CENTRE for LiveableCities SINGAPORE

SUBJECT:	**CLC Lecture Series: Scotland's Transition to a Low-Carbon Economy**
SPEAKER:	**Mr Chris Stark, Director of Energy and Climate Change, The Scottish Government**
MODERATOR:	**Leonie Lee, Director of Energy and Climate Policy, MEWR**
DATE:	**31 Oct 2016**
LOCATION:	**CSC Auditorium**
DURATION:	**1 Hour 20 Minutes 21 Seconds**

Note:

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xx	CLC lecture series is one of the platforms through which urban thought leaders share best practices and exchange ideas and experiences. In this lecture, Mr. Stark will share how Scotland's move towards a low carbon economy heralds an exciting but challenging economic and social transformation. The format of today's lecture, we'll start off with a presentation by Mr. Stark, followed by a Q&A [question and answer] session with the audience, moderated by Ms Leonie Lee, Director of Energy and Climate Policy from the Ministry of the Environment and Water Resources. We would now welcome Mr. Stark to deliver his lecture.
CS	I'm Chris Stark, I am the Director of Energy and Climate Change in the Scottish government. Now, it's a very grand title, and it's a very grand job and I do love it but it's worth just explaining just a bit about the Scottish government as an institution. So we are the government of Scotland. I worked in Westminster for 10 years, where I worked at the UK [United Kingdom] Treasury for most of that time. My background is in economics, rather than energy or in low carbon. But I moved north to Scotland to work on these issues so it's been quite an interesting time for me too of the past 6 years or so and I'll try to tell you a bit about that. For your information, I'm not just here to give this lecture, although I'm very glad to do it, I'm actually here for nine days and most of that time I'll be with a group of people who've been selected from across all the old commonwealth countries and we've come together once already this year and now this is the second time we'll have met to learn a bit about one of the commonwealth countries and what they've done. It sounds very colonial but I promise it isn't. And it happens to be Singapore this year, and this is a thing that's run annually. So Singapore is the place that we've come to learn a bit about. So I've been reading a lot about Singapore and what it does. And I have to say I'm absolutely delighted to be here and very happy to speak to you today.

So there are some parallels between Singapore, I think, and Scotland. But a great many differences too, so one of the interesting things for me is to contrast those two things.

Firstly, a bit of history about Scotland. I am going to focus at the early part of this discussion on energy. I was just discussing that with Leonie. Energy is a big feature of Scotland's historical past, when you think about its economic development and it continues to be, and they've been various transitions over time around our energy resources so it's been fascinating, so I am going to talk about that. I'm going to talk less about the energy sector, I think that's probably not what we should be discussing today but so much of what's happened in the past in Scotland has been defined by our energy resources so we'll talk a bit about that, and I know that's very… there are some very different… historical differences, between Scotland and Singapore.

Secondly, I'm going to talk about a more modern expression of what it is we're trying to do with our energy system, our economy in Scotland, some lessons or some insights from what's happened in Scotland over the last decade. And next, in the last part of this, if you'll indulge me, I'm going to talk about where we're headed next in Scotland, and a great many ambitions that we have to address some of the issues that we'll be discussing today. Ending with something that… which I'm referring to as a whole system approach to energy and climate change, and I'll try to explain a bit about that too.

So let's begin with history. So first of all, I said I wouldn't assume anything. Let's just talk about Scotland and where it is in the world. So Scotland is, of course, part of the United Kingdom, and this is a map of the United Kingdom; we're the green bit at the top so something between a third and a half of the land mass in the United Kingdom is in Scotland. But, the UK has a population of about 60 million, and 10% of that roughly is in Scotland so our population in Scotland is about 6 million people. We have a number of cities, the capital of Scotland is Edinburgh. Has anyone been to Edinburgh? It's a very beautiful place if you go. And it's the historical capital as well,

it's… all of the professional services, financial services, administrative functions sit in Edinburgh.

Scotland's history is a very interesting one. Typically we were a rural economy; a lot of fishing and a lot farming took place there. And then in the Victorian era, Scotland, in particular a place called Glasgow where I'm from, was the industrial heartland. So there was for a number of years, Glasgow was the centre of industry in many ways, of the Victorian… industrial… the farms, and a great many… I mean we talked about the commonwealth there earlier, huge number of colonial things started with that industrial past that you see in Glasgow. We used to make a lot of ships there, there was a big steel industry there, a lot of heavy industry was made in Glasgow. And it was once one of the biggest cities in Europe. And has since shrunk slightly in size.

And the story I'll tell you today is partly about that post-industrial vision for the economy and what's happened over a period when that was very damaging for the Scottish economy. So we are now past the point where there is heavy industry now in Scotland by and large, and into this, more interesting in many ways, post-industrial, lower carbon vision of economic growth.

The other thing is, I did mention energy reserves, and I'll talk briefly about that so, the story of the industrial revolution, which is a global one, Scotland has a great many links to that so one of the reasons is that there are a lot of coal reserves in Scotland so you'll find right across the centre… if I can use this thing here… right across the centre of Scotland, just out there, we call that the central belt and it ties very closely to all where the coal reserves were. And a lot of the industrial revolution when it started, began in Scotland, heavy industry and engineering because of those coal reserves, so the cities of Scotland grew up around those coal reserves, and the other big energy resource is of course in the North Sea. Scotland in the '70s discovered these vast oil and gas reserves, which are predominantly in Scottish waters so the UK has been taxing that and making a great deal of it for a number of

years now, 40 plus years and there are still a big… there are big oil and gas reserves in the North Sea yet to be exploited although the easy ones have gone now, so that's a big part of our story as well.

Briefly, a word on climate, so it's freezing in Scotland. Very, very, cold, certainly in comparison to Singapore. It rains a lot and it's not very sunny, so it's very, very, windy as well, it's linked to a part in the story I'll tell you earlier [*sic*]. Very, very different climate to Singapore as you might expect.

And then last thing I'll say on Scotland is that the United Kingdom, Britain… I am British, I'm thinking myself as British, Scotland has been a part of the United Kingdom now for 400 plus years, but there is a movement at the moment to consider further independence from the UK.

So you may know that, well, two years ago now there was an independence referendum in Scotland, when it was decided that we would remain within the UK. The other thing you may be aware of is that the UK recently voted to leave the European Union, in a process that's been called Brexit, and Scotland didn't vote that way. So that's again changed the constitutional questions of whether we might remain part of the UK, and some of that energy policy and their policy toward the economy runs all the way through that too, so there are big constitutional questions about how we might handle some of these things in the future. So, very live debate at the moment in Scottish politics and in British politics about the future of Scotland in the union. But, equally, very close cultural ties of course between all of those things. So that's Scotland.

On now to the topic at hand, so I said I would talk about energy and I think it's important to do that because it's so important to the things that we'll discuss today. And the story, you know, the old story that I told you of discovering vast carbon reserves, energy reserves, is one that's well-known, but the one that you may not know is the story of what's happened to the energy market in the UK over that period, over the most recent period. And the UK really led the way with this question of liberalising the energy market

so we once had our own state-owned set of energy sectors as many countries in the world did and still do. But under Margaret Thatcher, there was a process of privatising and liberalising those markets and the UK really went further actually than most countries around the world in doing that. So privatised energy utility companies, and the idea of the state regulating those things rather than owning them.

There was once a very important Ministry [*sic* Department] of Energy, which has been slowly dismantled really, we were just discussing that before the lecture began. And replaced instead with a regulator that we call OFGEM [Office of Gas and Electricity Markets], and now the policy toward the energy market, where the government tries to make it, is largely done in an indirect way so there are, in particular how the regulator is set up, what the regulator is asked to do, and taxes… the taxes that we put on particular types of energy use. And then there are a set of, you might say, more removed controls that the government exercises over the energy market through planning, underwriting for liabilities that we do, for example of those in the North Sea, and there's a nuclear power fleet as well in the UK. There's limited grants available for things and there's been research funding along the way too but basically we're moved from being a country of the world where everything was state-owned and state-controlled to one where actually the state owns nothing any longer, so everything is indirect, or controlled and exercised indirectly.

