have to increase by, because battery storage is a huge concern for many of my constituents right across the north-east of Scotland.

Dr Devane: Our pathway begins at 15 gigawatt hours for just 2025. I do not know how much of that figure was modelled and how much of it was actual.

Douglas Lumsden: So, it is a huge increase.

Dr Devane: It is a big increase, but over 20 years.

Douglas Lumsden: Okay. Thank you, convener.

The Convener: I am tempted to ask Eoin Devane how many more battery storage sites that would mean are dotted around Scotland—as well as the size of each of them—but that is maybe too difficult to work out.

Dr Devane: That is a lot of detail.

The Convener: We are talking about thousands, however, are we not?

Dr Devane: We are talking about big projects. You have small battery storage and you have things such as bigger pumped hydro facilities, which already exist. Our modelling looks at quite a mix of different technologies and approaches.

The Convener: I will bring in Mark Ruskell before I delve into that too deeply.

Mark Ruskell: Thanks, convener. I turn to buildings—both homes and other buildings. Earlier, you put it to us that there is a real need to switch to much more efficient technologies that are lower cost for consumers but also much lower carbon. I ask you to reflect on the change that we have seen in expectation. In the 2020 climate change plan update, the Scottish Government had a very ambitious programme—well, it was not a full programme as such, but it contained an ambitious target of a 63 per cent reduction in emissions from the building sector to 2030. That clearly represented an enormous ramp-up of a range of technologies, although the programme at that time did not really specify how that would be achieved. That differs quite a lot from what you are now putting forward in the balanced pathway, which sees a much greater adoption of technologies than in the third and fourth budgets.

Can you offer a bit of narrative as to what you think has changed around the expectations on building carbon reduction in recent years and what is now the realistic pathway?

Dr Devane: Our pathway shows a reduction of about a third by 2035, and then a 92 per cent reduction by 2045, which you are right to say is slower than the previous 2030 ambition. On what has changed, I suppose that, over the past few years, there has not been the progress in delivering that transition that was maybe hoped for when those previous commitments were made.

Today, 88 per cent of Scottish homes are heated with fossil fuels, so the biggest scope for reduction is in moving away from those fossil fuel heating systems so that about 40 per cent of homes are heated with low-carbon heat of some form by 2035—mostly heat pumps in either individual or communal systems. The big challenge in delivering that is to ramp up the market for heat pump installations.

Currently, across the UK, under 1 per cent of homes are heated with a heat pump. We have looked at a credible rate of ramp-up from that 1 per cent to 20 per cent, to 40 per cent by the mid-2030s, and then beyond that to a mass market. We have looked at comparable markets across Europe. The Netherlands and Ireland are two notable ones that are quite a bit ahead of the UK, so we have looked at the pace at which they have delivered the ramp-up and have based our modelling on that.

Rather than making an assumption that we need to install a certain number per year, we have instead looked at the pace at which markets can grow and the S-curves that we see as new technologies are developed in comparable markets. That gives a growth rate that starts quite slowly, because that is how an S-curve starts. You are right that, once you get into the second carbon budget period and certainly into the third period, it goes quite quickly at that point.

10:30

Our modelling is based around the UK 2050 net zero target, so it is based around phasing out and removing fossil fuel heating by 2050. I know that the Scottish Government has a target to do that five years sooner; that came out after our modelling was finalised.

A simple heuristic is that the average boiler lifetime is about 15 years so, if you want to be in a place where you can replace heating systems without needing to rip the average system out early, you need to be in a place where the market will scale up to be able to deliver the full market of annual installations by 15 years before the target date. If the target date is 2050, you need to have scaled up your heat market from where we are today to a full market-wide coverage by 2035. If you want to do that five years sooner, you need to do that scale-up five years sooner.

We are clear that, while the actual emissions savings might be coming on stream a bit more slowly, the action really needs to start happening now to deliver that scale-up quickly.

Mark Ruskell: You set out very clearly that you are disappointed that the Scottish Government abandoned its proposals for the regulations to upgrade properties at the point of sale as part of the heat in buildings bill. Can you say what impact that decision might have on that pathway for decarbonising heat? If the Government sticks with that position after the election and does not put the measure back into the bill, what else can it do to speed things up and grow that market more quickly?

Dr Devane: In our most recent Scotland progress report at the start of last year, we gave a—[*Inaudible*.]—of the previous plan for the heat in buildings bill. We said that the point of sale regulations could provide a template for the rest of the UK, so it is disappointing to see it not being taken forward. We have said that there is a need for a plan in its place. Whether it is that plan or another means to grow that market, there is an urgent need for a set of plans to deliver that soon because, otherwise, that target is at risk.

Mark Ruskell: I am struggling to work out what that would be, because, as you described, the growth of the market in other places has been very slow. It is very much an S-curve, which puts all the carbon reductions and progress back to the later years. Instead of putting those regulations in place, what measures can the Government take right now to really speed up that market? I am curious to know what the plan B would be, or are we just pushing everything back?

Dr Devane: It is, crucially, a joint responsibility between the Scottish and UK Governments. It comes back to the point that James Richardson made earlier about reducing electricity prices. A heat pump is between three and four times more energy efficient than a gas boiler, so, if you can bring your electricity prices down to three to four times less than the price of gas, people will see savings on their bills as soon as they switch to a heat pump. The short-term action that James talked about to move those levies off electricity prices is a big player in enabling people to see those savings. In addition to that, we will see the medium-term change that he talked about, with prices coming down as the cheaper renewables come on stream. That will also help to build the case for people to get a heat pump.

In addition, there is, as you will all be aware, an up-front cost to getting and installing a heat pump. There are subsidies in place that will help with that, which is beneficial. There is also the UK-wide clean heat market mechanism, which has the potential to provide a duty on boiler manufacturers and installers to install a certain share of heat pumps, which could help to provide a regulatory lever to grow the market. In addition to other regulatory or energy efficiency standards, those sorts of things could play a role.

Mark Ruskell: So you really see the reduction in electricity price as a trigger, whether it is for transport, for home heating or for people shifting over to electrifying technology. At the moment, we are not quite there in terms of a market signal being sent to consumers that it is obvious that they should switch to an electric vehicle and an air-source heat pump.

Dr Devane: It is our key recommendation to the UK Government.

Mark Ruskell: Okay. I think that you are advising decarbonisation in non-residential buildings earlier than in residential buildings. Will you explain that?

