OFFICIAL REPORT
AITHISG OIFIGEIL

# Economy, Energy and Fair Work Committee

**Tuesday 17 December 2019**

Session 5

The Scottish Parliament
Pàrlamaid na h-Alba

# Tuesday 17 December 2019

## CONTENTS



## ECONOMY, ENERGY AND FAIR WORK COMMITTEE
**36th Meeting 2019, Session 5**

**CONVENER**

*Gordon Lindhurst (Lothian) (Con)

**DEPUTY CONVENER**

*Willie Coffey (Kilmarnock and Irvine Valley) (SNP)

**COMMITTEE MEMBERS**

*Jackie Baillie (Dumbarton) (Lab)
*Colin Beattie (Midlothian North and Musselburgh) (SNP)
*Jamie Halcro Johnston (Highlands and Islands) (Con)
Dean Lockhart (Mid Scotland and Fife) (Con)
*Richard Lyle (Uddingston and Bellshill) (SNP)
*Gordon MacDonald (Edinburgh Pentlands) (SNP)
*Andy Wightman (Lothian) (Green)

*attended

**THE FOLLOWING ALSO PARTICIPATED:**

Professor Gareth Harrison (Royal Society of Edinburgh)
Professor Gavin Little (Royal Society of Edinburgh)
Professor Rebecca Lunn (Royal Society of Edinburgh)
Professor John Underhill (Royal Society of Edinburgh)

**CLERK TO THE COMMITTEE**

Alison Walker

**LOCATION**

The David Livingstone Room (CR6)

# Scottish Parliament

## Economy, Energy and Fair Work Committee

*Tuesday 17 December 2019*

*[The Convener opened the meeting at 10:00]*

## Decision on Taking Business in Private

**The Convener (Gordon Lindhurst):** Good morning, and welcome to the 36th meeting in 2019 of the Economy, Energy and Fair Work Committee. I have apologies from committee member Dean Lockhart.

The first item on the agenda is to decide whether to take items 3 and 4 in private. Do members agree to do so?

**Members** *indicated agreement.*

## Energy Inquiry

10:00

**The Convener:** The second item on the agenda is our energy inquiry. Today, we have a panel of members of the Royal Society of Edinburgh's energy inquiry committee. I welcome Professor Gareth Harrison, Professor Rebecca Lunn, who is deputy chair of that committee, Professor John Underhill and Professor Gavin Little. I understand that Professor Lunn has an opening statement.

**Professor Rebecca Lunn (Royal Society of Edinburgh):** Good morning, everybody, and thank you for inviting us.

The Royal Society of Edinburgh's energy inquiry report took slightly over a year to produce. We took evidence from a wide range of people, and we had public meetings as well as meetings with the industry and the Scottish Government. I will give a brief summary of the findings.

I will start with a realistic reminder of the scale of the problem. With regard to the carbon targets, the Scottish Government is committed to reducing carbon emissions by 42 per cent by 2020 and by 80 per cent by 2050. Probably its most famous target now is to be net zero carbon by 2045. Although the report is partly about meeting energy needs, it has that target very much in mind, together with the challenges as we move forward to try to meet it.

The data at the moment shows that 78 per cent of Scottish energy consumption is in transport and heat. When people talk about energy, they think mostly about electricity, but the 2017 Scottish Government data shows that 78 per cent of consumption is in transport and heat. Members will be well aware that, to address that issue for the carbon targets, there is a move towards the electrification of cars and heating.

Renewable generation has steadily increased as a percentage of electricity consumption, and Scotland is ahead of the game, with more than 60 per cent of electricity generation now in renewables. Low-carbon generation in Scotland is much higher because of its two nuclear power stations. Around 80 per cent of the generating capacity in Scotland is low carbon. However, those nuclear stations are due to go offline.

If we look at energy as a whole, which is what we are interested in to realistically meet the net zero carbon target and in order to provide Scotland with energy, we see that only 17.8 per cent of Scottish energy consumption is provided by renewables—that is Scottish Government data. Around 80 per cent of consumption remains fossil-fuel based. That is a very large percentage of

energy that will need to be replaced either with alternatives or by capturing the carbon.

In the whole of the United Kingdom—much of the issue is not devolved—25 per cent of current consumption is what we would deem to be low carbon, as it is either nuclear or renewables energy. Turning that into something else is a really significant challenge.

The current plans for the UK are to replace the current nuclear fleet and possibly to grow it in capacity, but that is proving challenging. In Scotland, we are likely to lose low-carbon generation because the nuclear fleet is going offline.

If we electrify everything and do not keep gas from fossil fuels as part of our heating or transport systems, we will face a situation in which we need to double or maybe treble electricity production. We are looking at a very significant increase in electricity generation set against a backdrop of 80 per cent of our energy consumption coming from fossil fuels at the moment. Therefore, we would have to substantially increase production if that is the way that we go.

One of the things that came out of our report was that there are no easy answers to the problem. There are some possibilities. In the report, we went through each of the different technologies and looked at whether they are costly, low carbon and require carbon capture and storage, for example. We also looked at the timelines, because some of the technologies are still in a research or development stage.

On the things that can be done, we can certainly reduce demand. That will involve making more energy-efficient infrastructure and housing and maybe having smart grids in order to use the amount of electricity that we have more efficiently. Increasing our energy storage would also allow us to use energy more efficiently. However, none of those measures will generate anywhere near enough to meet the gap that we will have.

With regard to other options, there has been a lot of discussion about hydrogen and switching our natural gas network to using it. That is fine and it is discussed in our report, but it requires CCS at source to work. Currently, the only way to produce a sufficient amount of hydrogen in a reasonably energy-efficient and low-cost manner is by cracking methane. However, if we crack methane, we create carbon dioxide, which means that we would need to have CCS at source and pump hydrogen round the gas network. That is a technological challenge in itself in terms of converting things, and it would require domestic boilers and some industry infrastructure to be replaced.

Another option is nuclear energy. I appreciate that the Scottish Government has said no to nuclear, but that is based on current technologies, so future nuclear technologies might also be an option.

Increasing renewable energy is an option. Two of the key technologies, which we looked at in the report, are offshore wind and geothermal and ground-source heat opportunities. There is the idea of putting in district heating networks. All of those will reduce demand to some extent. However, there would have to be a really significant—a multiple times—increase in renewable capacity to meet current needs purely with renewables, and I think that that is not feasible at the moment.

The report's key recommendations largely revolve around the fact that we did not feel that it was our place to make recommendations about exactly what technologies the Scottish Government should invest in, because there are multiple routes and, undoubtedly, a basket of options will be required, as there is a significant challenge ahead. The key recommendation is to establish under statute an expert advisory commission that would cover all aspects of energy, including policy, economic aspects and technology.

People not bringing the public with them is often one of the main things that hold up major infrastructure projects or even stop them completely. We can see that from some of the nuclear problems in the UK. Finance is also an issue for major projects. Therefore, the commission should cover all aspects of energy, including the problems with non-devolved energy matters.

I will not go through all the recommendations. However, if we do not produce more energy and we continue to consume energy at the rate at which we currently consume it or at a higher rate, Scotland will be left with extremely poor energy security, which would make us very vulnerable as a nation and would leave us in a poor position geopolitically. It is hard to apply moral pressure to states if we rely on them for energy production.

One of the key recommendations was to have "a clearly articulated position" on the security of supply that Scotland would feel comfortable with in the future.

There is a clear need to improve storage options. That is an easy win, and it can help us to use energy more efficiently and smartly.

Reducing demand should be a priority. It is the most obvious thing to do, but it is not easy. It will require investment. It needs to happen in industry by using things such as waste heat, as well as in buildings and infrastructure.

There is a clear requirement for investment in research and development. There are no straightforward technological solutions, so we will need R and D if we are to meet the targets by 2045. We also need a skilled workforce to go along with that, which means investing in skills.

Finally, there needs to be communication at all levels across Government. When we went to talk to the UK Government—not the Scottish Government—we found that we had to talk to different departments, that the department responsible for transport was not aware of energy policy, and that there was no joined-up thinking across the piece. It is difficult to achieve joined-up thinking across departments but, if we are to meet a challenge as large as this one, we need to think about that in all the decisions that are made.

That is a summary of our findings. We are happy to take questions.

**The Convener:** Thank you for your opening statement, Professor Lunn. It is very helpful in giving us some context and setting the framework for today.