We have consistently been an energy rich country, in the United Kingdom, and that continues to be the case but we have moved in the last 10 years to becoming a net energy importer, so we used to have very substantial gas supplies in the North Sea, very high purity of natural gas that we found there, and now we are a net importer. There's still a great resource there that's exploited and used in the UK, but now we import more than we export.

And the other part of this story is the planned energy system. This is the map of the United Kingdom, or Great Britain actually, which is the kind of centre island, and we have, we are still kind of living in the United Kingdom with

the legacy of the old planned energy system, so when it was state-owned. So we have an extensive National Grid, one of the most extensive in the world for electricity and gas. 99.8% of homes in the United Kingdom are connected to the National Grid for electricity, quite a bit less than [that] for gas.

And the big pieces of infrastructure generating electricity, we are now at the point where most of the ones that were built by the state have gone and we are relying on the private sector to build the new ones now. So that's what's so interesting about it. And this map is from the 1970s and it still shows you a pretty accurate description of how the grid is laid out, and how the main transmission networks are laid out for electricity, there.

This piece of legislation that you can see here is for something called the Central Electricity Generation Board; it was a piece of legislation that created that in 1957. And that's when we were setting up what is now called the National Grid. So there's been a very long history of a very planned, well-managed energy system, in UK. And at—this is at Great Britain level—this is the story of how we generate our electricity from the '70s onwards, for those of you who can't see it. So the first year is 1970, the last year is 2014. And what you see is the blue line, which is coal, so the majority of electricity came from coal in the 1970s as you would expect. Very little indeed from natural gas, and I know in Singapore you have a predominantly gas-based generation mix. The green bit is nuclear, so that's the other part of the story in UK history of energy. Very strong support for nuclear power in the '70s… '60s, '70s and the 80s, which dropped right off. There wasn't community… there wasn't really a national acceptance of new development of nuclear power. And that has now changed, so we're in an interesting, well we're in… new nuclear is a thing for us.

And the dotted line which you can see at the bottom there is renewables and you can see that kind of steady rise in renewable electricity along the way, and we will come back to talk about that. The big difference here is gas, so the red line shows you gas, and gas for the purposes of generating electricity, which really picked up in the 1990s, when there was… the last sort of big

state intervention in the energy market was to create a set of incentives for new gas power station is to be built, we called that a "Dash for Gas". And you see that very dramatic increase in the use of gas for the purposes of generating electricity over that 10-year period. So that electricity.

And here is oil and gas. And don't worry if you can't see the numbers on this, this is really an illustrative thing, which shows you the UK continental shelf which is really the North Sea, just to the east of Great Britain. And what this shows you is how we've recovered the oil and gas that was there under the North Sea over a period of about 30, 40 years.

And this shows you… each colour is a new field that was discovered, and how the gases, the reserves were recovered. And what you can see, hopefully, from looking at this, is that when oil and gas was first discovered in the 1970s, there was a heck of a lot of it. So the first fields that were discovered, some of them are still producing. Fields like the Forties Field, and they had vast reserves of both oil and gas. And you could almost kind of… you could almost get to the sea, you could dig a bit in the sea and once you got to the bottom of the sea, and all the stuff would come out; there was so much of it. What's happened since is that the biggest fields have been found, almost fully recovered and increasingly the things that are still there are much smaller, which is what this kind of… you see this kind of… all the fields are much smaller as it comes later. And what that's showing you is that basically, now, to recover oil and gas from the North Sea, you need to have much higher investment cost. Much higher investment and potentially much lower return at the end of it.

And we are therefore very, very exposed to the prevailing oil and gas price in global markets, so it's expensive to produce oil and gas in the UK, and although there's a lot left, we don't expect all of that to be recovered now, so we're probably past the halfway point in our oil and gas reserves. And we really need a really high oil price to justify the kind of investment now that would be required to develop new fields in the North Sea.

So, we are facing, really for the first time in 40 years, the idea that we might not… we can actually see an end now, to the point of us producing oil and gas. I don't expect that to be for some time, but the idea of the UK being entirely self-sufficient in its energy reserves is definitely not something that's prevailing in government policy terms. Hopefully you can understand that.

So the other story in our energy sector is how we've invested in research and development [R&D], and this is public research and development. This is the stuff that the government spends with taxpayers' money. And again, please don't worry if you can't see this, this is an illustrative thing, but this section here, is pre-1992, 1993 or '94, so about 20 years of public sector activity there in research and development. And the big thing that dominates it in energy terms is that blue bit of the chart and that's nuclear. So there is a big nuclear civil R&D programme for a long time in the UK. It was once seen as a real national strength actually, that we had developed the expertise to build nuclear power plants. There are a great many nuclear power plants in the UK, many of those skills are exported to other countries around the world. Then that stopped in the mid-90s, and the period after that, there've been much more interest in renewable power in the UK albeit not on the same scale as the spending in the '70s. So we have pretty much changed our interest, I suppose, in technology, over a period of 30 years or so in the UK from nuclear to renewables, and the current flavour of government in Scotland, is a party called the Scottish National Party who are in favour of Scottish independence, and they are anti-nuclear. So they have a different energy policy from that of the UK government. And the way that the devolved settlement is set out, energy is specifically reserved to the United Kingdom, so some of the issues that I deal are very complicated to explain to an audience, but energy policy, in particular the sorts of policies that would support a new nuclear power plant being built, those decisions are still made in London but a set of decisions are made in Scotland that allow us to ban it in effect in Scotland. So if I can explain that a bit more.

Energy policy under Scottish devolution is a complicated thing. I mean in

	1998, there was an Act of Parliament that first established the Scottish Parliament, so that was under the Tony Blair government, if you remember, and it was widely celebrated at the time. There had been a long period of agitation in Scotland for there to be a Scottish Parliament. And when that was created, there was something called the Scotland Act [1998] that sets out the rule of the Scottish Parliament. And energy is not part of that rule. So that's what's so interesting about it really. But Scotland has a long history of being expert in energy used so there's always been this tension from day one around what role the Parliament in Scotland could play in setting an UK energy policy. And one of the things that is devolved to the Scottish Parliament is planning policy so that is the ability to determine the rules for new planning developments and new developments. And it's through that planning policy that we exercise, for example the policy of no new nuclear. So we ban, in our planning rules, nuclear power stations. What you see since 1998 which wasn't very long ago but over the period of the next 20 years you've really seen the Parliament in Scotland, almost from the off, really, really looking to have a role in energy policy decisions, And I think that's because they are so important to the Scottish economy, and again we'll talk about that in a second. And when the Scottish National Party came into power, they were very keen that there should be an energy minister, so there is now an energy minister in Scotland. I run the bit of the civil service that supports that minister. So there is an energy team, there is a climate change team there goes alongside that, and really a very active energy policy now in Scotland from the Scottish National Party despite the fact that it specifically not… it's been ruled out as part of the Scotland Act, so… Don't worry if you haven't followed all that, but it makes it extremely interesting to do the job I do at the moment. So part of what we do, in effect, is to make the case for decisions to be taken in London, and we often disagree, so… in a very public way we have a very different policy towards energy than the UK government does, which is great

because it means I can stand up in front of you and critique what my UK policy colleagues have wrought…

So, that's the background and I hope you followed that, but that's some background on Scotland and how we make decisions about energy; I said I would focus on energy. I'll focus less on energy now if I can. So, Scotland as I mentioned has its own ambition and it has an ambition for low carbon actually, or decarbonisation more than it does for energy. So if you stand back from that, how does it express that? Well, in 1998 the Parliament was set up, and it has since then, as I mentioned, been looking at what it can do to try and define its own policy towards the decarbonisation of the Scottish economy, and that was really expressed in 2009 with this piece of legislation. I wouldn't normally stand on a platform and talk about a piece of legislation, because that's very boring and dry. But this is a very interesting piece of legislation, which if you have an interest in low carbon, it's worth looking at. And it was passed unanimously in 2009 by the Scottish Parliament and it's an incredibly far-reaching set of things that are contained within that Act.