Dr Devane: One thing that we have looked at is the role that public sector buildings can play, not only in setting an example, but in helping to grow these markets. We are aware that the technologies for big commercial public sector building decarbonisation and home decarbonisation are not quite the same, but there is read-across in installations and market growth. What we have assumed in our pathway is that the public sector will go a bit faster in delivering the transition to low-carbon heating, and that it will do so a bit sooner than it might have done if it had waited until the boilers ceased to operate.

What we have called for in Scotland, and in the UK more broadly, is a proactive plan to think programmatically about how to decarbonise our public buildings. Those might be central Government buildings, schools, military barracks or local authority buildings. We need to ensure that long-term plans and funding are in place to deliver that change as quickly as is feasible in order to build those markets and build public confidence, as well as business confidence.

Mark Ruskell: Do you think that scrappage schemes more broadly have a role to play here, within both the public sector and the private sector?

Dr Devane: In our public sector modelling, we assume some level of early scrappage of heating systems. We do not assume that in our residential modelling, which assumes that heating systems will be replaced only at the point at which they were due to be replaced anyway. As long as we get on with building scale up in that market now, on an average basis, we think that we can deliver the transition without the need for scrappage schemes in a residential setting. However, we talk about them as an option to go further or faster, or as a contingency measure if things were to fall off track.

Mark Ruskell: But surely, if you have a scrappage scheme in place next year, you will be able to move faster than if you wait, say, up to 15 years for the natural life of a boiler to come to its end.

Dr Devane: That is right. It is an option to go faster.

The Convener: Before we move on from the issue of heat pumps, I have a question. I am thinking about a two-bedroom, two-public room house with a kitchen and a bathroom, which was built before 1950. As a surveyor, I would estimate that, by the time you have put in the heat pump, insulated the house and replaced all the equipment in it, it would cost between £30,000 and £40,000. Those are the sort of figures that I have been given by the industry. If electricity prices were to reduce the price of heating the house by £500 a year, it would take 70 years for somebody to pay back that cost.

How will you encourage somebody to buy in to replacing an oil system that is running at the moment and to spending, say, £30,000 to £35,000 on a heat pump system for their house if they do not have that money in the first place and it will take them 70 years to pay it back? I am just trying to get a price for individuals so that they understand what this will cost them. It will then be up to them to make a decision. Are the figures that I have quoted unreasonable?

Dr Devane: Clearly, the exact figures will vary from house to house. We expect those costs—the cost of the technology and, more important, the cost of the industry learning to install that technology effectively and efficiently—to come down.

Since our previous analysis five years ago, there has been a bit of a move away from an expectation that people will need to install lots of energy efficiency measures or to replace all the radiators in their house. In many cases, people do not need to do as much of that as was previously the case, and that, in itself, will bring down the costs. However, we are aware that, at the moment, in many cases, the cost that is quoted up front is too steep. Those costs need to fall, in the same way that electricity prices need to fall.

Dr Richardson: The costs that you cited sound particularly extreme. The evidence on actual costs that are being borne in the market shows that costs are typically around £13,000 to £14,000 for a property. Obviously, the cost will be more for a larger property and less for a smaller one. For example, with a smaller property, the cost might be closer to £10,000 to £11,000. Of course, if someone is having solid wall insulation and all sorts of other things installed, it is possible to get to the kind of numbers that you mentioned. However, as Eoin Devane said, the technology is now moving in such a way that that is extremely unlikely to be the choice that anyone would sensibly recommend. That is not what we have in our—[*Inaudible*.]

It is true that there is a cost to this and that that can be a barrier to people, so it is important that the Scottish Government continues to provide support, but the costs for a two-bedroom house are not £30,000 to £40,000. That is simply not correct.

The Convener: That is interesting. The committee visited a place down in the Borders, where the cost of bringing houses up to the

required state was much higher than that. In some cases—with old farmhouses, for example—up to £0.25 million was being budgeted for to make them fit for the new technology and to meet the energy performance certificate requirements. Obviously, a lot has changed since I was a surveyor, but I think that I still have my finger on the pulse.

The next questions will come from Bob Doris.

Bob Doris (Glasgow Maryhill and Springburn) (SNP): Convener, your questions about prices have made me think about the need to ensure that the market is operating properly for consumers, because the prices that you gave indicate that there could be price gouging in the system. It is necessary for consumers to get a number of quotes to ensure that they get best value.

Do our witnesses have any advice to give to ensure that, as people move to ground-source heat pumps, they are not price gouged by less-than-reputable operators in the market who might wish to extract maximum profit rather than provide public and community benefits?

Dr Devane: Building the market will have a benefit in that regard, as it will mean that there will be more competition among trained installers and rival companies, from which people can get quotes. There is also a role for certification schemes. We know that consumers want to have confidence that the installer they are hiring is certified and trustworthy—that is true of all home improvement works. There is the microgeneration certification scheme. As that grows as the market grows, that will, I hope, build confidence—people will be able to take confidence from that certification and from seeing reviews by people who have had companies do installations.

Bob Doris: Did you want to come back in, convener?

The Convener: No. I was simply going to suggest that, before you go on to your next line of questioning, which I think is on agriculture, it might be appropriate to take a wee break. We have been going for an hour and 45 minutes, so I suggest that we take a 10-minute comfort break until 10.55 to allow everyone to stretch their legs before we continue.

I suspend the meeting for 10 minutes.

10:44

Meeting suspended.

10:55

On resuming—

The Convener: Welcome back. Bob Doris, I apologise for cutting you off as you were about to launch into the next bit. Over to you.

Bob Doris: That is absolutely fine, convener—the caffeine was very helpful.

I will move to the issue of agriculture. As we know, the Climate Change Committee has suggested a sustainable and balanced pathway to net zero. You have been clear that there are other routes that could be taken, but that that balanced pathway still has to be secured.

The Scottish Government has not taken up the cudgels in relation to the policy to reduce livestock numbers—it is looking for another solution in that regard. Can you talk about what the implications of that Scottish Government decision might be for emissions reductions in the agricultural sector and beyond?

Dr Devane: I will come in on that. Agriculture is currently the second-highest emitting sector in the Scottish economy, and our pathway predicts that, within a few years, as surface transport emissions fall, it will become the highest-emitting sector, so this is clearly an important area. By 2045, it will make up quite a considerable share of the residual emissions in Scotland, so it is important to bear down on those emissions as much as is feasibly possible.