You referred to many issues but, if I understood correctly, there are three initial issues: the production source of energy and whether it is renewable or environmentally friendly; the efficiency of the provision of that energy to the public, business and industry; and the consumption of energy and whether we can reduce that, given that, if there is a demand for something, people are prepared to produce it.

How important is the consumption issue? It is probably like most things in life. People are quite willing to say that they want to see a reduction in the consumption of energy and environmentally friendly approaches to energy, but what is the scale of public consumption of energy in Scotland and how does that relate to the practical willingness to reduce consumption? Perhaps that applies to all of us. How important is that in the scheme of things? I am happy for anyone to comment on that.

**Professor Lunn:** I will start. That is extremely important not least because, if we electrify vehicles, we are looking at doubling the need for electricity production. That is the direction that we are heading in. It is not at all obvious that the market can cope with following that without gas-fired power, which will not help us to meet our carbon target—unless we invest in CCS.

If we import energy, it is hard to see how we will import low-carbon energy, even if we install interconnectors, particularly as Europe is trying to hit the same set of targets that we are and is also gas reliant. In the end, if we do not want blackouts, the default will be to import carbon-based energy, which would give us an issue with the net zero carbon target. The more we can reduce demand, the more doable producing low-carbon electricity will be. However, the idea that the technology to allow production will just happen because we wish to consume the energy is unrealistic.

**The Convener:** Does anyone else want to comment on the issue of demand? If we have electric vehicles and everyone really likes them, people may start driving even more and therefore increase our energy requirements. What can be done on that?

**Professor Gavin Little (Royal Society of Edinburgh):** It is an important point. With the process that we have had to date in the energy sector and in relation to the low-carbon transition, we have primarily taken a top-down, technocratic approach. As we start to address heat and transport, the approach will involve a much greater cultural and social dimension, and we need to reflect as a society on how that will be addressed.

There is much more scope—or much more necessity, in fact—for political involvement in the process, because it is an inherently political process. That was one of the issues that lay behind the recommendation for a statutory commission, because there is a need to move beyond merely focusing on technocratic and engineering solutions to issues and start thinking about how we will organise ourselves as a society to address the cultural shifts that undoubtedly must occur.

10:15

**The Convener:** In your report, you look at public engagement and the engagement of those who are involved in the energy industry, and you have members who have expertise in those areas. Was the thinking behind that to try to start that process and that conversation, or to encourage it?

**Professor Little:** We were very much in listening mode in our meetings. I took part in a number of them and, as the Royal Society of Edinburgh, we were really interested in finding out how people felt and what they thought, rather than in trying to start a process of managing that.

**Professor Lunn:** In our report, we discuss the idea of having a more deliberative public consultation as part of some future commission. There is no reason why there could not be members of the public on that commission. There is without doubt a need to bring the public in.

**Professor Gareth Harrison (Royal Society of Edinburgh):** It is important that we do not lose sight of the fact that a lot of the solutions, certainly for reducing energy demand, are already here. One of the biggest issues is heating. The vast majority of buildings in Scotland are abysmally

insulated. One of the challenges is that better insulation would save most people money but the amount that they would save is not particularly large. It is partly about an undervaluing of energy, but it is partly because it is a pain in the neck to have a house insulated. However, insulation needs to be done, and one place where we could start is by making sure that new builds are properly insulated and that proper standards are enforced. We are not doing that.

**The Convener:** I think that the up-to-date standards for insulation in new builds in Scotland are quite advanced compared with the standards 10 years ago. Is that fair?

**Professor Harrison:** They undoubtedly are. They are certainly higher than the standards in England, and they need to be. However, the standards in Scotland are still quite low compared with Scandinavian standards. Scotland has a fairly similar climate to Denmark and southern Sweden, but heating bills there are relatively low compared with ours.

**The Convener:** You mentioned enforcement. What is the problem with that?

**Professor Harrison:** I believe that larger building companies are able to self-certify on some of the building standards. There are simply not enough building standards people in the councils. At present, someone who is trying to build an extension in Edinburgh is not waiting for planning permission; they are waiting six to nine months for the council to find somebody who can look at the building regulations. There are issues with capacity. If we really want to be serious about this, we must make sure that the bodies that are charged with doing that are able to do it.

**Jamie Halcro Johnston (Highlands and Islands) (Con):** I represent the Highlands and Islands, including the northern isles, Orkney and Shetland, where there are high levels of fuel poverty in places that can get pretty cold pretty quickly. Even in those communities, however, organisations that offer things such as free insulation in an effort to make houses warmer struggle to find people who will take it, or to get that message across. Why do you think that is? Is it partly because too many different organisations are offering that information and there is not a single concerted effort?

**Professor Lunn:** There is a notable lack of skills, or an insufficient number of skilled people to do the work. I cannot comment on Scotland, but I know that in the rest of the UK there have been a number of examples where work has been done extremely poorly and there have then been problems with new-build houses, such as their being damp because there is no proper ventilation. The issues around that are to do with the training and regulation of the workforce.

However, the issue is not just about that. In Scandinavia, district heating networks are standard in modern estates, which saves a significant amount of energy. Houses could be built to generate energy locally, and when we develop infrastructure, we should think about making it as energy neutral as possible, ensuring that it can generate energy as well as reducing demand.

**Jamie Halcro Johnston:** I think that the largest user of electricity in Scotland is Scottish Water. Is part of the issue that, when we build new properties, we should ensure that their water requirements are reduced? At present, all water is produced to the same standard, whether we drink it or wash our car with it. Is there a role to help, in particular, companies or organisations to reduce their usage?

**Professor Lunn:** Yes. I think that you are referring to grey water.

**Jamie Halcro Johnston:** Yes—thank you.

**Professor Lunn:** Only a small percentage of the water that a person uses in their house is required to be of drinking quality. It is less than 10 per cent. I cannot remember exactly what the percentage is, but it is small. However, we use drinking-quality water for everything. There is a high energy cost in purifying that water and treating everything afterwards. We could easily develop housing with two networks so that people could use the water from their washing machines and roofs to flush their toilets and all the rest of it. Grey water could be used for almost everything other than drinking.

**Jamie Halcro Johnston:** Is that issue being taken seriously enough?

**Professor Lunn:** Not at the moment. Scottish Water has funded a research project in which it is looking at whether rural communities in the Highlands and Islands can recover heat from waste water and use it as the power for waste water treatment. Part of what energy is used for in waste water treatment is to heat the water so that the bacteria work efficiently—it needs to be at 37 degrees, or something. We lose a lot of heat in waste water from houses, through washing machines and things. That heat could be harvested and then used locally for water treatment, for example. Scottish Water has a project that is looking at that, but it is at the R and D stage.

**Jamie Halcro Johnston:** Okay. Thank you.

**Willie Coffey (Kilmarnock and Irvine Valley) (SNP):** Professor Lunn, will you clarify a point that was made about consumption? Your report, which

I have in front of me, suggests that energy consumption in Scotland is dropping, with a consistent fall since 2007. However, I thought that I heard that it is going up.

**Professor Lunn:** That is Scottish Government data. Demand is dropping, but that will absolutely not be the case once we move to electric vehicles. At present, transport accounts for 25 per cent of total consumption, which is about the same as our current electricity consumption. They account for about 25 per cent each, basically. If we move all cars over to electricity, we will approximately double our electricity demand, depending on the efficiency of vehicles and how it compares with current oil and gas efficiency.

**Professor John Underhill (Royal Society of Edinburgh):** There are about 200,000 electric cars in the United Kingdom, but that is estimated to increase to 35 million by 2040. The current peak demand for electricity is 61GW. If we use those figures to project future demand, we could have an increase of between 5GW and 30GW, so we could need 50 per cent more electricity. That will put stress on the system, and everybody will want to plug in overnight. Where is the electricity going to come from? Will enough be available overnight, given the competition in that space? Is the grid competent and fit for purpose? Those are some of the demand issues that we face.

There are some unintended consequences, too. The raw materials for the batteries that are needed are things such as lithium, cobalt and nickel, and it will be extremely challenging to scale up the process of obtaining those resources. For example, there are only a few sites for the extraction of lithium, one of which is the lithium triangle in South America, and more water is needed to get the lithium out of the ground than is needed for hydraulic fracturing in the Permian basin in the western US. Lithium can be mined in Australia. Congo is where cobalt can be extracted, but there are challenges to do with child labour, social responsibility and environmental impact.