I will talk a bit more about that later but the legislation itself was very interesting so the government of the time was a minority administration, that is, they had to rely on another party in the Parliament to get the legislation through and the party that it relied on was the Green Party, which as you might expect was very pro climate change… pro action on climate change… and really the product of that relationship was this piece of legislation. And it sets out a whole load of things which I won't talk to you about today, but basically it requires us to have a 2050 target to decarbonise the Scottish economy and that target is to reduce the emissions in Scotland from to where they were in 1990, by 80% by 2050, so an 80% fall in carbon over that 60-year period.

And the other thing that it does, is it requires us, the Scottish Government to put a plan to Parliament every three or four years, and we're about to do that for the third time in January and I'll talk to you about what we'll do. But the Act is really prescriptive about what that plan must say, so that it doesn't

give you any wriggle room. You must put a very tightly defined plan for how you will reduce emissions by 80% over the next 30 or so years. And the plan has to be credible, so the other thing the Act does is it sets up another body to independently scrutinise the plan. And it's very difficult, some of the decisions that are required to decarbonise on that level are very, very difficult. So we are really now, for the first time being required to put some of those things to Parliament and they are big economic decisions about the future for the Scottish economy. So that's really where I am… there's the kind of statement about Scottish ambition which I'll return to several times. But what it requires, is a remarkable change really, in both the Scottish economy and in the Scottish energy system. So a system change really, or at a scale really, that we haven't done before, and which most countries around the world haven't done before either. So our ability to hit an 80% reduction in emissions will be entirely determined by decisions that we take really over the next five years or so because these are big infrastructure questions that take generations frankly, to sort out.

And we have a bit of information about how we might do that so if I could just dwell for a bit on what's happened in Scotland over the last decade. And the big story in Scotland over the last 10 years has really been about, again, our power sector. So in Scotland, we, for a long time, had what was more or less a separate electricity system from the rest of the UK, with even a separate voltage and all sorts of things attached to it, and very little inter-linkages between Scotland and England for the export or import of power. And what's happened over the last decade is that we have very strongly supported the process of building brand new transmission links between Scotland and the rest of the UK, so north to south. And so National Grid has invested billions and billions of pounds sterling over the last 10 years and about half of that has been in Scotland to build new transmission links to export power.

And the reason for that investment is because we have such big renewable resource in Scotland. So it's really windy, it's the kind of… It's not very

sunny, but it's very, very windy, and it's very wet as well, so we have a lot of water to do things with too. And we are now, I mean the vast majority of renewable investment in the UK has been in Scotland. And we are now seeing them, the impact of that, so if I show you… this is our Scottish renewable electricity output since 2000 to where we are today. And the blue bit is some very big hydro-stations that were built in the 1950s and '60s and '70s by the UK government. And what's changed in the last 10 years or so is the green bit of the chart, and that's renewables. That's onshore wind. So we've seen this dramatic increase in onshore wind and if I just tell you what that is, it'll give you some flavour of how much that's change.

If you think about the percentage of renewable output as a proportion of how much we consume, we are now, as I stand here today, we are producing 60% of the electricity that we need in Scotland from renewables which is a vast figure, and it's changed dramatically, so in 2003, that figure was about 10%, which was all hydro at that point. And mainly that's onshore wind, so we've seen this very, very big change now in how we produce electricity over the last 10 years. And another way of looking at that, this is the generation mix in Scotland. In 2014, the blue line at the top there is nuclear. So we have two very big nuclear power plants. We used to have more, but as they are closed, they are not being replaced, so that's the government's policy in action. The green bit is coal, and gas is the purple bit, and the bit that's rising all the way through that is the red line and that's renewables.

And here's another way of looking at that, this is the Scottish electricity generation capacity. The black line is how much we need, so, in Scotland. The rest of it is exported now over quite substantial transmission links. And the majority of that now is wind. So wind generation now is the biggest single source of generation. The next bit, the red bit just above that is a place called Longannet. That was a coal-fired power plant which closed this year. And as I speak to you today, the very interesting thing about that is that we have… if I just go back to this chart… today, in 2016… I don't have the data for it yet… the last coal-fired power plant closed this year so we have no coal

on the system whatsoever. Gas is hardly used at all. We still have nuclear power and the rest is renewables and that's continuing to rise. So we have a more or less fully decarbonised electricity generation sector in Scotland. There is hardly any basis of carbon at all, there is only one gas plant which is very small, which is used only for backup.

So we are one of the first countries in the world to fully decarbonise electricity provision. And the reason we're able to do that is because we've built this input capacity with the rest of the UK. So although it's great to say that we're fully decarbonised, the reason we're able to do that is because we're importing electricity all the time when it's needed, when the wind doesn't blow from England, over very big transmission capacity that we've built, and that's an interesting thing to do, it means that we're specialising in what we're good at, I suppose. So if there is a lot of wind in Scotland, it makes sense, I suppose, for us to be generating electricity from it. But when the wind it doesn't blow, we are now, we are dependent on another part of the UK or another country you might say, for that not to be a problem.

So we know a bit about how to do these big system challenges, that's just the challenge in electricity. But the interesting thing about decarbonisation, when you've already done it for the power sector, and here is where I think it's interesting to for Scotland to set that challenge to decarbonise at that level. We can't look to the power sector any more. We need to look to the other sectors of the economy to decarbonise. And that's extremely difficult so some of the wider questions of how one decarbonises at that level are still to be answered, really. And we're going to have to answer them over the course of the next 12 months or so.

So we've really come to the end of an era for the story on energy policy, and I'll just briefly explain this chart. So, we've had for a long time, quite a strong comparison between what Scotland wanted from its energy system and what my colleagues in Westminster of the UK government, wants from its energy system. But that consensus changed this year with the change of government, I suppose you might call it, in Westminster. So, we moved… I

won't bore you with politics in the UK but it became a Conservative government in the UK, for the first time in 20-plus years, and basically they have reset energy policy. So Westminster government has reset its approach to energy, and it's returned to the doctrine of conservative governments throughout the world—which is markets. It's all about markets now.

So they have, they've done a number of things, which are really about changing the way the energy market is structured. It's not entirely anti-green, but some of it is. They've ruled out coal, so any coal in electricity generation will be gone by 2025, and that's a good thing from our climate prospective. And they've given the green light to nuclear power, so these are the big changes, really that… and we are against that. We, the Scottish government have a position of being against nuclear… bit of that. Previously, they were very pro-renewables. So previous incarnations of the UK government gave quite generous subsidies for renewable generation. And that has changed. And really that's what this chart is showing you. For the first time now, we have a budget for the subsidy that are offered for renewables. Previously, there was a very generous thing called the renewables obligation which is a traded certificate for power generators.

And now, the total cost of that is capped in a single budget. And the budget for it out to 2021 is already spent, so there will be no new subsidies basically for renewable power in the UK, except for offshore wind, which is still an industrial question. So in Scotland, we are not going to see the kind of investment in renewable power that we've seen over the last 10 years because there isn't a budget to pay for it now, which I suppose is the main message. And we've now kind of reached this point where the UK government have done a number of other things, like they've removed some of the incentives for energy efficiency that previously existed in the market, and they've returned as far as it's possible to do so to the idea that the market decides. And of course the market likes cheap carbon-based power, so that's the tension now that you see now laid out in energy policy. And really we are not a position to address this directly, so the idea of there being subsidies for

renewables is something that is defined entirely by my colleagues in London. And we are now, in Scotland, thinking what we can do about that. And that is the last part of this lecture, so I'm going to talk a bit about where we're going next with this.