In our pathway, agriculture emissions fall by about a third by 2035 and by about 40 per cent by 2045. Importantly—this is a new feature of our analysis—we have looked at agriculture and the land-use sector together, and we believe that, taken together, those two sectors can reach net zero, which means that there would be a net zero contribution to emissions from the land sectors in respect of the overall Scottish net zero target.

Some 64 per cent of emissions in agriculture come from livestock, and the Scottish Government has said that it wants to take a different approach to livestock number reduction from the one that we modelled. In our pathway, we look first of all at measures that can be achieved without reducing livestock numbers, which would deliver about half of the emissions reduction in agriculture that we expect to see. However, the other half of the emissions reduction involves a roughly 26 per cent reduction in livestock numbers by 2035 and a 36 per cent reduction by 2045. If you were not to deliver those reductions, that would add about a megatonne—1 million tonnes—of emissions to the Scottish emissions pathway compared with what

we have published. I note that, by 2035, we see the agricultural emissions pathway as being around 5 million tonnes, which is an increase in the sector's emissions of about 20 per cent. Even accounting for the fact that some additional reductions will be delivered through the use of things such as feed additives, if you have larger herd sizes than we have modelled, your emissions will still be higher and, in addition, you would lose some of the land that our modelling assumes is freed up for things such as peatland restoration and tree planting, which would have a knock-on impact on emissions that would go beyond that 1 million tonnes, but we have not quantified that.

Essentially, all of that would leave a gap that would need to be filled. Our report sets out a range of contingency measures that could be applied on top of what is in our pathway. Many of them are in sectors other than agriculture, but there is one in agriculture that looks at the potential additional application of feed additives beyond what we have modelled. Obviously, there are quite big uncertainties around the wider environmental impacts of some of those additives, which is why the specific ones that we have used in our contingency measures are not in our balanced pathway, but there is possibly potential for Scotland, with its large agriculture sector, to pioneer some of those types of approaches and go beyond what we have modelled. However, of course, it is for the Scottish Government to decide exactly how it wants to deliver the emissions reduction to meet carbon budgets, and we look forward to seeing what it sets out in the climate change plan.

11:00

Bob Doris: That is helpful. You have touched on some other aspects that I want to ask about, particularly in relation to peatlands. I might come back to the point about contingencies at the end. The Scottish Government has spoken about not following advice on peatland restoration, as I think you were referring to, Dr Devane. It has said that it will set ambitions

"at a realistic level supported by measures to increase delivery capacity".

Do you have an idea of what that might mean in practice? The issue is what the implications would be of not following the advice set out by the Climate Change Committee. I suspect that you might be talking about contingencies, but perhaps we could deal with that at the end. The Scottish Government is doing a number of things where it may have to rely on other contingencies to get to a balanced pathway.

Dr Devane: Let us talk about peatlands. The restoration or re-wetting of peatlands is the biggest driver of land-use emissions reduction in our pathway. We have modelled an increase from about 29 per cent of peat being under restoration or management today to about 45 per cent by 2035 and 67 per cent by 2045. We are supportive of ensuring that whatever is in the plan is realistic and deliverable. Our modelling has tried to take that into account by starting in line with the present levels of restoration activity.

In 2024 and 2025, restoration activity took place on about 15,000 hectares, which is the highest level on record. That is good news, in that we have seen an increase. Our pathway average is about 20,000 hectares per year out to 2030, reaching a maximum of 36,000 hectares, which continues that growth. It is perhaps noteworthy that our pathway is below the ambition of 250,000 hectares by 2030, which the Scottish Government set out in the 2018 climate change plan. We look forward to seeing the revised ambition that is set out in the upcoming climate change plan.

Bob Doris: That is a reasonable answer. You have hinted at land use in relation to not reducing livestock numbers. Perhaps you could say a little bit more about that. If we are not reducing the headcount of livestock, will that have a negative impact on the available land for reforesting and woodlands and so on? If we keep the headage of the dairy and red meat sectors as it is now, what might the knock-on effect be?

Dr Devane: That is right. Referring to how our analysis works, we commissioned experts in the sector to consider the land that is available across Scotland and the types of land that could be freed up by reducing herd sizes. Our modelling works by looking at the types of land that are currently being used for livestock and at the types and areas of land that could be freed up, and it then considers an appropriate alternative use to provide emissions reductions and to provide wider social benefits and benefits to climate resilience on farms and so on. If there were no reductions in herd sizes, there would be a knock-on impact from not as much land being available for the alternative actions. That would have an impact on the available carbon savings that could be delivered through the land use sector, and it would have an impact on the available wider benefits that could be delivered through the land use sector.

Bob Doris: Could you clarify something a little bit? Are we effectively saying that the strategy of the Climate Change Committee would have been to use the land that is being used by cattle and livestock today for other purposes to help meet our net zero targets, but that that land will now no longer be available? Can you quantify the amount of land that would have to become mixed use? How would we square that circle? I know that that is for the Scottish Government to set out, rather

than for you, but do you have any thoughts in relation to that?

Dr Devane: I do not think that we have a Scotland-specific number. Across the UK, about 14 per cent of agricultural land is being taken out of agricultural production and used for things such as tree planting and restoration of peatlands. We want to see policy that provides farmers with the right incentives to diversify their income. We see that as potentially a benefit to the farming community if it is done right, by providing wider social benefits but also making farmers' income streams more resilient and diversified across actions such as tree planting, peatland restoration and renewable energy on farms, alongside continued farming.

As I mentioned, we have looked at the combined agriculture and land-use sector's ability to get to a net zero contribution to the overall net zero target. In a way, our analysis shows that use of the land for things such as tree planting can allow a sustainable continuation of livestock farming, alongside those other land-use measures.

Bob Doris: I will move on to my second-last question—I want to come back to contingencies after this, convener.

There is a suggestion in my notes that the Climate Change Committee wants to see reduced demand for meat and some dietary change. I would always encourage people to use locally sourced meat with high welfare standards and to buy Scottish, but there will be imports in the meat sector. What contribution could reducing or eliminating the imports make to our net zero ambitions? Could that offset some of the requirements to reduce livestock numbers that have been suggested by the Climate Change Committee?

Dr Devane: Part of the reason why we assume a dietary change is to avoid reductions in domestic production of meat being offset by increases in imports. In our modelling, we maintain the self-sufficiency ratio: the proportion of meat that is produced locally versus the proportion that is imported. We have also said that there might be a case for trade policy to consider how to avoid an increase in higher-emissions imports, if that becomes a risk.