As we look ahead, we need to ask whether the capacity of the electricity system is sufficient for us to go over to electric vehicles for transportation and what the unintended consequences of doing so might be. Before we know it, the move to electric vehicles might be rejected by the public because of environmental or social concerns, and that leaves aside how the market will respond in five or six years' time to the demand for those resources.

There are a number of pathways that we can go down, but they are not without consequences. I hope that that answers your question.

**Professor Lunn:** I will add one thing to that. The World Bank estimates that metal production will need to increase by 1,000 times if we are to meet the 2°C reduction in temperature target. That is extremely significant.

**Willie Coffey:** At the start of your report, there is a nice section about social acceptability, economic wellbeing and so on. There is a lovely description of the three key factors—decarbonisation, affordability and security of supply—as a "trilemma", but that has been superseded by a fourth consideration, which is the need for a transition to be acceptable to the public, economically sustainable and just. Why have you included that fourth consideration in the report? What is its significance? Can you give us any information on how important the UK and Scottish Governments believe that that consideration is in the transition to a low-energy economy?

**Professor Little:** It is important to understand that each aspect of the energy quadrilemma is interrelated with the others, so it is a complex dynamic. It is difficult to look at one aspect of the quadrilemma in isolation because, if there are changes to one aspect, there will almost certainly be an impact in another area.

The Scottish Government has moved forward with its just transition commission, but the UK Government is rather less developed in its thinking. The work that the Scottish Government has initiated in looking in some detail at the issues around a just transition is important. In the business that it has looked at, the Scottish Government's commission has reflected the fact that the idea of a just transition is difficult and controversial.

It is also the case that the idea of a just transition is under development. It is moving away from largely being concerned with issues to do with, for example, workers' rights. We have already had an energy transition in Scotland in relation to the coal industry, the disappearance of which had enormous social costs that were not articulated particularly well. Looking to the future, an idea that is inherent in the low-carbon transition is that we ought to be able to factor in social justice as an important element of what we are trying to do.

10:30

The idea of the just transition moves beyond simply being about workers' rights and industrial issues to a much broader concept of how communities and individuals are affected by what is undoubtedly going to happen in the low-carbon transition. That feeds back into the idea of having an independent statutory commission to look at all aspects of the energy sector, because one of the key things is to assist the Governments in Edinburgh and at Westminster in negotiating the

mediation between the different elements of the energy quadrilemma.

We also need to recognise that the process of transition that we are embarking on is a long-term process—it is going to take decades—but that our governance system as it is currently constituted is inherently short term, as it operates on five-year political cycles. We need to address that if we are to be successful in having a just transition.

**Willie Coffey:** You have talked about the various technologies, options and possibilities. Where are we in terms of public readiness to embrace any or all of those? I get the sense from previous discussions in the committee that both Governments need to do a little more to get the public to embrace the challenges. The public tend to go along with it when they see the green agenda—they very much sign up to that—but when it comes to actual technologies on the ground and their costs, which hit people in the pocket, where are we on that side of the agenda? Do we need to do more to take the public with us?

**Professor Underhill:** I look back a few decades to the three-day week and where we were in the 1970s. People realised that things such as North Sea oil and gas were going to be almost a salvation, and people bought into that because of the struggles and challenges that resulted from the three-day week and related issues. We are in a similar situation now, but I get the sense from many of the conversations that we had as part of our committee's work that it is hard to articulate or for people to understand the complexity of the energy system and the need.

I absolutely agree that, if people buy into the green agenda and the need to address and ameliorate the climate situation, they understand that, but when it comes to a local happenstance of storing hydrogen or carbon dioxide beneath one's feet, or building a wind farm just down the road, there are challenges. People look at the local scale, perhaps, rather than at the broader, long-term picture and the gain. There is a real need to educate the public on the need and demand and why it is important for future sustainability to ensure that we do not get power outages or other challenges in the energy sector.

There is a lot of work to be done there. As I said, in the 1970s, people perhaps realised the need and bought into it, at least in the short term, because the lights were out.

**Willie Coffey:** Can you point to any examples, perhaps from across Europe, of places that are ahead of us in this field, where the public have been persuaded to accept and embrace the technological changes that we need?

**Professor Underhill:** I will give a couple of examples. One is an example of failure. The example that I use of where it has not worked is that, in Holland, the idea of converting depleted oil and gas fields into carbon storage sites ran ahead of itself without public acceptance. Protests at a place called Barendrecht led in the end to the fact that $CO_2$ could not be stored anywhere onshore in Holland because of the lack of public engagement or understanding.

A success in the same country is that low-enthalpy geothermal has been used to warm a town, Heerlen, where people have been taken along with that. A Scottish example of where that might happen is in areas of former coal mines, where fuel poverty, which was mentioned earlier, is particularly drastic. To use a soundbite, I note that we could actually turn the old black into the new green, because many of those coal mines are now flooded, because of which they have warmer water. Such water is not warm enough to boil a kettle or have a bath, but it is warm enough to be included in a local district heating system, with ground-sourced heat for radiators and the like. If that lifts the heat sufficiently in those deprived areas to take people out of fuel poverty such that they are not so worried about putting money in the meter and can put food on the table and keep warm enough through a winter, it will clearly have done social and public good.

We can draw on a number of examples from Europe and look at how to apply them to the UK. Perhaps we can turn some of the old coal mines to good effect for geothermal heating. We can learn a lot of lessons from Europe on that. Where it has been successfully deployed, not just with hot rocks but with warm rocks, there are opportunities on a local scale. The issue is whether we can scale that up. Maybe it is a case of horses for courses, with different things working in different areas depending on local happenstance. However, we must not forget the broader, larger aspiration and issues. There are local solutions and there is the longer-term gain.

**Andy Wightman (Lothian) (Green):** You have talked about setting up an independent expert commission. I want to explore what that might look like. We already have the Committee on Climate Change, Governments, Parliaments and experts. You said that the commission would be advisory. Would it be a UK body or a Scottish body? What difference would it make?

**Professor Lunn:** It would be ideal if it was a UK body because—

**Andy Wightman:** Would that not be essential?

**Professor Lunn:** We discussed that in our committee, but it is a difficult matter. That would certainly be better, but we all thought that there would be value in having a long-term look across

the piece, regardless of whether it was a UK or a Scotland body.

The value of an independent commission would be in its having a broad range of skill sets over the long term. Those skill sets could include planning policy, economics, technology and legal skills. It could include members of the public.

The commission could look at a broad range of pertinent issues, including building and infrastructure, which, including construction, account for about 39 per cent of energy consumption.

I do not think that there is any organisation like that that could look across the piece, give advice, think about the relationship with the rest of the UK and at least apply pressure in the rest of the UK, even if it was not possible to set it up there.

I completely agree that it would be much better if the commission was a UK body. However, all the members of our committee thought that there would be significant value in the Scottish Government having such a body, not least because it would provide independent advice and put pressure on and provide pushback to the UK Government. It would also provide advice on local generating possibilities, including on the planning and legal systems.

**Professor Underhill:** When we started our inquiry, given the original terms of reference, we discussed long and hard whether the body should be Scotland-centric. A number of us argued strongly that we cannot look at Scotland's energy future without thinking of the UK, including within its European and global context. I will give members an example. Up until the early 2000s, the UK was completely self-sufficient in oil and gas. We are now in a situation in which at least 50 per cent of our oil and gas supplies are imported.

We have to think in terms of its all being joined up—that is really important. In that example, where does liquefied natural gas come from and get delivered to? Where are the interconnectors? We rely on one oil and gas field—Ormen Lange in Norway—for 30 per cent of our oil and gas needs. What would happen if that pipeline stopped? That would have consequences, too.

To answer the specific question, if we are looking at Scotland, there is a need to think about solutions. What we did well as a committee was that we mapped the landscape and recorded it in our report. We did not take the next step of looking for solutions, pathways and consequences. That needs to be done next. We need to weigh up the impact of taking a certain route and consider whether that is the most desirable route or whether there is a better way to go. Somebody needs to do that piece of work on a local scale, without forgetting the UK and the broader dimension.

**Professor Little:** The powers and competences that deal with energy governance in Scotland are spread between the Holyrood and UK Governments and Parliaments. The Scottish Government's ambitious plans for a low-carbon transition, net zero emissions and the future depend very much on effective collaboration with the reserved powers authorities in London.