So we can no longer rely on the policies that are set from the Westminster government in London, to do some of the things that we've previously set out as our objectives and we therefore need to do a lot in Scotland ourselves, is the best way to think about it. So we have to define our own policy towards the energy system.

And that, I think, leads you to this: so rather than worrying about energy supply, or electricity supply, we are going to, in Scotland, think a lot more about energy consumption. And it's a fascinating thing to think about the world that way and I'm sure that you don't think about the world that way but throughout the world, energy policies are typically considered in terms of energy supplies, particularly about the supply of electricity or the supply of gas, or… And actually, you know, that's, to my mind, slightly… that's quite an uninteresting story now. So if you look at this chart, this is how in Scotland, we consume our energy—across the three main types. I expect this would be a very different chart in Singapore. But the green bit is electricity consumption. So it's about a fifth. A quarter of our energy needs are for transport, and more than half are for heat. That's the bit I think would be very different in Singapore. Heating and cooling, I suspect.

And that bit, that heating bit of it, really stands as the central challenge for us. And what's so interesting is that, I've just done it here as well, you know the discussion on energy policy typically focus, certainly in the UK, on that fifth of the chart, almost to the exclusion of everything else. And what's interesting, for me at least, as a policymaker working to the Scottish government, working to the Scottish Parliament, is that most of the policy tools to change the energy system lie in how we consume our energy. And therefore we need a better policy towards those things. So what that means really is that a better energy policy would have us living in warmer homes,

for example. A better energy policy would have us using the transport system less, or using different types of vehicles. And that's the way we are now interpreting our energy policy in Scotland.

So we are more focused on how we consume our energy, more focused on reducing our consumption of energy. And the policies that are necessary to do that, lie in quite different areas from the way that conventional energy policy, at least, is considered. It's about housing, and transport, and how we use our land, how we use our rural economy.

And just another insight on that, this is domestic energy consumption which just gives you a better idea of how we consume as citizens. Again the thing that really is important to how we consume our energy is heating in Scotland. Unsurprisingly, if any of you have visited. But there is a whole story going on here in terms of our domestic energy consumption. So the biggest part of that chart of course is the blue section—that's space heating. But you might add into that hot water as well. A half to two thirds of our energy needs in the domestic sense are defined by the need to heat. So you know, we are… the reasons for that, of course it's cold, but we actually have a… we don't have a great quality of building stock in Scotland.

Two reasons for that, a lot of the buildings in Scotland were Victorian buildings, they weren't built with energy efficiency in mind. They're hard to treat, in terms of energy efficiency measures. And a lot of the new housing stock that was built over the 1970s was built ironically with the idea that it would have at night, free power from nuclear power stations to heat them, so they weren't built, again, with the idea of energy efficiency in mind. In fact they were built to be very energy inefficient. Those houses have quite literally a heating source that is… it's electricity. And it's bricks in storage heaters that were defined to be heated up at night when there was an excess of nuclear power and less demand.

And that idea of nuclear power being the single source of electricity never took hold in the UK, so there was always… in fact coal was always the

dominant source of power. Other countries around Europe went further, like France, for example. France really grabbed the nuclear thing. Nuclear is not very flexible, so once you turn a nuclear power plant on, it's hard to turn it off. And the idea was that we would convert that electricity to heat at night, and therefore that the new building stock would be heated fairly cheaply. And that didn't happen. So there is quite a unique set of challenges to the building stock in Scotland that needs to be addressed. They are common across northern Europe, where prevailing weather conditions are similar. But that idea of the Victorian building stock and the newer buildings all being themselves quite different… difficult to treat in some sense is a big issue for us.

So we're going to be looking much more at those things when we think about our energy and economic policies in Scotland. And this idea of heat is something I want you to bear in mind. The other thing is transport. So, we are still, although we have six million people living in Scotland, the majority of them live in our three main cities, which are Glasgow, Edinburgh and Aberdeen. There is another city called Dundee as well, which is… which is where… they're all within one grid. But we are still very spread out, so a great many people, 30 to 40% of people still live outside the cities and have a lot of… to have big transport requirements. So many of the emissions that we are seeking to tackle will come from people whose emissions are hard to tackle unless we change the type of transport that we have in Scotland. So that's the other part of the story here – transport.

So we are moving on, I suppose, and if you might… take from this that we've done something really quite amazing actually, to this bit of the chart, which is to decarbonise it, and make it renewable, and we rely still on the nuclear power plants which we expect to last for another 10, 15, 20 years. The big challenges for us are now in heat and transport, and in changing that, to decarbonise that and to be more efficient about all of that, when we think about it. And that's what I'll tell you more about now.

So this is a great chart, which don't worry, I'll talk you through, but this is

how we consume energy. This is a chart of British energy consumption, there is an equivalent for Scotland, and it's over the course of four years. The equivalent chart for Scotland is just the same, so I don't mind talking a bit about the GB [Great Britain] energy consumption. What this shows you is four years of energy consumption. Sourced in all the ways that we've discussed, and why do I like this chart so much, well it shows you the three things that we've just discussed, but it shows you over the course of years. So the bottom line is electricity consumption, and what you see is a shallow wave as it gets darker over the winter, basically, so we have greater lighting requirements.

The next chart is transport fuels, and it's pretty flat over the year, and the reason for that kind of stepped thing is that we had data from the forecourt and gas stations. And the thing that utterly dominates that chart is heat. So that's gas really, almost all of our heating comes from gas.

And why is that such an interesting chart? Well, it shows you so much about what you need to do to your energy systems. So the first thing to say is that you may have heard someone like me, standing on a platform like this 10 years ago, talking about electrifying heat as being the answer. So there was the idea of that time that we would make renewable power, and then we would convert our basis of heat to electricity. But this chart shows you why that's not possible because it is very difficult for us to electrify all of that and because we'd have an enormous amount of redundancy in the system. So we need to meet the peak of that chart there, when it's coldest, and in the summer when it's warmest, we need almost none of that infrastructure. So electrifying all of that is not a good idea. So there's a set of challenges there.

The other thing that strikes you is that if we're going to have renewable power, renewable is intermittent, so we need a way of storing it. So if we're going to do that, we're going to have to do something quite dramatic to that whole energy system. So if I just overlay on that some of the priorities for our energy policy as we think about it, we need to increase the clean supply of electricity to meet all these new demands. We're going have to have a

more flexible power system to do that, so we're going to have to have new forms of energy storage, as batteries and some of the old things too. We're going to have to have a smart, more localised system of energy provision and use, because we're producing electricity and power in places, and heat in places that we'd never envisaged before.

And we need to reduce the demand, in particular for heat, and the main way of doing that is by having a better policy towards our building stock. So we're going to have to regulate to improve the quality of the building stock, we're going to have to have incentives, some of them tax, some of them directly, financial incentives to do some of that. And we need the private sector to do the majority of the investment there. So we need a new set of building standards, new set of building regulations to do that. And we have to have lower carbon forms of energy storage, and especially making use of that gas grid that I talked about. So the gas grid at the moment is our biggest storage asset in the UK and in Scotland. It's filled with natural gas at the moment, but the question whether we can decarbonise the supply of gas and use that is a big thing for us. We have to reduce the use of traditional transport fuels, and that means having one of the world's most ambitious strategies towards low carbon vehicles. And we need a strategy overall that's about decarbonised fuels, more generally. And we're going to try and make that as a Scottish opportunity. We already know a lot about refining of fuels, we do a lot of it because of the legacy of the North Sea and our oil and gas reserves.