On dietary change, you are right that we make the assumption that, by 2045, there will be about a 30 per cent reduction in meat consumption. That builds on existing trends across the UK: we have seen about a 9 per cent reduction between 2002 and 2019—that is the long-term trend. More recently, over the three years between 2020 and 2022, we have seen a further 10 per cent reduction.

Our modelling does not assume that that trend will be sustained, because part of it might well be cost of living related. However, that shows that, historically, there have been trends towards lower meat consumption in the long and short term, which we expect will continue and can be built on. There are obviously wider health and wellbeing benefits from a more balanced diet. The Dimbleby report recommended a higher reduction in meat consumption by the early 2030s than we assume, which was for health benefits and not just carbon benefits.

Bob Doris: I have a final question on contingencies. I will not explore the health benefits—we will leave that sitting for the moment.

On carbon budgets and reaching net zero, it is for the Scottish Government to say what its alternative route looks like in relation to peatland and livestock numbers, but you have mentioned contingencies. Will you say a little more about the extent of those contingencies that would have to be exercised to bring the Scottish Government's policies—such as they are likely to be when the climate change plan is ultimately published—back into line for the balanced pathway to net zero?

Dr Devane: You are right that it is for the Scottish Government to decide the balance of measures, and we are very comfortable with that approach. Our pathway sets out that the targets are achievable and credible, but the exact balance of measures is rightly for the Government and Parliament to debate and decide.

We have talked about specific contingencies that might be particularly relevant to Scotland, building on the modelling that we did for our UK advice. The first of those, which was mentioned earlier, is to go further on car kilometre reduction. Based on the evidence from across Europe, we believe that there might be scope to take the 6 per cent reduction up to about 8 per cent. We have also talked about potential scrappage schemes, on both the vehicle side and the heating side. Those are not in our core pathway, but they could be options to go further.

It is worth noting that our modelling of technology uptake assumes reaching 100 per cent low-carbon technologies by 2050 rather than 2045. The Scottish Government has the opportunity to push, for example, to get the transition to heat pumps completed slightly earlier, which would give higher emissions reductions.

In the indicative statement, the Scottish Government has also talked about tree planting as an option to go further, as well as engineered removals. We saw a very good year for tree planting in 2023-24, in which planting rates increased quite a lot, but then they dropped back again with budgets being cut. I think that there is

cause for hope with that, but consistent, long-term confidence in funding is needed if that is to take place.

Bob Doris: That is very helpful—thank you. I have no further questions.

The Convener: Mark Ruskell has some questions.

Mark Ruskell: I am interested in your thoughts on how the market is changing, in particular for livestock. I talk to farmers and estate owners who are actively selling on to natural capital companies, pension funds and others who have ambitions for woodland creation, commercial forestry, peatland restoration and renewables.

I am not sure whether you will want to comment on this, but the Government probably has a political difficulty in providing a target for livestock reduction. To what extent is it implicit in the way that the market is going that there will be a livestock reduction anyway because, although it is still early days for them, the market in woodland creation and natural capital is clearly going to grow over time? Is there a bit of smoke and mirrors involved in the Government saying, "We are not going to reduce livestock numbers", while the reduction is implicit in everything else—it will happen anyway? It feels a bit like what you said about diet. Nobody wants to call it and say, "We are going to be eating less meat", because that might sound extreme, but it is happening anyway.

I just wonder about transparency and how the role of markets and the trends relate to livestock. Are we afraid of calling something that is happening anyway?

Dr Devane: The way that we frame that issue in our advice is twofold. First, we think that farmers and land managers need to be appropriately incentivised to—[*Interruption*.] Sorry, I am not sure whether my connection is cutting out. Can you still hear me?

The Convener: It is cutting out a bit. Will you start that answer again? It was a bit juddery.

Dr Devane: I will start again.

The Convener: We have got you now.

Dr Devane: The way that we frame that issue in our advice is twofold. First, we think that farmers and land managers need to be incentivised to diversify their income streams to a wider range of activities than just livestock farming. We have spoken to the Nation Farmers Union and other farming groups throughout the process of producing our advice, and I think that you are right about a lot of what is happening already. Farmers recognise the benefits that taking alternative action on some of their land can bring to their land.

A second aspect is what we set out on dietary change. We do not say that we will tell people what to do or anything like that. What we are saying, and what came out clearly from our citizens panel work, is that people want to have choices available and they want those choices to be affordable and attractive in terms of taste, texture and quality. If those conditions are in place, people are quite willing to make alternative dietary choices. We want those conditions to be put in place, with alternatives to meat being widely available in supermarkets, including in ready meals et cetera, so that people have that choice.

11:15

The Convener: I have a couple of questions. One of my concerns is that, in Scotland, herd reduction has been going on apace for many years. Numbers have been decreasing naturally, as Mark Ruskell suggested. The problem is that reducing livestock numbers will undoubtedly affect small-scale producers, who will feel that it is no longer possible for them to continue farming if the returns from their animals are reduced because they are asked to keep fewer of them. In my opinion, it will disadvantage small-scale producers.

I support the Government making some moves to reduce the calving interval, but farmers as a whole have increased maternal traits of their cows, which means that less is driven by bags. There is also earlier finishing. Most farmers can produce an animal for the table in 11 months, but they are not allowed to sell it as Scotch beef until it is 12 months old. They are forced to keep it for another month until it becomes Scotch beef, in effect, which seems bizarre to me.

Farmers have also driven with less intervention and they have followed the old principles of Turnip Townshend. Eoin, I am sure that you have looked back at those. They are about crop rotation and making sure that mixed farming is going on. That is what we should be driving towards, rather than, say, putting trees in pastures, which to my mind comes with problems regarding flies. That causes problems with all the cows and livestock that are there.

Do you not think that having a more integrated and clever farming system, with mixed farming at the core of farming in Scotland, would be a better approach than just having a blanket reduction in livestock numbers?

Dr Devane: There is absolutely a role for more efficient use of the land, and some of the things that you mention are within the first half of the emissions reduction that I talked about earlier, in relation to keeping livestock more efficiently. We include a role for agroforestry and the planting of trees in mixed spaces with continued livestock

farming, which has value in our pathway alongside woodland creation.