The success or failure of the complex regulatory and governance dynamic will have a considerable impact on what happens with the low-carbon transition of Scotland and our energy future, and an important thing that a Scotland-focused committee could do is take full account of that. If you sat down and designed from scratch a regulatory system for Scotland's energy, you would not design what we have now. The system has come about by constitutional happenstance and the way that the Scotland Act 1998 was set up. If we assume that that is the reality that has to be dealt with from a governance perspective, there is a strong case for saying that there needs to be a Scotland-focused commission that keeps all the devolved and reserved issues in play, because dropping the ball on one side of the fence would result in failure.

**Andy Wightman:** That is helpful. I do not demur from the fact that the proposed commission might be useful, but Governments do not have a good habit of paying attention to commissions.

Energy efficiency has been mentioned. We already have the European Union's energy performance of buildings directive, which mandates nearly net zero by December 2020, and we had the Sullivan report in 2007, which recommended net zero for new build by 2016-17. Two months ago, the 2019 building regulations were published, and they contain no change to the $CO_2$ reduction targets from 2017. It is an intentionally political issue.

Rebecca Lunn mentioned members of the public. Recently, the role that citizens assemblies and other deliberative methods have played in a number of European countries has been interesting. We need a long-term solution. Everyone will have to change their behaviour, buying habits, outlook, perspective and so on. Is there not a role for more imaginative ways of planning the future as opposed to an expert commission? I am sure that its members would be extremely well qualified, but the Government would find it very easy to ignore it, because the issue is difficult.

**Professor Little:** You are right to be wary of having yet another official body. However, in the deliberations of citizens assemblies, for example,

and the formulation of Government policy and thinking, it is important that authoritative, evidence-led research is available for people to work with. That is what a commission of this sort could provide. There is a danger of going down blind avenues and, ultimately, failing on the low-carbon transition.

That is not to say that a statutory commission would be the only game in the town. It is clear that community and citizen involvement has been crucial in countries such as Denmark in taking forward a low-carbon transition and developing the energy sector. However, there is a need for far more authoritative evidence to inform policy making across the energy sector.

10:45

Of the bodies that are in existence at the moment, the Committee on Climate Change, for example, obviously does good work in a range of areas in relation to energy, but it is primarily focused on climate change. Similarly, when the National Audit Office does something on energy, it is a snapshot of particular budgetary issues in the energy field. When the Competition and Markets Authority gets involved, it looks at the competition aspects. There is a lack of a holistic, whole-systems approach to analysing what is happening with energy. Given the interconnected nature of different aspects of the energy quadrilemma, that is a gap in the regulatory and governance structure.

The point about how the findings of committees can be and are regularly ignored is absolutely true. Nonetheless, it is important that those findings are made and that they are out there. It is also the case that the Committee on Climate Change, for example, has a much more authoritative weight behind it. In large part, that is, of course, because it is a statutory body that has a degree of permanence and independence which a normal political advisory committee does not have. They can be time limited, as the just transition commission initially was, and they have a far more limited ability to influence debate over the long term.

Those were some of the ideas that we had in relation to underpinning the idea of a statutory commission.

**Andy Wightman:** Okay. I have a couple of other questions. What will we do when Hunterston and Torness come offline?

**Professor Lunn:** You tell us.

**Professor Harrison:** Build wind farms.

**Professor Lunn:** Basically, we will import across the border from England. We will import nuclear if it comes online—that is inevitable. Yes, we will increase renewable production but, in doing that, we will still be trying to meet the gap and not trying to double production, which is what we need to do.

We have not talked about the way that we commission renewables. Recently, I was at a meeting in which floating offshore wind generation was looked at. The design lives for the renewables were 25 to 30 years. That is not good enough because, by the time that we hit our net zero carbon target, they will just about be going offline. We need to think in a wholly different way and not buy the cheapest thing that can be manufactured in China or wherever. We need to think about a form of offshore renewable production that is modular and recyclable and that can be part of the circular economy, so that we can build it in such a way that parts can be recommissioned and it is a long-term solution, not a 25-year one. We need that kind of long-term thinking or, in 25 years' time, we will be in exactly the same position with our renewables fleet going offline.

If we are looking at 1,000 times more metal production just to meet the Paris agreement, we cannot do that again to build another set of renewables. We need to think in a very different way about how we do things.

Although that is all very doom and gloom, that is not the way that people are thinking. If we are ahead of the game in thinking about that as a future, we can export those technologies and think about bringing in taxes to fund some of that. If we think differently, we can not only solve Scotland's problem, but make a business out of it. Although some people would not invest in that, I am sure that much of Europe would invest in things that are renewable and recommissionable and use recycled components, and if there was different thought about a long-term renewables solution.

**Professor Underhill:** The elephant in the room is, of course, the North Sea, and the oil and gas reserves that sit in neighbouring waters and west Shetland. In relation to climate amelioration, if they are to be used to make up the shortfall, that demands that carbon storage works and that we ensure that it is done safely and on the right sites.

The current estimates are that more than 90 per cent of the remaining reserves of oil and more than 60 per cent of the gas lie in Scottish waters. Will that be left in the ground or used to help to make up the shortfall that has been described, so that there is less need to import from the south or from further afield? In order to do that, carbon storage needs to go alongside that, and that is, of course, a largely untried and untested technology in the North Sea.

**Professor Lunn:** And expensive.

**Professor Underhill:** Yes—and expensive. The first exploration well for a $CO_2$ storage site—the Aurora well—is currently being drilled in Norway for the northern lights project. The question is whether we can do something similar and repurpose many of the depleted oil and gas fields for that while still producing oil and gas safely and sustainably. That might make up the shortfall.

**Andy Wightman:** In your report, you said:

"Research suggests that in order to have at least a 50% chance of meeting even the 2°C goal, globally, a third of oil reserves, half of gas reserves and over 80% of coal reserves will need to remain unused."

The Scottish Government's response to that challenge is to say that, if we did that, we would just import them. Is that a cop-out?

**Professor Underhill:** I will answer that in a slightly different way. I go back to the point that one of the things that we are seeing is that energy supply and demand are driven largely by population growth. If we look at projections ahead to 2040 or 2050, we see that, whether we like it or not, oil, gas and, indeed, coal in the far east are still very much part of the equation. Exploration is still going on and there are oil and gas reserves that we may be able to import even if we do not use oil and gas at home. We can even effectively export our carbon as a result in the way that Germany and other countries have done. The question is whether there will be a sufficient supply of new reserves to meet even that demand. That is why China and the far east are looking at coal and are still developing it at a pace now. They are trying to meet their own energy needs and demands.

The United Nations sustainable development goals include clean energy and tackling fuel poverty. China and the far east are pointing at those tasks and saying that they give them a mandate to go after coal, oil and gas. If we are really serious about the climate and carbon emissions, we have to do something to address that through carbon storage or similar technologies. Being able to do that at the scale that is needed, given the pace and finance demanded, is a real challenge.

**Andy Wightman:** Okay. I have one technical question and one more substantive question.

On the substantive question, I understand that there are proposals to build an electricity interconnector with Norway. The bigger question is: how important will it be for the UK to stay part of the emerging EU energy market in order to provide a smart grid at that scale?

**Professor Harrison:** I am not 100 per cent sure about the market arrangements if the UK is not part of that. They are reasonably straightforward if it remains within the emerging European market.

Generally, there are ways of arranging things so that there is bilateral trading. My understanding is that most of the interconnectors are merchant based—that is, somebody takes a bet, and Ofgem generally regulates the prices. What drives that is the extent to which prices diverge or whether they will diverge. Certainly, the European market is trying to dampen that. Something like that could be quite valuable to Scotland. To a large extent, it means that more renewables can be generated, the excess can be exported either south or across to Norway, and then it can be imported back. It is really about distributed storage on a very large scale. I am reasonably in favour of that, but the interconnector capacities are not sufficiently large to rely on whole-heartedly. We can put a degree of reliance on them, but we need stuff that is based here.

I am less pessimistic about the need, and I think that we can do an awful lot with renewables. The Committee on Climate Change certainly thinks that we can do a great deal with them, although not absolutely everything. We have a competitive advantage in the area in terms of resources. Jobs and the infrastructure for manufacturing as well as the operations and maintenance need to follow that. There are a lot of skills here.

I am not too worried about 25-year lifetimes for wind farms. That means that, at the end of 25 years, they can be replaced with something bigger and more efficient, because that is the way that the technology is going.