So there's a heck of a lot coming. And these are kind of the summary themes of what we need to do over the course of the next year or so… is implement a new Scottish Energy Strategy. So if I just finish on a brief discussion of that, we are going to try and have a policy towards energy and this is just energy that tries to look at the whole system, that's both supply and demand, and that means we need an integrated policy towards heat, power and transport, for the first time. We need to do that in line with the Climate Change [(Scotland)] Act [2009], so the 2050 goal for that Act, so we need to have a

stable idea, an idea of a stable transition over that time.

And this thing about localised energy provision. Our energy system, more generally, is becoming a more localised or distributed thing, so we no longer in Scotland, for example, have these big centralised power plants that we used to have. There are a great many dispersed wind farms now, in places there are solar panels on roofs. Everything is done at a smaller scale so we need to think of a way of integrating all of that so it's to the benefit of the consumer.

And the last thing I'll cover, I promise this won't be long, is in addressing that whole system thing, we have to address the central challenge of decarbonising, so back to this Act of Parliament that I talked about, the Climate Change [(Scotland)] Act [2009]… Briefly, that sets out a requirement to reduce emissions by 80% from where they were in 1990, a huge challenge, and, to put regularly a plan to Parliament. And when we do that in January next year, that will really be the first time we've had the economic modelling capacity to do it properly. So we've never been able to model the whole economy and to understand where the carbon emissions are, and now we are able to do that. So really, when we put the plan to Parliament in January, that will be the first time we've been able to do a real piece of planning around what sort of economy, what sort of energy system, how we would like to have by 2050, how we expect citizens to respond to that, what sort of incentives, motivations, we need to put in place to make it work.

And the other thing is that, there was a Scottish election this year, and the party that won again was the Scottish National Party, and they just did a manifesto of having a new Climate Change Act, or a new Climate Change Bill which we expect to up the ambition even further so we might expect something like a net zero emissions target to be implemented over the course of the next year as well; we need to work that up into something. But that will be in this year's… next year's parliamentary session, so we are working towards a more ambitious statement, even still, of climate objectives in Scotland.

	And I suppose the really interesting thing about that, why do it? Why do this at all because our actual contribution to global emissions is tiny? And the answer is two things, really. One is that our historical contribution to emissions is enormous. We still rank, even Scotland alone, ranks in the top 10 net emitters in global climate terms. So all of that heavy industry I told you about was based entirely on the burning of coal, and of course all the oil and gas reserves that we pulled out of the North Sea, some of which were exported, some were burnt in the UK, have a massive contribution to the global challenge, so there is a kind of a moral obligation for of us to do something about that. But the other thing that this Act is about, is I think, turning around the Scottish economy to a genuine low-carbon basis, and the reason to do that is actually an economic objective in the long run. So, if we do it, in line with that Act, quicker than the global economy chooses to do it, then we should at least in theory, build a set of services, industries, standards, sectors, products, that can be exported. And of course we did that in the early years of industry in Scotland too, it was all the engineering that was done in Scotland that was exported throughout the world, So I think this Act is really a statement of, in many ways, macro economic policy over the long run. This is about us trying to do something in Scotland before others do it. Whether that's true or not is another matter, but that's what the Act needs… it needs to deliver. And very briefly, I mentioned where we were, this is where we are on that emissions reduction target. So the start of this chart is the baseline for the target, 1990 levels of industry and carbon. And today, we are sitting at a roughly 46% reduction on that level. So we've almost halved emissions since 1990, which is an enormous thing to have achieved. But the majority of those emissions falls were achieved by de-industrialising the Scottish economy, so… Margaret Thatcher's industrial policies to close heavy industry in Scotland, steel plants, ship-building, those sorts of things, have led to the happy circumstance of us having halved the emissions. And the other part of it is our power sector.

So those things have been done. It is hard for us to extract further emission falls from industry. And what's left is much harder, frankly. So that's the other part of our story… is that, that is an unique challenge, almost, to Scotland. We've done the job of removing all industry and the heavy industry and we've done the challenge of decarbonising power provision. What's left is really about transport and heat, and these are issues… heating and cooling are issues that other countries around the world will face in due course but probably not in the same time frame.

This thing here is our interim targets. We are ahead of our interim target, and that's the ultimate goal.

And two more slides, I promise. That's how those emissions will fall over the period left, to 2035, when we are required to have a target. We are modelling a lot of that and are really quite… another thing that we are very proud of is the economic model that sits beneath this, so we are modelling things in our whole economy. We have a patching in all these micro-models for every sector of the economy to allow us to do that. And in January when we make that plan and put it to Parliament, we're doing it by having this idea of collective decision-making around the Scottish Cabinet table. So we're using that economic model to constrain the choices of our ministers for the first time.

And they will have to make a decision on how we decarbonise each sector of the Scottish economy. So we need to put to Parliament, not only the plan to decarbonise in that way but quite detailed set of policies to allow that to take place. And this is the drop by sector, where… each sector is represented here. And a better chart is this one, which shows you how those sectors are planned to decarbonise over that period. So this is what we are looking at… this is a very live thing; I've just taken the latest modelling run.

What we are doing is we have a Cabinet in Scotland, and that is the Scottish Cabinet of Ministers who make decisions and they are bound by this economic model. So what that means is, if they are not happy with the

	policies that decarbonise the housing stock in Scotland, that's fine, but they need to make a decision about what, therefore, they do, for example, to the transport sector. So the two things are constrained by the overall target to decarbonise in Scotland which is laid out by the legislation. So every choice has a consequence. And the Act is very prescriptive about the need for a plan. So the very live discussion that we have in Scotland at the moment, is how much should we expect from the transport sector, and you can see here where that stands at the moment… You'll see electricity is already fully decarbonised, that's what I mentioned, so that… the tall bit of the chart… the electricity sector, there, has gone already, so that's the coal plant that we have, the last remaining coal plant. We are actually predicting negative emissions from electricity at some point, and that's carbon capture and storage, so we need that technology to come along too. But what's left really, [unclear, feedback on audio at 48:00] very much, so the challenges are great for us, in particular, the building stock and the transport stock, and that's where the big challenges lie. The rest of it, agriculture you see, is very big but it's difficult to address, so it's hard to remove emissions from the agricultural sector. And I won't go through this, but there are various packages of policies that support that, and some of them could… very dramatic… policy changes there we'll have to see implemented over the course of the year. So I hope you will look forward to that happening in Scotland, and I hope there will be a set of very ambitious policies that will allow us to say credibly for the first time, how we intend to address climate change for the first time. And I'll stop there, for questions. Thank you.
LL	Hi, I would like to thank Chris. I thought it was very fascinating discussion. There are some similarities with the Singaporean approach. But our ambition isn't so great, you know… Chris, 80% is very, very ambitious. For Singapore, we've pledged at the UNFCCC [United Nations Framework Convention on Climate Change] last year in Paris to reduce our emissions

	intensity by 36%, from 2005 levels, and it's not absolute emissions, it's emissions intensity because we are a very open economy so a lot of the products in Singapore are exported, so we thought that would be a better way to account for emissions. But that's our plan too. And I think there's a lot that we can learn from the Scottish government. But I will not dominate this session, maybe I can open the floor for questions for Chris?
David [Lee?]	Good afternoon sir, thank you for your presentation. My name is David [Lee?], I'm from North West CDC [Community Development Council]. I know Scotland is really huge compared to Singapore. Our population though, is quite close. I just want… At the beginning you were mentioning that there were some similarities and differences between Scotland and Singapore. Could you maybe briefly let us know what are the similarities and what are the differences? Thank you.
CS	I can say… I mean, the main similarity is the population. So what's so interesting is that we have almost exactly the same population; I looked it up before I came here. But just such a dramatic difference in… I mean, I've talked a lot about energy, and I think that's because [it's] the central theme running through all this, but such a different set of energy priorities here. You have similar power requirements so there's the other thing there that we can talk about. I think the… both… what's interesting is focusing on this idea of the system, the challenge of decarbonisation, So actually the idea of carbon intensity is where we're heading in Scotland actually as a means to address all these things. And when you do that, if you focus on a system metric like that, it's better actually, as a means to understanding what policies you require. And it's much more tolerant, therefore, of the differences in the economy for it, that we have in Scotland versus the economy somewhere else. So what I hope is that we, in Scotland, learn something about how to implement the right basket of policies if you focus on the right metric, and that might be something that we could export to other countries in the world as well, if we were able to do that.