I would push back on the description of what we are assuming as a "blanket reduction" in livestock numbers, because ultimately what we think is needed is a means that will give farmers choices to take actions that benefit their farms and their income streams. In our UK analysis, we looked at the options for policies and the impacts that they could have on farmers' returns on the land. That showed that, for many farmers, policies could be designed that would mean that they would take more profit, essentially, from the land through a mixed approach, with some land being taken out of livestock production but some land maybe being used for tree planting or renewables or being in mixed use.

The Convener: Okay. I have concerns about the principle because I do not think that it is detailed enough. To my mind, it is too blanket and it will drive smaller farmers out of the market because it will incentivise bigger farmers who can spread their costs across more livestock over a larger area. Does that not concern you? It obviously concerns the Scottish Government.

Dr Devane: We are keen to see this delivered in a way that supports rural communities and protects them as far as possible. We would definitely recommend and support consideration of small enterprises and smallholding farmers as part of the design of policy.

The Convener: I could get too involved in this, so I will move to Kevin Stewart for the next question.

Kevin Stewart: I will move on to carbon capture. You assert that

"Scotland has natural advantages which favour development of engineered removals".

Will you say a bit more about those advantages and why the Acorn carbon capture project is on a later timescale than CCS projects in England? Scotland can do more, but the priority for engineered removals seems to be resting with the UK under the current Labour Government when it comes to investment.

Dr Richardson: There are essentially two key advantages in Scotland. One is access to storage sites, a lot of which are off the coast of Scotland, and the other is the very large availability of renewable energy. Engineered removal is a very energy-intensive process, in particular for direct air capture. Having those large sources of low carbon electricity in Scotland makes it a suitable place where that energy can be used for direct air capture instead of the energy having to be shipped out. We think that Scotland is well located geologically and from an inputs perspective. You are right that this is dependent on the development of carbon capture and storage technology—it needs those pipelines and stores to be developed.

As you say, the Acorn project is currently in tranche 2. We were encouraged to see that development funding has been made available for tranche 2 in the UK government's recent spending review. However, that still puts it behind tranche 1. We hope to see that move forward rapidly. Obviously, there will always be somebody who is first and somebody who is second, but the person in second does not have to be very far behind.

This will be the key question: can tranche 2 be pushed forward at a rapid pace? In our modelling, it is available from 2030, and we still hope to see that. That is technically feasible and it would enable direct air capture and wider uses of carbon capture in Scotland pretty rapidly.

Kevin Stewart: Scotland has been an afterthought for the UK Government when it comes to carbon capture investment, and yet, Scotland has the advantages, as you have rightly pointed out. In relation to our industrial future, are a carbon capture plan and Acorn required to ensure that Scotland continues to have an industrial base? Does the lack of investment thus far compared with the investment south of the border put us at a severe disadvantage?

Dr Richardson: I would not say that it is a severe disadvantage, but carbon capture and storage plays a role in industrial decarbonisation. However, by quite a long way, the largest role in industrial decarbonisation is played by electrification. We think that a lot can be done in Scotland through electrification. The largest part of that is using electric steam crackers at the ethylene plants, but it is also something that can be used in, say, Scotland's extremely successful whisky industry. Electricity can be used to produce the heat and steam that is needed across food and drink production and to remove fossil fuels from industries such as that.

Carbon capture and storage is used in industry only in cases where there is not an electric option. That mostly concerns what are called process emissions—that is, emissions that are not due to burning fossil fuels but to chemical processes. Parts of the chemicals industry and, in particular, the cement industry produce carbon dioxide as a chemical by-product. For those, we see CCS as being essential.

That is a relatively small part of Scotland's overall industrial decarbonisation, but CCS needs to be there for those industries. Electricity would be the place to start with decarbonisation of your industrial sector.

Kevin Stewart: You talked about Scotland's advantages when it comes to carbon capture. Did the UK Government, when it was formulating its investment plans, ask for your thoughts on carbon capture and where investment should go, or did it just go ahead and do its own thing, leaving Scotland as an afterthought again?

Dr Richardson: On the decision on which projects went into tranche 1 or tranche 2, that was taken before my time at the Climate Change Committee, so I do not know whether those discussions were—[*Inaudible*.]

On the recent spending review, we discussed our views with the UK Government on carbon capture and many other technologies, so it was certainly well aware of our views on those issues. Of course, prior to the spending review, we published our advice in the "Seventh Carbon Budget". We also published "Scotland's Carbon Budgets", although that was only shortly before the review. However, as I said, I cannot comment on the specific tranche 1 versus tranche 2 decision.

Kevin Stewart: Did you highlight that Scotland was in a prime position for carbon capture projects?

Dr Richardson: Yes. That is clearly stated in our advice, and we have made the point to the UK Government on the importance of not just tranche 1 but tranche 2 for carbon capture and storage.

Kevin Stewart: Thank you very much, Dr Richardson.

The Convener: I think that Douglas Lumsden wants to come in on that issue before I move on to Mark Ruskell.

Douglas Lumsden: Yes—thank you, convener. What is the importance of the Acorn project in helping us to reach net zero? What percentage will it account for? What amount of carbon emissions can it remove in helping us to meet our carbon budget targets?

Dr Richardson: It is a relatively small proportion of the overall reduction in emissions. What is important about it is that it is an essential part of some things that are essential for getting to net zero. It is not that it is a large part of the overall emissions reduction. Broadly speaking, electricity and electrification make up about half of emissions reduction; everything else makes up the other half, of which CCS provides a few percentage points. However, if you do not have CCS, you cannot do those engineered—[*Inaudible*.] If you do not have CCS, you cannot decarbonise the cement industry or parts of the chemicals industry. If Peterhead were to go ahead and convert to CCS, that CCS infrastructure would be in place.

It is one of those things that are relatively niche in terms of quantum, but it is an essential part of how you get to net zero. The nature of net zero is that you have got to do it all. Therefore, you must have the technologies that enable the most difficult thing.

Douglas Lumsden: I guess that it is net zero, not absolute zero.

I am just trying to understand what percentage we are talking about. Is it 1 per cent? Is it 5 per cent? What is the scale of our emissions that that project would remove?

Dr Richardson: We have that number—let me see whether I can find it.

Dr Devane: By 2045, engineered carbon removals will account for about 10 per cent of the total emissions reduction. On top of that, a small amount of CCS will be used in industry—I think that it will be about 16 per cent of the industry sector.

Douglas Lumsden: The Acorn project would not account for that 10 per cent. I am just trying to understand how big an impact not having Acorn would make. I do not want to be in a situation in which our Governments in Holyrood and in Westminster play a blame game about why we have not reached our targets. I can imagine that some people will say that that is because we have not made progress on the Acorn project. I am trying to understand whether we can blame that for not meeting our targets, which is why I am trying to understand how much carbon Acorn would remove.