**Professor Underhill:** I have one concern that I want to share with the committee. It is like looking into a crystal ball about what will happen with the European Union in the future. In Holland, the Groningen gas field is about to be decommissioned, and Holland will leave 50 per cent of its gas needs in the ground, largely because of earthquakes, ground subsidence and the loss of public acceptance of getting gas out of the ground from an onshore gas field as large as that. The consequence is that Holland now needs to import its gas from somewhere else—Russia or wherever. If that demand is heavy and the UK is at the end of the line, what is the implication of being outwith Europe if we need the gas at a certain time? Having other interconnectors to Norway and so on is important—I would say that they are essential—but there might be impacts that we have not even predicted, let alone ones coming along the road that we know about, such as from Groningen, but have not done anything about yet.

**Andy Wightman:** I have a final, daft-laddie question. Paragraph 23 on page 39 of your report states:

"In 2017, the UK imported 151,891"

kilotonnes of oil equivalent energy. It then states:

"For reference, final consumption of energy that year was 149,139 ktoe."

Can you explain that? We are importing around 151,000 ktoe and consuming around 149,000 ktoe, and I presume that we are also generating quite a bit. Is an export figure missing that would balance all that out?

**Professor Harrison:** It would be clear if we had a Sankey diagram. The amount of energy production in Britain is certainly quite high. I think that what is happening with those figures is that we export things that are different from what we import. However, there is also the fact that an awful lot of energy gets consumed in the processing of energy into different products. We would have to look at those figures though.

**Andy Wightman:** Can you come back to us on that?

**Professor Harrison:** Yes.

**Andy Wightman:** I do not understand why we are importing more than we consume, but I will leave it there for now.

**Jackie Baillie (Dumbarton) (Lab):** Some of my questions have already been covered, but it is worth focusing again on the oil and gas sector, which Professor Underhill mentioned. There are many in the Parliament who would argue that having full economic recovery in terms of oil and gas extraction is not compatible with declaring a climate emergency and wanting to reduce the use of carbon. I am clear that that was not the view that you presented, Professor Underhill, and that you think that oil and gas are critical for closing the energy gap that we will experience, provided that carbon capture and storage offsets that extraction. Is that a fair summary of your position?

**Professor Underhill:** It certainly is. Our approach was to look at having a low-carbon energy transition, rather than going off a cliff on carbon reduction, and assessing how to manage that. The amount of oil and gas that we need has to be balanced with the carbon emissions targets—we cannot do one without the other. Equally, though, we cannot do without the oil and gas if we are to continue to have the energy supply and the quality of life that we have been having. Basically, that is the challenge. That is an uncomfortable conversation for many people to have, but it is an honest one. We need to engage with the public on that in order to have a social licence to operate, if we are going to do so. However, we must do it with open eyes and connect with everybody, so that they understand why it is important, because not doing it would have consequences for the energy supply in Scotland.

**Jackie Baillie:** What timescale do you envisage for having that review, if people were to be engaged in looking at the changing policy landscape and what it means for them? How quickly do we need to do that?

**Professor Underhill:** We need to do it very quickly, because the impacts will be lasting. We have to make a difference in the next five to 10 years.

In answer to an earlier question, if we set up a statutory commission, it might not be listened to but we will have a meaningful energy policy for the long term, which is important. We should set shorter-term timescales for reporting, so that the commission will report and not just be a talking shop. It should give the full suite of options, so that people can look at them, engage with them and perhaps appreciate that there are difficult decisions and challenges ahead in relation to our lifestyle and energy supply.

11:00

**Jackie Baillie:** Do you envisage the commission or any other body looking at the cost of what you describe as offshoring oil and gas in relation to jobs, the economy and carbon emissions? Should it also look at a just transition for oil and gas workers, which matters enormously to the economy of the north-east?

**Professor Underhill:** I absolutely agree with everything that you have said. To underline Becky Lunn's point, Scotland has the opportunity to lead and to export skills, techniques and technologies across the world to other countries that have a burgeoning oil and gas business but which will be facing the same questions about their social and worldwide responsibilities. I see an opportunity for the north-east and for Scotland in general to develop the skills and techniques and to export them for good.

**Professor Little:** There is also the potential for Scotland to blaze a trail by developing ideas around governance of the energy transition. That would be appropriate, given the legislation on climate change and net zero emissions that the Scottish Parliament has passed and the way in which not just the Scottish Government but the Scottish Parliament has engaged with the work of the Committee on Climate Change. From a global perspective, Scotland is already ahead of the curve in thinking about governance and how it can deliver a low-carbon transition. As we move to the next phase and think about heating and transport, there is the opportunity for Scotland to lead in those areas, too.

**Jackie Baillie:** The convener raised the issue of energy efficiency and demand reduction at the start of the meeting. Has any assessment been

made of the costs of energy efficiency and demand reduction programmes, as opposed to the costs of just increasing generation?

**Professor Harrison:** No assessment has been made by us, but a lot of work is going on. The Committee on Climate Change has done a good bit of work on that issue, as have a number of academic groups and the Department for Business, Energy and Industrial Strategy. There is a cost to such programmes for somebody, but they do save money. Certainly, at the early stage, the vast majority of the low-hanging fruit saves us money; it is only by doing things at the extreme end that it starts to cost us something. We did not look at that issue explicitly, but there is plenty of information available.

**Jackie Baillie:** In order to convince people, we might want the Government to do a cost-benefit analysis of the different options that are available.

Local authorities have a role in some of the energy efficiency schemes that are running. What role should they play in delivering net zero emissions? Do they have the capacity and resources to carry out that role?

**Professor Harrison:** I will answer the last question first: no.

**Jackie Baillie:** I think that I knew the answer to that, but I wanted expert opinion.

**Professor Harrison:** The expectations on local authorities right across the UK are very high. A number of organisations, particularly Energy Systems Catapult, can help them to masterplan local energy plans. However, we need trained people on the other side who have the ability and capacity to act on those plans, and we need the money to implement them. It is not credible to expect under-resourced councils to deliver something that is critical.

**Professor Underhill:** There is also the issue of granularity. Each local council will have different problems: we heard from the Highlands and Islands previously and we can think about conurbations. They all have different challenges. Quite rightly, the local authority will be looking after its local population, but this is a much bigger issue that needs to be joined up.

**Professor Lunn:** I have a point to add on the financial side. The committee will know more about local authorities than I do, but I suspect that whether it is up to local authorities or individuals, finding financial means to spread the capital cost is probably the only way to make it feasible. Most people cannot afford a large capital sum to change their home and the same goes for local authorities carrying out large infrastructure projects and making very big changes to the current council infrastructure. There will have to be some thinking about financial systems to try to spread the cost.

**Professor Harrison:** That is a feature of the emerging energy supply, as we move from something that is dependent on paying as we burn to something that is investing in capital to save or produce. It lends itself well to a more mortgage-style approach. Given how low borrowing rates are, that might not be a bad idea.

**Jackie Baillie:** It is interesting that local authorities and housing associations have done very well in relation to their own stock, both for new builds and in retrofitting, but there is a whole blank canvas in respect of owner-occupiers and businesses. Is there a need for us to require owner-occupiers and businesses to do something and who would bear the cost of that?

**Professor Lunn:** There will be a need for such a requirement. If we are to hit the net zero carbon target it is impossible to think that there will not be a need. Who bears the cost and how that is done depends on governance.

**Professor Harrison:** One of the attractive things about going for hydrogen as a heating fuel is that we would not need much change in the way that people heat their homes, but the downside of that is that there would not much change in the way that people heat their homes. People need to take action. I am guilty of not taking appropriate action in my own home. I should probably have already insulated my home to the rafters—it is mostly the rafters that are insulated.

You may need to go down the mandatory route. However, you probably do not want to try that first. Perhaps start with encouragement and guilt—all the stuff that normally works.

**Jackie Baillie:** It has clearly not worked for you and this is your area of expertise.

**Professor Harrison:** I am just waiting for my seven-year-old to start telling me about it—that is coming soon. [*Laughter.*] Making something mandatory works. One place in which we can get owner occupiers to do something is in planning and building regulations, if they want to extend their properties, for example.

**Jackie Baillie:** Another place is the point of sale.

**Professor Harrison:** Indeed, yes. It is certainly something to consider for rental accommodation.

**Professor Lunn:** Again, spreading the cost against the reduction in energy bills would make a big difference to individuals. That is not what currently happens. There are issues when someone sells their house—we need to find ways in which to sell that investment on to make it a viable option for people.