	But the answer to your question is, I think there are probably very few similarities in terms of the carbon and the make-up of the economy. But a fascinating contrasting challenge for a similar population, so that's… I suppose that's what I find so interesting looking at it. So, very few similarities… I shouldn't have said that at the start… other than the number of people who live here.
James [Tay?]	Hi, I'm James [Tay?] from CLC. You spoke about Scotland having a devolved government and a highly privatised sector. So then, in terms of your carbon policies there is limited levers that the government can use outside of economic and financial levers. So how do you think then such an aggressive target is doable with very limited control from the government?
CS	One of the criticisms of that piece of legislation I talked about, the Climate Change [(Scotland)] Act [2009] is that the Parliament made a decision unanimously to implement that target, but without all of the economic levers to do so, so that as a devolved government, some of the central economic levers… so things like carbon taxes are very difficult for us to implement. And it has been criticised on that basis. But that's what's so interesting about it, the fact that we don't have those levers at our disposal forces us to think about a side of things that are really about… it's that question of energy consumption. So, and we will have to have, in Scotland, a domestic policy that is much, much tougher on emissions, or rather energy efficiency, from transport and heat, and that's it. And both those things are fully devolved issues, so we can have a planning policy, we can have a set of building standards that are different from the rest of the UK, and we can regulate such that if, in the event, at some point in the future, the building stock is not as energy efficient as it should be, then consumers are forced in some way, or coerced in some way, to do something they may not otherwise do. So we're going to have to look much harder at those issues of setting regulation and standards, and those are politically very sensitive issues.

	I mean, I don't sit here today with a… I have an idea of what we might do, but my politicians, the politicians that I work for may have a very different idea of whether that works or not. So what's really interesting about that Act… it's where I keep coming back to, is it requires the politicians to do something they wouldn't otherwise do, which is to set a long-term policy for these things. And the fact that some of the economic levers are not at our disposal just makes it harder. And these are the sorts of challenges that every country around the world faces actually. So I do believe that there is a chance that we will do, by addressing these things now, we will have to develop a different sort of economy in Scotland from even the rest of the UK, and that should be exportable. Some of these things should be something that we can learn a bit from and develop our economy around. But I'm not shying away from the fact that some of the things that we'll need to do are really tough. So they are not naturally bedfellows with economic growth, for example. These are things that are a challenge to, at least conventional ideas of how you keep the economy growing. And that's really tough too. But the Act is designed like that. So it assumes a set of things, and you may not be familiar with this, but there is an emissions trading scheme that works right across Europe, this is a bit… we have… trading carbon emissions. And the Act assumes that [EU] ETS [European Union Emissions Trading System], as it's called, does its thing. But if it doesn't work, then we are required to make up the shortfall with our own domestic policies. So, you know, these are things that are very, very clearly considered and thought out in that piece of legislation. Parliament spoke unanimously when it passed that legislation, so we are… you know, we could… there's no sense in complaining about it, we've got to do something about these things.
UNKNOWN MALE	I want to know if Scotland's population, is it still growing? And what is the growth… what is the GDP [gross domestic product] like for Scotland? Another question I'd like to ask is whether there any plans to… for the

	buildings to go net zero in the near and medium future.
CS	So, GDP, I should really know that stat [statistic], and I can't remember what it is but is roughly 8.3% of UK's GDP, so it's very in line with the population. So we're 8.3% of the population, we're 8.3% of the GDP. And the population is growing, but very slowly. So we have a problem with our ageing population. There's a big demographic issue. So we… I mean one of the reasons for being here this week is to learn a bit about how Singapore has managed its economic issues and the challenge of population here. It's very different in Scotland. So Scotland has, you know, an ageing population; it does grow, but most of the growth comes from migrant workers—so from the rest of Europe. So there is a very, very interesting or horrifying, depending on where you are, story of what might happen if we leave the European Union. Because we rely on the fact that there is free movement of people around the European Union often to fill the population challenges that we have. The Scottish economy is quite a successful economy though. So we are, if you remove London from the UK, not that you'd ever choose to do that, but the London economy is unique. You know, it's a super-city, a global mega-city. We… other than that, the Scottish economy is probably the best performing bit of the UK. So that… at least on conventional measures. So it's a successful economy but it's predominantly services orientated. So Glasgow and Edinburgh are very big services sectors. And the other big sector we have is oil and gas, so although we are… it still dominates as the biggest single industrial sector that we have now, in the oil and gas sector. Although its production is declining, what we're seeing is a set of industries now that are rooted in Scotland, so they're exporting services, really, to oil and gas industries right around the world. So that continues to be a big and important part of it. But it's a growing economy, albeit not growing as fast as London. Our population does grow, but we are ageing, is the best way of describing it.

MALE	What about the building sector? Are you building… 00:57:21
CS	Ah, of course, the net zero!
MALE	The net zero, yeah.
CS	Yes! I think, we haven't got there yet, but I think it's essential that we'll have it. I mean, if I was a betting man, and I'm not, but it is impossible to meet those climate targets unless there is a commitment to net zero. So the easiest decision is to have a standard of net zero emissions for new builds, but what we know is that by 2050, somewhere between 70 and 80% of the housing stock will be existing, so it's things that are already around. So the biggest challenge isn't in setting that new building standard, it's actually in addressing the existing housing stock and the existing building stock. And it's not just the… it's not the housing stock, it's the other thing that's often referred to. It's the building stock, so it's commercial buildings as well as public buildings. And there is a huge challenge outside of residential building stock to address too.
KWEK?	Ok, I'm Mr. Kwek. I'm from the oil and gas as well as from the marine renewable energy [industries], in Singapore. Few… couple of questions as well. First, I noticed that the R&D for the renewable energy in Scotland in 2010, it peaked. And subsequently, it's gone down. Is there any particular reason?
CS	Sorry, I couldn't hear that properly.
KWEK	In 2010, the R&D funding for Scotland, have gone… there is a peak. But subsequently, it's been going down. I just wanted to know is there any particular reason. And second question, you mentioned about storage. Could you touch more on energy storage systems? Because we all know in the world, if these energy storage systems come true, it will change the whole landscape in how good the power is being consumed. And the third question, oh sorry, I got a hundred questions… No, I've got a third… last question.