Dr Devane: In the short term, by far the biggest reductions will come from electricity, as James Richardson has said. In the near term in the first and second carbon budgets, the quantum of it will be relatively niche. As you said, by 2045, we are aiming for net, not absolute, zero—the net in net zero is partly tree planting, but it is also partly engineered removals, for which you need the ability to capture and store carbon.

11:30

Douglas Lumsden: So, is it correct to say that, whether Acorn goes ahead or not will be irrelevant to meeting our targets over the next two budgets?

Dr Devane: It will have a very small role, but it will not be zero.

Mark Ruskell: The closure of the Grangemouth refinery was regrettable for jobs and perhaps was a failure of the operators to put in place a just transition that was led by workers up front. Given that that is now happening, have you factored it into your budget calculations? There are other industrial plants that may close as well. For

example, decisions may or may not be made about Peterhead, including the on-going continued operation of Peterhead 1 while Peterhead 2 is being built. What are you factoring into your budgets in terms of those proposed closures?

Dr Richardson: In response to your first question, yes, we do include the refinery closure. On broader industrial production, we assume that industrial output continues, so we do not assume plant closures, and we assume that plants are decarbonised. We do not model for this level of granularity but, of course, there might be periods during which plants are temporarily closed as they get upgraded. Our modelling is not able to look at that, but things may have to be taken offline to replace technology. In some cases, there may be a build in parallel before things are be switched over, so you might see those kinds of effects. We do not assume industrial plant closures.

Of course, those are international markets and decisions will be made. As you say, it is very important that there is a just transition and that all stakeholders are involved in it. However, I think that there is a fundamental difference between an oil refinery and other economic activities in industrial clusters. The demand for petroleum will fall because electric vehicles are cheaper than the internal combustion engine, which is essentially an obsolete technology, so it was always inevitable that there would be a reduction in refinery output. As you say, the challenge here is the failure to plan for that and plan—[*Inaudible*.] That is not true of things such as ethylene production or cement production. We will still need those things, so there is no reason from a net zero perspective as to why that output should reduce. We need to find a way of continuing those economic activities that is consistent with our net zero targets, which is about changing the technologies that we use to deliver those products. There is no fundamental reason why there should be a reduction in demand for them.

Of course, providers will have to remain internationally competitive: things such as carbon border adjustment mechanisms can play a role in that. It will be important that all stakeholders are involved in those kinds of decisions, but it is not as though those other industrial activities have the same features as the refinery sector.

Mark Ruskell: In essence, would you see investment in net zero policies increasing the competitiveness of sectors such as ethylene or cement, which you see as having a long-term role in Scotland, or do you think that there are risks in going too fast?

Dr Richardson: I think that both of those things are potentially true. There are risks in getting ahead of the market for low-carbon products, which is why it is important that the Government engages with the providers and thinks carefully about policies such as carbon border adjustment mechanisms that can protect companies and decarbonise what they are designed for.

The trend will clearly be for people to purchase low-carbon goods and there is no long-term future in producing high-carbon goods in an economy such as Scotland's. Scotland is a producer of high-quality, high-value products and that will mean low carbon in the future. The markets to which we sell, both domestically and internationally—particularly in Europe, which is by far our biggest trading partner—will charge for high-carbon goods and there will be a premium for low-carbon goods. That is the economic future for Scottish manufacturing.

Mark Ruskell: We will be future proofing entry into those markets.

Dr Richardson: Yes.

Monica Lennon: I will turn to the issue of waste. It is the eighth highest-emitting sector in Scotland, so we know that we have a lot to do in reducing waste and becoming a more circular economy. My question is about the infrastructure for energy from waste. Scotland has a moratorium on that, but energy production from waste emissions continues to increase and new plants are in the pipeline and have planning consent, although they have not yet been built. It would be helpful to clarify the assumptions that the Climate Change Committee has made about Scotland's total capacity for energy from waste and the implications that that might have for Scotland.

Dr Richardson: There are two aspects to that. I may have to get more detailed numbers from colleagues, but I can certainly talk you through the overall position.

The first part is that we want to remove from the waste stream any items that can be recycled. Our modelling assumes an increase in recycling rates across all nations of the United Kingdom, which will reduce carbon emissions, particularly from fossil products such as plastics, which are burned and release fossil CO_2 into the atmosphere.

The second part is that the residual waste that still ends up in energy from waste plants will mean that those plants will have to be fitted with carbon capture and storage technology, which takes me back to the point that I made earlier about Acorn. If you have biological carbon, you get a negative emission from that. There will always be a certain amount of end-of-life bio waste. If you put that into an energy from waste plant with CCS, that biological carbon ends up being permanently stored, which is a net removal from the atmosphere.

We think that it is important that all the remaining energy from waste plants are connected to CCS infrastructure. That has implications for siting, because the CCS infrastructure will predominantly be concentrated around industrial clusters. You can connect to those pipes, but you cannot easily connect across the whole country, so that suggests that you would probably want to have a smaller fleet of larger individual plants, connected to CCS near the pipelines. You would then have the ability to flexibly generate small amounts of electricity, which is helpful, and also to generate some negative emissions. So, some of the removals in our pathway will come from waste plants.

Monica Lennon: If we are to have significant progress, we need to see more work on waste reduction and a system change in embedding reuse and repair in our daily lives, our communities and our industries. Does the CCC have any advice for the Scottish Government about which measures will be needed to support our local authorities and the third sector to make that easier for people? We talk a lot about behaviour and about culture change, but how can we make that easier for people? What are the levers at UK level? We are in danger of giving the public mixed messages if we ramp up the infrastructure for energy from waste at a time when we are still struggling to do more recycling and to be more efficient with resources. Regarding bigger industries, is there anything that you can say about construction and about the vehicle and textile industries, which are some of the biggest emitters of waste?

Dr Richardson: The starting point would be to push up recycling, a lot of which involves simplicity of collection for households and small businesses, for example having standardised systems across Scotland so that people know what can be recycled and what cannot. Collecting as much as possible from the kerbside has been shown to be particularly effective at driving up recycling rates. I would suggest working with local authorities, which have a role and responsibility here. Target setting for individual local authorities has proved very effective in Wales, which has the highest recycling rate in the United Kingdom and one of the highest recycling rates in the Organisation for Economic Co-operation and Development. There are certainly things that you can do. I would advise the Scottish Government to talk to the Welsh Government—if it is not doing so already—which has been very successful at pushing those measures.