**Gordon MacDonald (Edinburgh Pentlands) (SNP):** I want to consider security of supply. On page 28, paragraph 49 of your report you say:

"The UK as a whole is unable to supply its own requirements for heat and power from indigenous sources and has an increasing reliance on importing gas and electricity."

You spoke to Andy Wightman about the interconnectors, but can you say a wee bit more about their importance? The recent Crown Estate report suggested that, by 2025, the amount of electricity that would come from the interconnectors would treble. Can you say a bit more about the dependency of the UK on the interconnectors?

**Professor Harrison:** Ten years ago, we had relatively low interconnection to the continent and one interconnector to Ireland. Now we have three or four interconnectors to the continent and two to Ireland. The volume of interconnection has gone up. The interconnectors are interesting because they are direct current links—essentially, they allow the UK, Irish and European systems to do their own things, but to trade when they need to.

Under normal circumstances, interconnectors allow us to get rid of surpluses and to cope with imports. Where it is interesting and becomes challenging is the extent to which we can rely on the interconnectors at critical points, such as during peak winters or when there are problems. We have not seen too many examples of hitting critical points and the interconnectors providing that security. Some people will argue that they are very secure—technically, they are—but we only have market coupling and sometimes it does not automatically work in the way in which you would imagine that it should, such that when energy is expensive, you ought to export it and get imports into your area.

Interconnectors provide a degree of reliance, but I would not say that you should bank on them whole-heartedly. They add something and are another diverse source, but you tend to find that, when you get low wind speeds in Britain, you get low wind speeds on the continent as well. Therefore, we may have the same problem.

**Gordon MacDonald:** The last time that I visited National Grid down at Reading, it suggested that between 3 and 5 per cent of the UK's electricity requirements came from the interconnectors and that we are a net importer of electricity. Would that be right?

**Professor Harrison:** I think that that is right.

**Professor Underhill:** There is the idea of building a new interconnector, but what has recently come on my radar is the slight upsurge in public opinion against having one built through Portsmouth in Hampshire. That was not the case for the other interconnectors—they were not even in people's consciousness. I can see a situation in which people question whether interconnectors should even be built and where they should run, and that may lead to opposition in future, although, as you quite rightly hint at, they are a crucial element in the energy mix. There may be opposition in certain areas that we have not seen before and that will challenge us.

**Professor Lunn:** We need to bear it in mind that, with electrification coming on line, the whole electricity demand profile will change. We will not be the only ones that require more electricity with electrification; all of Europe will. It is not clear to me that we can rely on the interconnectors to meet missing production. They are clearly a better way of storing surplus, and there are clear advantages in energy efficiency to having the connectors when it is less windy and we have no energy and other parts of Europe have a significant excess of energy. There are some obvious advantages, but it is not clear that we can rely on them, as we cannot produce enough energy in total.

**Gordon MacDonald:** On page 29 of the report, you go on to say:

"Brexit could also potentially cause disruption for cross-border UK/EU energy governance, policy making, regulation, enforcement and funding."

If that is the case, what impact would that have on the interconnectors that we are so dependent on?

**Professor Little:** Obviously, we need to wait and see what type of Brexit emerges, but what we had in mind in relation to that section of the report was the fact that, if we are no longer part of the EU, we will no longer have access to the same level of financial support from the European Investment Bank to develop projects of common interest, such as interconnectors. The financing of such infrastructure could well become more challenging—it may not, but it could. It is those concerns that we are trying to outline in the report.

In many ways, key aspects of the energy system will be relatively untouched by Brexit. When people are switching on light switches, the lights will still come on, but Brexit may suck out investment for future developments, which will potentially have a very significant knock-on effect further down the line.

Initially, the impact of Brexit will probably not be very significant, but 10 or 20 years down the line, we may find that we have not been able to develop things in the way in which we would have done, because we have not had access to the same political dynamic or the same financial resources.

**Gordon MacDonald:** As I understand it, the profile of Scotland's energy needs is roughly 25 per cent electricity, 25 per cent transport and 50

per cent heat. If we assume—rightly or wrongly—that the 50 per cent heat need will be met by hydrogen or something like that, we need to focus on transport and electricity. We are electrifying our railways, and we have targets for more electric vehicles. Will you say something about Scotland's installed capacity for electricity and current peak demand? I know that demand will grow, but where are we at the moment?

11:15

**Professor Harrison:** I am trying to remember the numbers—they are definitely in the report. I think that peak demand is about 5GW. Installed capacity is far in excess of that, but—

**Gordon MacDonald:** It is double that, I think.

**Professor Harrison:** We must remember that a large lump of that is wind.

Demand will go up, with electric vehicles. Doing it right involves encouraging people to charge at the right times, rather than at 5 o'clock, when they get home. Smart charging is a critical part of that. A lot of the assumptions that National Grid and others make are based on smart charging working, and there are good indications that it will work.

The electric vehicle side of things is coming; the availability of EVs is certainly far better than it was even two or three years ago. I expect demand to go up, whether it goes up by 30GW, on a UK basis, or by much less than that because of smart charging. The other side of that is that there will be better air quality and better overall engine use.

**Professor Lunn:** We must bear it in mind that our production will go down significantly when the two nuclear power stations go offline.

**Professor Harrison:** Indeed.

**Gordon MacDonald:** What proportion of our renewable installed capacity is nuclear? According to the numbers that I have, our installed renewable capacity is 11.3GW and peak demand is 5.3GW. There is a bit of headroom there, albeit that that demand will grow. What proportion of that is nuclear?

**Professor Harrison:** About 2GW is nuclear, but with Hunterston going off, it is going down a bit. Peterhead currently adds about 800MW.

In some respects, we are quite light on large generation. The direction of travel for electricity is away from very large, centralised plant and towards smaller stuff. The issue there is the extent to which wind farms, combined with storage, smart control and demand response, can replace the centralised plant. I am reasonably positive that all that can go a very long way; other people are pessimistic.

**Gordon MacDonald:** Is there anything that we can do to encourage more domestic generating capacity in Scotland? For instance, must contracts for difference be changed to encourage more investment?

**Professor Harrison:** There is a lot of evidence that the feed-in tariff had an enormous impact in the context of solar PV. What did not help was the constant fiddling with it and tariff degression; what we want is a stable climate for it. I certainly feel that removing solar and onshore wind from the contracts for difference is unhelpful, because those are the cheapest forms of energy—domestically, they are a little more expensive, but large-scale solar and large-scale onshore wind are cheap and should be encouraged.

**Professor Underhill:** Let me answer part of Gordon MacDonald's question by talking about the security of our gas supply. At the moment, around 45 per cent of our gas needs are met by indigenous gas. Of the remainder, to make up the shortfall, 75 per cent comes from Norway, and about 10 per cent, in combination, comes from Holland and Belgium. I have mentioned the challenge in Holland, and I cannot help but notice that Belgium does not have any oil or gas. We import gas from Belgium, but it actually comes from Russia. According to the most recent available figures, from 2017, 40 per cent of European Union imports of gas come from Russia, along that line. We are security dependent in that regard.

Of the liquid natural gas imports, which make up the remaining 15 per cent of our imports, around 84 to 85 per cent come from one country—Qatar—with the remainder coming from places such as Algeria, where there are LNG ports. I cannot help but notice that Qatar has issues in the middle east and that Algeria is not necessarily the most secure source of supply. Given the energy mix and how much we rely on gas for domestic heating and other uses, there are significant challenges there.

As most members are aware, in March 2013, the country came within five hours of running out of gas. There was a particularly severe cold snap, during which Brighton beach froze over. If we had not had an LNG delivery to Milford Haven, we would have lost the domestic gas supplies. That is how close we came to running out of gas.

It is not coincidental that, within days of that happening, shale gas came on to the radar. People started to say, "Crikey! Where are we going to get gas from if we can't rely on imported gas?" People looked across the Atlantic at the States and thought, "Ah! We have shale in this country—that will work." However, the issue is that, here, the geology is not with us. In Lancashire, the fault networks generate

earthquakes when one drills, and in places where the country has been uplifted, geologically speaking, the coal mines are at the surface; shale was mined in the midland valley. In the States, where shale gas is a source of energy today, the shale gas that has been successfully produced is at a depth where the temperature is sufficient, whereas many of what some people consider to be prospective sites in this country are shallow and exposed and not at that depth. They are not overpressured and are highly fractured.