	Power grid, the microgrid, if you are going towards this direction? 00:59:05
CS	So these are really, really interesting questions. I mean I spend most of my time in this job looking at those sorts of questions actually, increasingly looking more at the question of the building stock in the last year or so. So the question of the R&D figure, remember it's public R&D, so this is money spent by the state on research and development. And you're quite right, so it does drop off and the reason is because we have a mature sector. So the technologies that matter most to the UK market, and I mean UK market are onshore wind, and increasingly it's offshore wind. And we're looking, if you think about the example of onshore wind, so many of the technologies for wind turbines that you see in countries right across the world were first developed in Scotland, so in some of the engineering firms that we have in Scotland. But they were not funded by the state, and the IP [intellectual property] for those technologies went to Denmark. So Denmark has become like a global leader in the design of wind turbines based on a set of intellectual properties that actually started in Scotland. So that lesson of almost how not to do things is a bit of a problem for us. But basically, there isn't much now public R&D in energy technologies at the moment in Scotland, or in the UK for that matter. So the government is not investing in a huge amount of R&D support, directly anyway, and the kind of research and development that it used to do in things like nuclear technologies. It's using instead, its regulatory powers to require industry to do something. And the best example of that is what the UK government is doing, with the Scottish government support, with offshore wind. This is wind turbines in the sea, where the resource is enormous, and where there are far fewer planning concerns. So it's far easier, in theory at least, to build an offshore wind farm then it is onshore. And what the UK government is doing is regulating to give a price for energy to those suppliers who are in the private sector that falls over time. So they are forcing innovation in the offshore wind sector by reducing over time, the

prices available or the price at which the power will be bought. And it's through those sorts of measures… we wouldn't show in that chart now… and that the government is intervening to try and drive research and development activity where it can. The question of whether that's an effective strategy is still moot. So it may be that that isn't working. But that's the reason behind it.

So you asked about energy storage. And energy storage, it's worth remembering energy storage is often talked about as if it's something new. But of course it isn't. So, all the technologies, the low carbon energy storage technologies that we think will be important are up against the most efficient form of energy storage that we know and that's carbon. So, you know you can have a lump of coal and we could have it here in front of us now, and that would store energy for a millennia, very cheaply and it's very efficient at it. So we are… all energy storage in comparison with that will be inefficient. So one of the problems is again the regulatory barriers of making the market work in the right way such that that happens.

So we already have in Scotland, very large amounts of energy storage in the form of pumped hydro, so… and most of that was built, again in the legacy of the state-supported, state-owned system. The incentives in the market to build new pumped hydro aren't there at the moment, so that's something that would need to be addressed, and it's very expensive. We are, though, very interested in some of the alternative technologies which might not be so expensive, they don't have the same infrastructure cost, and which are quite efficient actually, in storing energy and which might not even need the same regulatory support. So batteries are something that is very important, but batteries are providing a different service frankly, from pumped hydro.

The big… for me at least, the big interesting objective for us… at least a thing that we should be looking at more is the gas grid itself as a storage asset. So were we to change the fuel source in the gas grid to hydrogen, hydrogen is a much cleaner… Well, it is clean. The source of it may not be clean, but… generating hydrogen is also potentially a game changer. So if we've got lots of intermittent renewables for example, when the power is not

required it could be producing hydrogen effectively as a free good, and that can be stored in the gas grid.

I think increasingly in the future, if we were to address the kind of system change that I've talked about with those climate targets, then we are going to have to use the gas grid as a decarbonised fuel storage asset. So I think that's where my interest predominantly lies. But again that's in the long run. In the short term I think batteries will be a bigger thing in the UK market for energy storage. But really what they're offering isn't storage, it's a system flexibility service that allows you to compensate for the fact that the power is intermittent. So there is probably still something missing that addresses the storage needs that we needed at scale. And again, a lot of… the fact that we have that target, the 2050 target means that Scotland, at least, should be a place to come and do innovation and to invest in those sorts of technologies to see whether they work. So we are very open to that as a priority for the Scottish government.

And related to that actually is this question of microgrids. So what's interesting about the Scottish energy system is how distributed it has become over the last 10 to 15 years. So the old paradigm of, for example, a big coal-fired power station in an area where you would have a coal-fired power station with lots of transmission to the places where the power is needed and the dumb consumer, you know, the consumer who just consumes blindly at the end of the line. That's all gone in Scotland. So we produce power now in places that was simply never envisaged 10 years ago. We have wind farms all spread out right throughout the country where the wind resource is best rather then where you might put a power station.

We've successfully connected those wind farms to the grid and we're now in a situation where… solar, believe it or not, in Scotland is quite big at the micro level, every new house almost exclusively has solar panels on it. We are generating power in places we never thought we would. And the challenge of renewable heat is the next thing. So if we are moving to one, and I think we are, where we are more locally self-sufficient in our energy needs,

	that is that we use it, we produce it and use it in a more localised sense and therefore the challenge is in having a smart system to manage that, then Scotland is a really good place to look for how best to do it because we're already managing that system now. And just to bring in the thing of the challenge of the building stock, if my programme to improve the building stock is going to be successful, then the other thing we need to do alongside the sorts of energy efficiency measures that we'll need to implement in every building in Scotland, is to have smarter energy systems within those buildings. Then again that's a story of having a more localised energy system than we have at present. So, a smarter and more localised energy system is one of the central objectives for our energy policy on a 2050 scale. Some of the challenges we don't know the answer to, but I know that we will need a regulatory environment, and a policy environment that supports some of those smarter, localised solutions. And I would absolutely encourage you to come and see some on the things that are done already in Scotland to manage some of that, because we have now, vast swings between when the wind blows and when it doesn't blow, and the management of that system is a huge challenge for us.
PSB	My name is [Pek] Shibao, I'm from Singapore Institute of International Affairs. I have two questions. First question is, I think with COP [Conference of the Parties] 22 coming up very soon, it's quite relevant to think about the kind of emissions that the INDCs [Intended Nationally Determined Contributions] that the UK has committed to. So I was just wondering what part or what percentage does Scotland play in the overall UK emissions landscape and whether there is kind of a sectorial difference, as you mentioned, because Scotland has a devolved government, in terms of what each territory or each country is obliged to commit to with regards to achieving these INDCs. And my second question is with regards to transport. So you mentioned that

	one of the major challenges for Scotland is that a lot of the population still live in rather remote areas and the two main solutions that I can think of to deal with making transport less carbon intensive is either to provide more public transport infrastructure or provide a shift to, perhaps, electric cars. But both of those also face challenges with such a rural and dispersed layout. So I'm just wondering if you have any thoughts on that.
CS	So to deal with it… I haven't quite got the figure in front of me, but we're actually quite a small proportion of emissions now. So there was a point when we would have had a bigger share then our population might suggest. Now it's less. So we're relatively… I wish I had the figure, but I can check it for you later. But we are relatively less intensive in carbon then the rest of the UK. There are big sectorial differences within that. So our biggest contributor is now agriculture and I don't expect that to change. We have… And that chart kind of shows you that, the final chart that I showed. We are basically, we have very little industrial emissions now in Scotland. What there is, comes from the refining sector which is still relatively big in Scotland, thanks to our oil and gas sector. And of course the plan, it is not to close the Scottish refineries, so it's… we need to manage that. So actually the answer about how we address all of that, which wasn't strictly what you asked, but it's there are some things we just need to accept, so we need to manage around those things. So one of the things we need to accept we will have in the future is on-going emissions from oil and gas refining. And to go on to your question about transport, that's one of the other things we'll need to accept. So there are a great many of transport journeys that are essential if you don't live one of the central cities in Scotland. And it is not practical, certainly in the next 10 years or so, to expect that they will be done solely from electric vehicles. So there is an element of the strategy here which is about tolerating a certain amount of emissions, albeit more efficient transport emissions. But some of those journeys simply need to be made. So we need to accept that. And it's more about what you do outside of that. So there is a relatively inflexible story when it comes to some transport journeys