In other sectors, construction waste is a large volume of waste, most of which is inert. A lot of it is earth that we dig up and move, or existing rock of one sort or another, including concrete. It is not typically sent to energy from waste, it is not combustible and it does not typically lead to large amounts of emissions. Likewise, in the vehicle sector, there are a lot of embedded emissions in a car from steel production. Nearly all of the steel in cars is recycled, so it is important that we enable that. Some of those goods are relatively easy to recycle, but it is important that they are all properly collected.

One of the things that we are seeing in the UK as a whole is a move towards electric arc steel production, which makes use of scrap material. At the moment, we tend to export our scrap steel to other countries; in future, we should have demand for that domestically, so it should be possible to keep those kinds of products in circulation. However, it is important that the business sector also targets clear regimes for recycling.

There are also things such as moving energy from waste into the emissions trading scheme. It is important to push up the cost of alternatives to recycling, because we have to ensure that it is cost effective to recycle material. That is something that the UK Government has done that will help out.

Monica Lennon: We are up against the clock, but you mentioned Wales as a good example of recycling that the Scottish Government could learn from. Can you briefly touch on what in Wales is working well?

Dr Richardson: It is mostly the things that I have talked about, for example, standardised collection, increasing collection at the kerb, working closely with local authorities and setting targets for individual local authorities that reflect their circumstances. I think that those targets had financial penalties associated with them, although Wales has managed to avoid having to levy them by working closely with the authorities to drive up collection. Those things seem to have worked well in other countries with high recycling rates, such as Germany.

The Convener: I will come back to you later, Monica, for a further question.

In this evidence session, I have been trying to get an idea of the costs for individual households. The estimate—if I have got it right—is that this will cost the Scottish Government 0.4 per cent of GDP per annum for the next 25 years. Is that right? I suppose that it will be front loaded at the beginning.

In your submission, you suggest that that would amount to about £750 million a year. On top of that, there will be additional costs for every household if we are going to reach the target for installing heat pumps, and households might have to use their cars less or even replace them. Is it unreasonable to say that, based on the figures that you have produced and some of the figures

that we have heard today, the average cost per annum per household in Scotland to reach the target of net zero by 2045 might be £1,000 per household per year, every year, for the next 25 years?

11:45

Dr Richardson: I just want to correct one point: the £750 million figure is the same as the 0.4 per cent figure. It is not the cost to the Scottish Government—it is the total cost. If that is divided by the Scottish population, we will get the average cost, but that assumes that the costs are all incidental in the Scottish population. As I said at the beginning, that is true of housing or cars. Obviously the cost of decarbonising a house will fall to the person who owns it, or to the Scottish Government if it is not going to fall outside of the borders of Scotland.

However, that is not true of all the measures, particularly of engineered removals. In our model, those costs will certainly be borne by the polluters, and the polluters will be UK-wide. Scotland does have a disproportionate share of industry, but that does not mean that a disproportionate share of the costs will fall to people in Scotland. This is driven mostly by the aviation sector, actually, so the costs will fall to people across the United Kingdom who fly, rather than proportionately to the people of Scotland.

Therefore, I do not think that you can just take that figure and say, "That's the cost to a Scottish household." It is also certainly not true that the cost will be over and above that £750 million figure, which is the total cost that will be borne within the geographical boundaries of Scotland.

The Convener: James, I sort of heard that answer. I am struggling with your sound today.

Dr Richardson: I am sorry.

The Convener: Maybe it is because I have not quite got used to my new hearing aids. I am working on it.

If you are refuting my previous comment, I want to try to work out the cost to each household in Scotland of reaching net zero in every year between now and 2045. What is your estimated cost?

Dr Richardson: We have not made an estimate of that—we should probably take it away and see what we can do. As I said at the beginning of the meeting, a good deal depends on the Scottish Government policy decisions that we are still awaiting.

We have looked at a UK-wide comparison between 2025 and 2050; I know that that is different to the exact one that you have asked about, but it suggested that households would save an average of about £700 a year on the costs of motoring, and a further £700 a year on the cost of electricity and gas—that is, heating and existing appliances. However, they would have to bear an additional cost of about £700 a year to meet the higher cost of the heating system itself relative to the cost of their boiler.

Those figures come without policy intervention and without assuming support from the Government. Therefore, by 2050, we would expect that household to be up on the deal by around £700 a year, because of the greater efficiency of the technologies and allowing for the cost of the technology itself.

As I have said, that is a UK figure. It will be slightly different for Scotland, and I am not sure exactly how closely we can model the Scotland figure. Unfortunately, the models that we produce are not granular enough to produce a purely Scottish figure, which is one of the reasons why we have not been able to do that. However, we can have a look at those questions and see whether we can give you an order of magnitude.

The Convener: That would be helpful. People also know that installation costs come up front when their boiler breaks down, and they have to meet them all at once; as a result, they have to carry the interest. Politicians are asking people to sign up to policies, and individuals want to know the price of them. I would love to be in a position to say that I will be better off in 2050, but I suspect that I will not be around to benefit.

With that, we will now have a question from Mark Ruskell and then go to Monica Lennon.

Mark Ruskell: I am struck by just how important electrification is going to be in all areas of our lives. Beyond the important UK Government decision on electricity market reform, decoupling gas from the electricity price and allowing CFDs—especially the new CFDs that you have outlined this morning—to reduce costs over time, what can householders do? How can they be supported to reduce their electricity costs?

At the moment, the market is providing low-cost tariffs. For example, under EV tariffs, people pay 8p or 8.5p per kilowatt at night, typically, as opposed to 25p to 30p per kilowatt during the day. What supplementary measures can the Government take to support people? Battery storage in the home would enable people to shift a great proportion of their electricity consumption to the night time and, as a result, they could benefit by signing up for those far cheaper rates.

I do not know what the picture should look like for householders and consumers, but, beyond the big question of electricity market reform, which householders are not able to influence, what

measures can people take in their homes? What should the Government be doing to support them on that journey?

Dr Richardson: There are big opportunities in relation to flexibility, as you have said, because the price of electricity varies through the day. In the wholesale market, it is much more expensive at peak time—that reflects the underlying reliance on more expensive plants at that time—and much cheaper at night.