If shale gas cannot provide a secure supply of gas, the question is, what now? There has to be a plan B or a plan C. Given the figures that I have read out on the extent to which we are dependent on imports, and given how important our gas supply is for Scotland and the UK, we need to be very nimble and to think carefully about where we get those resources from.

**Gordon MacDonald:** Is there any evidence that the UK Government is seriously trying to address the issue?

**Professor Underhill:** The general feeling was that, if shale gas worked in the States, it could work here, because the geology is the same, but actually it is not. There might be relatively small areas in the UK where all the ingredients work for shale gas, but they appear to be in places such as the east midlands rather than Lancashire, where the drilling that has been done so far has taken place, or Scotland. I do not see the technical assessment being done to underpin the work that will inform policy. It seems to be more a case of, "It works over in the States, so it must work here." If it does not work here, we need to ask what the other sources could be.

That is quite independent of the issue of the social acceptability of going after a resource such as shale gas, for which I would say that there is very little appetite.

**Gordon MacDonald:** When the committee last looked at the energy system, a few years ago, there was an issue with black start. South of the border, there was the situation in which just over a million people lost their electricity supply. At the time, my understanding was that our hydro stations would restart the system by kicking in Longannet, which, in turn, would kick in the nuclear power stations and we would be up and running within about eight to 12 hours. What has changed? Is the situation changing? Is there still an issue with black start that has not been addressed?

**Professor Harrison:** It is being addressed, but it has not been addressed yet. Quite a lot of work is going on between the two transmission operators here and the National Grid in England to address the issue. Basically, that involves replacing the positive things about large thermal generators with something else. The issues are the ability to cope with rapid fluctuations in demand as things are brought online; the ability to energise very high-power infrastructure, which raises lots of voltage control challenges; and that sequenced approach. The system will be designed completely differently. It is on its way, but it is not here yet. I think that there is money budgeted through the new transmission licensing arrangements to allow that to go ahead. That is not cheap at all, but it is essential.

**Gordon MacDonald:** Will that allow electricity systems to be back up and running as quickly as happened with the previous system, or will it take days rather than hours?

**Professor Harrison:** I am not sure about that. I understand that the aim is to get towards three days rather than seven. Ideally, you do not want it to go off.

**Gordon MacDonald:** Absolutely.

**Colin Beattie (Midlothian North and Musselburgh) (SNP):** As has rightly been mentioned, many of the issues around energy are in the hands of the UK Government. One worry that I want to highlight is that the energy transition readiness index shows that the UK is eighth out of nine countries, which, frankly, is not very hopeful for the future.

I want to touch on the uncertainties around new technologies. I have a simple question. Who should take the lead on and be responsible for developing and putting in place the new technologies that we need?

**Professor Harrison:** That is a good question. I presume that we are talking about generation technologies. The recent history has been that the private sector takes on development, and it is generally the public sector that provides the initial investment and the ideas. Certainly, a lot of university work has spun out, but it is generally the private sector that drives it through. Government has a role in providing an environment in which it is possible to bring through new technologies by providing stable regulation and appropriate funding at the right points of the development cycle. In the past few years, some parts of that have not gone brilliantly, but the underlying development capacity is there. There is an awful lot of capacity available to do that.

Interestingly, the overseas institutions and companies often steal a march on us at some point. We saw that with wind. It has not yet happened with tidal, but it may. There is a mixture of responsibilities between the private sector and the Government, but the Government ought to take a reasonable lead in providing an environment in which development is possible.

**Colin Beattie:** The scenario that you describe, in which there is a division of responsibilities, is historical, but is it appropriate for the future? That is what has always been, whereas we are moving into new scenarios. Can the private sector shoulder the costs that you are talking about, and can the public sector raise the money to fund what it needs to fund?

**Professor Little:** That is an important issue. Since the privatisation of the electricity and gas industries in the 1980s and 1990s, the Government or state has, in essence, stepped back from taking key decisions. The state is understandably reluctant to decide which horse to back, because, in some respects, it has a pretty patchy record on backing winners when it comes to new technologies. However, the privatised and marketised energy system that we have was not designed with a low-carbon transition in mind; it was designed to operate in a fossil fuel-based sector.

11:30

There is a greater role for the state in taking key strategic decisions on technologies. It must be up front about saying that something might not work and we might lose money on it but that the overall objective of a successful low-carbon transition and contributing to climate change mitigation is so important that we have to take that on the chin.

We are now in a time and space in which the state should step up rather more than it has done in the past. It should steer the direction and set the channels in which private finance and enterprise can operate and the big companies can do the running.

**Professor Underhill:** I have examples of when that might have happened with a couple of false starts in the $CO_2$ storage sector. Under the Miller project, which was proposed 15 or 20 years ago, $CO_2$ would have been stored offshore in the Miller field, enhancing oil recovery while offsetting carbon targets. I was at a meeting in Westminster of the all-party parliamentary group for earth sciences, at which Greenpeace, BP and the British Geological Survey all said that it was a great idea. Yet the project was rejected, primarily because politicians did not want to be seen supporting the oil industry at that time.

Three or four years ago, the Goldeneye project was cancelled. It was a state-funded, billion-pound scheme whereby Shell would have handed over a depleted gas field with a view to the St Fergus gas terminal near Peterhead being used to put $CO_2$ into the ground. When the British Government cancelled the project, Shell left the arena. In such company-state co-operation, the state has a really important role to play.

I have noticed that many oil and gas companies consider that there is an existential crisis over their future. They realise that they need to invest in R and D in new technologies, which is what they are doing. Total has pledged 10 per cent of its annual R and D budget to clean energy. Shell, BP and Equinor—formerly Statoil—are going back to alternative energies and they see themselves as energy companies rather than oil and gas companies, because their futures are at stake. In addition, investment houses are holding their feet to the fire and asking difficult questions about what they are doing in the arena of new technologies for clean energy.

Much of the change that Colin Beattie is alluding to is already taking place in companies as part of their R and D. It is not necessarily well publicised, but it is beginning to happen. With the state and industry working together, and with public opinion and investor appetite being what they are, that is a powerful conflation of forces.

**Professor Lunn:** On a smaller scale, there are many examples, particularly in the renewables sector, of intellectual property being developed in Scotland and lost offshore. That is because of a lack of investment to keep IP here, and opportunities to grow businesses and an economy around renewables and to export have been lost. My feeling is that, if that is allowed to happen again, energy will always end up being a net cost. We need to invest in the IP that we develop here, and we need to recognise that we should export not only skills but technologies and manufacturing.

**Colin Beattie:** Those comments lead me to the next part of my question.

Due to the nature of the challenges that we face, a lot of the technologies are emergent—we do not really know where they are going. Should projects involving those emergent technologies be kept alive in the hope of future breakthroughs and the benefits that might arise from them? Who should fund such projects?

**Professor Lunn:** They should be funded, at least in part, by Government. We do not have a big culture of hedge fund activity, as they do in the US, or huge private investors, which might make it a bit easier. However, if we do not invest in those technologies, we will lose all opportunity to make economic gains.

A couple of examples came up at a recent meeting. One was to do with recycling and remanufacturing fibre composites from wind turbines. A small start-up company is struggling to find investment to do that, yet that work must happen, because we cannot continue to have a disposable economy.

The other example was to do with the replacement of rare earth metals with ferrous

alternatives. That is the future. We cannot keep relying on rare earth metals—the clue is in the name. They are also extremely environmentally damaging to produce. The technology already looks like it is moving to China, because it cannot get investment here. Even if it cannot be sold now, that is clearly the future—the market for it will be huge. We need to make investment decisions.

**Professor Underhill:** There have been moves in that direction at the UK level. Up until about five years ago, a lot of the big research funds were for documenting climate change, but there has been a change in emphasis. The former research councils in the UK have come together under one umbrella to form UK Research and Innovation. It is trying to tackle global challenges. We have the global challenges research fund and the national productivity investment fund. What do those align with? The industrial and clean energy strategies.

Has that move in direction been enough? Has it been fast enough? I would argue that it has not been. As a result, some of the emerging technologies are withering and dying rather than being supported in the medium to long term.

The change in emphasis to tackling the challenges and problems and finding solutions to those, rather than simply describing the changing climate is important to do. The Scottish Funding Council has a research pooling initiative. Louise Heathwaite has done a superb review of that in her report that was published in the summer. Her recommendation is that universities' work on those issues should be challenge and theme led, and that they should get central funds from the Scottish Funding Council and the UK Government through UKRI to tackle that. I would hope that that would be the case.