	that need to be made. And it means you need to work even harder in those areas where you think you can make a difference. So what does that mean? Well, it means we're having a very, very active policy towards our cities which is one of the reasons why I'm so interested to be in Singapore because we need to have a city strategy that basically moves people and goods around less. So that's one of the most efficient transport strategies. We'll also, though, need to have very, very ambitious strategies towards electric vehicles. In January I'll be able to see exactly how ambitious but that's one of the really key decisions points for ministers at the moment. But we will need to be very exacting about electric vehicles, much more so even than the rest of the United Kingdom will because we need to cut emissions in a different way from the rest of the UK. And the reason we need to do that is because we've decarbonised industry and we've decarbonised power provision, so our interest in decarbonising transport and the building stock is greater than all across the UK and indeed, other parts of Europe.
Bridgette See	Hi, I'm Bridget [See], I'm from a little writing agency called Tuber [Productions Pte Ltd]. I… actually it's not so much a question, but more of a comment. I'm just wanting to congratulate you guys actually for setting a really ambitious target, because I think, many, many governments like to set very conservative targets, Singapore included, I feel. Of course government servants, civil servants, may not agree with me. But I think, you said something that was quite enlightening, which means, when you set such an ambitious target you really have to look at systems change and radical change, and I think that's what spurs innovation. And I've looked at a lot of Scandinavian countries; they've set themselves very ambitious targets as well. Things that many Asian countries, and of course the US themselves, would not be promising or not dare to think and so therefore I feel that, that you may not, I'm not sure whether you guys will reach the goal, but I think you really will spur innovation and really thinking very differently and

	therefore I wanted to congratulate you guys.
CS	This thing about target setting is fascinating to me as someone who's interested in the policy development process generally. We have a target of achieving 100% of domestic demand for electricity by 2020 from renewable sources and that was a target that was in a manifesto, a political manifesto for a party who was then elected. And we as the civil service really didn't like that target. So we spent a long time writing papers to ministers telling them the target was impossible and it was a silly thing to do. And I completely agree now that it was a sensible thing to set that target because it lifted the ambition to a level that would never have been lifted. We would never would have got close to the levels of renewable power that we're producing now had there not been that target. And one of the reasons why that target is so important is because we are in a global market—I mean Singapore is as global as it gets, really, when it comes to trade and in investment. And global investors look for these things actually, as a reason to put safe investment in a particular country. So for some time, Scotland has been seen as a place to do renewable investment. And one of the reasons is that we have a planning policy that supports it. But one of the main reasons, I suspect, is that at multinational level, in board discussions of where to put investment, things like having that target really matters. So, we've seen the benefit of that and having a positive political environment and some of those things. So I think you're absolutely right, and your other comment on systems is where I think it's just really exciting. So one of the biggest challenges of government actually, is to think in a systems way. And carbon allows you to do that, so what… I could have said more about it, and I'll say something now about it—the process of making decisions around carbon is just the same as making decisions around financial budgets. So the idea of carbon budgeting is something that I'm sure everyone in this room understands. But the idea of constraining the decision of an elected official or a minister because there is a

	carbon impact is still very novel and it's easy to not make those decisions. And I think what we've done relatively successful[ly] in Scotland through that Act, is tie that decision… tie that into the decision-making programme in a more real sense. So everyone understands that people have to make… ministers and officials have to make decisions about money, and you know, if you can't afford it, you have to stop. That's something that is commonly understood. And the same thing needs to happen with carbon. And the fact that we have a piece of legislation that says there must be a plan, and that you must have an annual carbon budget for each sector of the economy, or at least a carbon budget overall, is something that frankly, ministers don't like. You know, that's difficult because it means that there are decisions that have to be taken now that aren't necessarily populist. But it's great! It works. So the idea that there is a collective decision making process around those things, that's the only way to do it, is something that I think that we are, I wouldn't normally say so but I think we are better at that in Scotland than in some other territories. So we have got, as part… because of the model of government, we have got the ability to trade off, you know, a decision about our housing policy versus our transport policy, you know that's effectively what you need to do. You need to have a plan for those sectors versus the power sector, versus the agricultural sector. And you need to collectively agree what that plan is, otherwise it doesn't work. So I'd like to think at least, that if we do that properly, that's something else that we might export, it's the idea of how best to do some of these things, so, hopefully…
LL	So you mentioned just now that the Parliament is reviewing the Climate Change [(Scotland)] Act [2009]? And they're probably going to… not just 80% but really net zero. What do you think would… And you talked about agriculture being difficult even though it's emitting one of the highest, and the focus is on buildings and transport. But to go all the way to net zero, what

	would then be your game plan? What would your strategy be?
CS	To go all the way to net zero would be an enormous decision so, if I'm being very candid, as candid is you can be on a public platform, I think that politicians throughout the world need to understand what that means actually. So there are… I think it would require technologies that are largely… that largely don't exist at the moment to make that work. That doesn't mean we shouldn't do it though. So we will have to be net zero at some point and then the question is when, rather than if. It would, in Scotland, require carbon capture and storage at scale, I think, to address the fact. Unless you shut down your agricultural sector, and no one is proposing that. So the fascinating thing about doing this economic modelling that we've talked about is how it reviews some of these choices. So one of the best carbon sinks that we have, so the ability to soak up carbon is our trees, our forestry. And we haven't been planting enough trees. So decisions that you take now about forestry, matter immensely in 20 years' time, And the modelling shows that. So it shows that you know, as trees get older, they cease to be a carbon sink. And that's an issue for us in Scotland. So we have vast forestry, which is state-controlled and invested in, it's still one of the few areas where we still use state-investment. We haven't done it enough, so there's that kind of thing… if you're serious about these sorts of commitments, we're going to have to really, rapidly increase the way in which we address those carbon sinks. We need an industrial policy of capturing emissions from industry and power, and we still have to do all the other stuff that we talked about as well. So I think it is possible. Whether it's possible on the same timescale is a real question there we'll have to address when we put a new Bill together. But we have a government in Scotland that has been elected on a green ticket, so it is seen as… it would like Scotland to be the greenest small country in the world. So again it might be back to this thing about setting a target that the officials don't like, but I think that's okay, I think that upping the ambition politically

	is the way that you get these things done.
FEMALE	I was just wondering, in terms of planning to achieve your targets, are there any implications for educational policies that you all might be considering or might be drawing up in terms of like for instance, in science education or in educating the public on energy efficiency? So are there any plans made to support your targets? Achievements?
CS	This state is very hands off when it comes to core education provision. We let the market decide. But we talk about skills provision more actively so that's… and there is an enormous question of skills and the resource available to do some of these things. And one of the really exciting things for me in addressing the energy efficiency of the building stock in particular is that we'll have to develop a new set of skills around that in the economy that are very useful, let's put it that way, in a global sense. So there is, there are plans at least, for us to invest more heavily anyway in some of those skills. The question… more generally of education provision is one that, actually, I don't think we've tackled as well as we should in Scotland. So we have… it's fine to set a target and we do that successfully, it's easy to set a target. But the idea of what sort of skills base is required to be produced by our education system to support that, is not one that I think we have addressed in perhaps as much detail as we should have. So again, that's the beauty of the Climate Change [(Scotland)] Act [2009], it's that it requires us to do something about that. So in January, we'll have to say something about education and skills provision. But it's mainly in the skills provision side, so there have been unsuccessful attempts in the UK in the past to address this question of how energy efficient buildings are. There's something called the Green Deal, which, if you are a pupil of government policies, it's worth looking at because it just didn't work. It was based on a very clever idea, but ignored the fact that people don't like people coming into their house and doing things to their house that they hadn't asked for. So what was supposed to happen around the Green Deal was that a new set of

	training was provided to the kind of services and the people that come to do some of these things like loft, like they're kind of improving air-[sufficiency?] of your loft or installing new windows and are making the fabric of the building energy-efficient. And that really didn't happen at the skill that we liked it to. So in planning a Scottish version of that which is what were doing now… and hopefully it will be a successful programme. We are thinking now about the skills provision that will be required and we control a lot more of that in the government, so we fund a lot of those skills programmes. And by that, I mean vocational skills. I don't think we've looked enough at the end of line challenge of how you might change the kind of educational mix, so I think that's a really good question, actually, I should be [drifts off] … [Video clip ends at 1:20:21]

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