One of the advantages of the transition is that a lot of the additional demand that comes on to the system is flexible. For most people, charging an electric vehicle overnight makes a lot more sense than charging it at peak times. It is much cheaper for people to do that if they are on one of those variable tariffs. Most people drive around 20 miles a day, while people in rural areas mostly drive less than 30 miles a day. A typical electric vehicle might have a range of 200 to 300 miles, so most people have plenty of flexibility in relation to when they charge, which means that they can charge on cheaper rates.

In addition, it is possible for a considerable number of households—although, I stress, not all—to use heat pumps flexibly. Essentially, they can store heat in the house by heating the house a bit before peak time and then turning the heating down—as opposed to turning it off—during the peak period. Heat pumps work very well in that respect, making it possible for people to avoid the peak.

You also mentioned batteries. I have a battery in my loft that allows me to store energy, and I combine that with solar panels. The use of solar panels might be less economically efficient in some parts of Scotland, but it is viable in some areas. These days, solar panels—especially on new builds—are extremely cheap.

There are a number of things that households can do. Such measures will not suit every household—not everybody will want to be on variable tariffs—but the transition presents opportunities for many households to buy their electricity at the times when it is inherently cheaper.

I should say that that also reduces the need to build a certain amount of assets, which will almost certainly reduce bills for everyone else. The exact workings of the market are complex, but if we need to build fewer transmission and distribution assets because people are using their electricity more efficiently, there will probably be a saving for people who do not make use of such measures, even if the biggest saving will be made by those who do.

Mark Ruskell: Do you think that those variable, far cheaper electricity prices will be a fixed feature for consumers and householders? Can consumers and businesses that supply technology such as night-time battery storage be certain that it will always be possible to buy cheaper electricity at certain times and thereby save on bills?

Dr Richardson: I think that they can be. It is pretty much an inevitable feature of the market that we want to have such flexibility. It is very valuable to the system, so incentivising it through such tariffs is a very economically sensible thing to do.

Of course, we have always had that in the wholesale market; what is new is that such tariffs are now becoming available to households. We used to have economy 7, which, as people of my generation will remember, was a very simple way of offering a cheaper tariff. What is being developed is a more modern, digital version of that idea.

Local authorities and the Scottish Government can help people understand such things, because it is all quite complicated for people who are not familiar with them. It is good to have trusted voices explaining what is available out there and why that might be good for people.

The Convener: The final question comes from Monica—over to you.

Monica Lennon: Next week, our committee will be hearing from witnesses on the latest climate science and on climate impacts in Scotland. Today, we have been addressing Scotland's emissions, but it would be helpful to hear from you briefly about where we are globally on emissions reductions and whether Scotland should be preparing for greater levels of climate change than we might have been expecting a few years ago.

Dr Richardson: That is obviously a very important point. We have talked about the costs of getting to net zero, but the costs of not achieving it are, of course, much higher. Some of those costs, unfortunately, have to be borne regardless, so it is important for Scotland to adapt. We have already seen storms, heat waves and so on becoming more intense, but it is clear that every effort that we make to get to net zero sooner reduces those damage costs.

To be honest, the international picture is quite mixed. Obviously, we have seen the United States take backward steps. Conversely, we have seen over the past nine months or so Chinese emissions start to fall, which could be a very big development if it is maintained. It is a little early to say whether that is a real trend, but there is nothing to suggest that it is a blip. It is not that the Chinese economy has gone into reverse or anything—the situation seems to have been driven by a massive uptake of renewable electricity. China is putting in more renewables than the rest

of the world, and there is a very high uptake of electric vehicles. China's share of electric vehicle sales is somewhat higher than the UK's, and the UK is doing reasonably well.

We see very encouraging signs in some markets, but global emissions are continuing to rise. We are not at the peak yet, which is very challenging. It is also important to take action on adaptation, and in doing so, to design for the climate change that is now inevitable and to plan for what would happen in a world much worse than this one. We think of it as building for two degrees and planning for four. That is the simple way of expressing it—it is all about knowing what you could do in a more extreme world.

There is only so much, of course, that anyone can do in that more extreme world, because many of those damages will become inevitable. However, if you are building, say, flood protection, you could be thinking about how you might build it higher in future if you had to. You could design it in such a way that the foundations could take a greater weight in future, if they had to.

It is important to think about such things. Certainly, we are not yet seeing the global decline in emissions that we need to happen very rapidly, but we are seeing a big uptake of the technologies that could provide that. There is good news amidst the bad.

Monica Lennon: I want to ask a final question, if I may. I am aware that some political actors would probably rename this committee the Net Stupid Zero Committee, which I would strongly resist. On a serious point, though, there has been a change in mood in how we discuss climate and net zero issues. What is the best advice that you could give politicians and Governments who are faced with these challenges on how we can continue to develop evidence-based policy and action to counter some of the political slogans that have developed?

12:00

Dr Richardson: I cannot give you advice on the politics of it, but in terms of communication, the starting point is that the science here is real. The climate does not care what people say—it obeys the laws of physics, not the laws of man. Sooner or later, therefore, action to achieve net zero is inevitable, because the costs of not doing so will simply become overwhelming. The climate cannot be fought. The starting point always has to be the science, and the science is unambiguous.

It is important to get across to households that there is an opportunity here. We are rapidly getting to the point where it will be cheaper to buy electric cars, which are much cheaper to run and maintain and are much easier vehicles to drive. There are big benefits from that. Heat pumps do come with up-front costs, and it is important that there is Government support in that respect; however, they are also cheaper to run—considerably so, if we can get electricity pricing right—and they do not emit pollutants into the home where children are playing.

Those technologies have big advantages and also bring job opportunities. There are opportunities in installing heat pumps and particularly in renewable electricity, particularly within Scotland and in technologies such as carbon capture and storage. There are lots of very important positives.

Essentially, we are replacing a series of obsolete technologies with better, more efficient, cleaner and—certainly in the long run—cheaper technologies, and we ought to be able to have a conversation with households about those things. People understand that the old is replaced by the new and that there will sometimes be a cost to doing that, but that there are benefits, too. I think people also understand that we must pass a habitable planet on to our children.

Monica Lennon: On that hopeful note, I will hand back to the convener.

The Convener: I thank both witnesses for their very interesting evidence today, and I would encourage them to follow up on the issues on which they said that they would get back to the committee. They should know that the clerks will be in contact to remind them what those issues are, so that information can be circulated to members.

We will now move into private session.

12:01

Meeting continued in private until 12:32.

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