**Professor Lunn:** There is still a gap, though. I presume that you are aware of technology readiness levels. The nine-level scale covers the fundamental idea to near market status. With UKRI funding, people can get to TRL 8 or 9, but they cannot start a business on it.

The two examples that I cited are people who have got right through to the stage of developing products. They have reached the stage of needing business investment and they are looking offshore for it. We have spent all that money developing and investing in the IP here and we just let it go. Somebody else is taking on the product and will make the profit out of it because we do not invest in the last manufacturing step and in building the business to a decent scale. We continually do that.

**Professor Underhill:** I agree. The role for Innovate UK and Scottish Enterprise in this space is important and I am not sure that that is weaved into the narrative currently.

**Professor Little:** There needs to be a culture shift in how we approach the matter. It is recognised that the state, in areas such as health and defence, has a leading role in decision taking. We now have to think of energy in that context, because of the imperative of low-carbon transition in order to mitigate climate change. In the context of a privatised energy system, we are not accustomed to thinking that way and we have to address that by shifting our thinking.

**The Convener:** I am conscious of the time and of the fact that Mr Lyle has yet to be given an opportunity to ask questions. Colin Beattie can have one last question to wrap up what he wants to ask.

**Colin Beattie:** This is a small question, although it perhaps leads into a bigger one—everything does. Are the existing distribution networks able to handle the current level of connections from small-scale renewables?

**Professor Harrison:** No. If you look at the heat maps from Scottish Power and SSE, you will see that vast tracts of Scotland are full with regard to smaller scale renewables. They can be fitted in here and there, but the bigger stuff is a challenge. Some of that is about the distribution networks, but the majority of it is about transmission, and the issue there is the export capacity to the south. There are issues to do with the ability to use renewables. When there is a lot all at once, we certainly struggle with it.

Part of that is to do with the way in which the networks are designed and operated and the procedures that are used to say, "This is enough," and, "This is too much." That is changing a bit, and I think that we will free up more capacity. The more we put in control systems and active network management as a matter of course, the more we will get in. The other part of it is—ironically—about consuming more locally, in the right places and at the right time. With things such as electric vehicles and potentially heat, particularly with the conversion of electricity into hydrogen, we can start to consume when there is more than we need and do the opposite when we have too little.

However, there is a genuine issue there. The tendency for the regulator to try to keep costs low invariably means that the networks are not expanding enough. That is their trade-off: they feel that they can do more with controls than with copper, although they generally use aluminium now. They can do an awful lot if they invest strategically in the larger scales. The business plan that went in from SSE certainly talks about reasonably substantial increases in capacity north to south that are driven by the demand for renewables connections, but the distribution networks are still a challenge.

**Richard Lyle (Uddingston and Bellshill) (SNP):** The discussion has been interesting. I have jotted down quite a lot of questions, but I will try to reduce them. Times have changed. In the 1970s and 1980s, councils modernised houses and changed them all to gas. Now they need to think about changing them from gas back to electricity. Let us be honest—electricity was very expensive then, which is why everybody went on to gas.

We need to get smarter and develop more projects. It is interesting that, when wind turbines were first being developed, most people were sceptics. Now, wind turbines are a success.

I have been pushing for years for car charging points to be installed in new homes. We should put them in when we are building houses so that we do not need to retrofit them. Wind turbines should be attached to houses, as should solar panels, and we need more clarity on pricing with regard to both.

In a street off Saracen Street in Glasgow, wind turbines were attached to houses as part of a project that was then disallowed because planning permission was changed in the UK and in Scotland and the firm that was doing the work went out of business. That firm has now developed a new project, but it cannot get funding. The most annoying thing is that we need the entrepreneurs that we have out there to develop more projects to meet demand, but they cannot get funding. I remember from my time as a councillor that Scottish Power used to export quite a lot of its power to England, but it does not do that so much now.

Do you agree that there are answers out there but companies are not being supported with funding? I know of one of them, but I am not going to name it. I have asked for a meeting with Scottish Enterprise to see whether it will come up with the funding. Is the thing that really annoys people the fact that there are projects but they cannot get funding?

**Professor Lunn:** I agree that there are technologies out there that would definitely reduce demand with local production but that there is currently no market driver for them. That is part of the issue. The problem is partly getting the technologies developed as a business and also whether there is a driver for new developments. For example, if a development is not the cheapest for a council or developer so buying that house will be a bit more expensive, the question is whether people will go ahead with that development.

11:45

There are two problems: the development market and incentivising more efficient houses that produce, store and reduce demand. You have not spoken about ground-source heat pumps; Scandinavia makes significant use of them, but we do not. They could really reduce our demand, but there is not a market to push their use.

Overall, the two issues are business development of new technologies and regulatory or financial incentive drivers to make them desirable to construct. At the moment, those are completing lacking.

**Professor Underhill:** The answer to the specific question is yes: funding is an issue. Scottish Enterprise and maybe other organisations may need to bring energy up their agendas. It is not there at the moment.

**Richard Lyle:** I hope that they are listening.

**Professor Underhill:** Professor Little made a point earlier about other areas—defence and so on—that have a statutory body and an energy policy that is long term. That allows them to experiment and try things that may fail, and there is investment in them. Energy seems to be left out of the discussion. The report sets out the current landscape; which direction we go in will obviously be challenging but, whichever direction we go in, this area needs investment, which all needs to be joined up. Energy seems to be left out, yet it is so fundamental, especially looking forward.

**Richard Lyle:** I agree with you. My mother-in-law was Dutch, and we went to schemes in Holland that were quite innovative. Denmark, Sweden and other places have waste-to-heat plants, but I had an application in my constituency for a waste-to-heat plant that everybody opposed because of health concerns. We really need to have a national conversation about how waste-to-heat can work. How is it that people in other countries say, “That’s fantastic,” but in Scotland we go, “No,” or as they say in Glasgow, “Naw—we don’t want it.”

**Professor Underhill:** The answer is yes to having a national conversation, which would be around not only waste-to-heat plants but all aspects of energy and how it affects our lifestyle.

**Professor Harrison:** A lot of what you have described is for mandating new build, in essence. The profit margins of a typical mass house builder are that a three or four-bedroomed house may cost £100,000 to put up but in some places it will sell for £600,000. There is profit in there, although some of it is for land.

**Richard Lyle:** I would love to go to the houses that you buy. [*Laughter*.]

**Professor Harrison:** A two-bed semi in south Edinburgh is half a million, but this is a national issue.

**Richard Lyle:** They say that it costs £5,000 to install a car charging point. If they can put in a telephone line, a satellite line and broadband, they can put in a car charging point.

**Professor Harrison:** A car charging point should be put in. At scale, that would be cheap, because they would be putting in the electrical infrastructure. That is where the opportunity should be taken to do the work at scale and do it properly.

**Professor Underhill:** I really like your idea about wind turbines or solar on every house. Depending on local happenstance, let us build something that is fit for purpose, using things that work in our favour in that area. It might mean ground-source heating if the new build is over an old depleted coal mine that is flooded. If the new build is on a south-facing slope, it may mean solar. Let us have that conversation and build that idea into the regulations.

**Richard Lyle:** Convener, I could physically send you the prospectus of the company that I referred to. The Government already has it, and I am waiting for an answer.

**The Convener:** Would Professor Lunn like to make some brief closing comments?

**Professor Lunn:** If we make Government-led decisions and regulatory decisions about these issues, the cost of technologies will drop once they scale up. That is clear with the cost of solar, for example, which has come down significantly. Making strategic decisions makes a big difference to the costs.

**The Convener:** Thank you very much to all our guests for coming in today. I will suspend the meeting and we will move into private session.

11:50

*Meeting continued in private until 12:14.*

Published in Edinburgh by the Scottish Parliamentary Corporate Body, the Scottish Parliament, Edinburgh, EH99 1SP

All documents are available on
the Scottish Parliament website at:

www.parliament.scot

Information on non-endorsed print suppliers
is available here:

www.parliament.scot/documents

For information on the Scottish Parliament contact
Public Information on:

Telephone: 0131 348 5000
Textphone: 0800 092 7100
Email: sp.info@parliament.scot

The Scottish Parliament
Pàrlamaid na h-Alba