DÁIL ÉIREANN

AN COMHCHOISTE UM GHNÍOMHÚ AR SON NA HAERÁIDE

JOINT COMMITTEE ON CLIMATE ACTION

Dé Céadaoin, 21 Samhain 2018

Wednesday, 21 November 2018

The Joint Committee met at 2 p.m.

MEMBERS PRESENT:

Deputy Jack Chambers,	Senator Paul Daly,
Deputy Marcella Corcoran Kennedy,	Senator Máire Devine,
Deputy John Lahart,	Senator Grace O'Sullivan.
Deputy Tom Neville,	
Deputy Thomas Pringle,	
Deputy Eamon Ryan,	
Deputy Sean Sherlock,	
Deputy Bríd Smith,	
Deputy Brian Stanley,	

In attendance: Senator Rose Conway-Walsh.

DEPUTY HILDEGARDE NAUGHTON IN THE CHAIR.

Business of Committee

Chairman: We have a quorum and will begin in private session.

The committee met in private session at 2.07 p.m. and resumed in public session at 2.13 p.m.

Third Report of the Citizens' Assembly: Discussion (Resumed)

Chairman: I welcome members and viewers watching the proceedings on Oireachtas TV to the 13th public session of the Oireachtas Joint Committee on Climate Action. On behalf of the broadcasting and recording services, I request all members, delegates and those in the Visitors Gallery switch off their mobile phones or switch them to flight mode as the interfere with the broadcasting and recording of the proceedings.

On behalf of the joint committee, I extend a warm welcome to Professor Valérie Masson-Delmotte, co-chairperson of Working Group I of the Intergovernmental Panel on Climate Change. I also welcome Professor Sonia Seneviratne from ETH Zürich, an expert on climate change extremes and impacts, and Dr. Pierre-Marie Aubert from the International Deep Decarbonisation Research Institute, an expert on the agriculture sector. All three delegates have made considerable efforts to be with us and we really appreciate their presence.

By virtue of section 17(2)(*l*) of the Defamation Act 2009, witnesses are protected by absolute privilege in respect of their evidence to the committee. However, if they are directed by it to cease giving evidence on a particular matter and continue to do so, they are entitled thereafter only to qualified privilege in respect of their evidence. They are directed that only evidence connected with the subject matter of these proceedings is to be given and asked to respect the parliamentary practice to the effect that, where possible, they should not criticise or make charges against any person or entity by name or in such a way as to make him, her or it identifiable.

Members are reminded of the long-standing ruling of the Chair to the effect that they should not comment on, criticise or make charges against a person outside the Houses or an official, either by name or in such a way as to make him or her identifiable.

I invite Professor Valérie Masson-Delmotte to make her opening statement.

Professor Valérie Masson-Delmotte: I thank the joint committee for the invitation and giving us the opportunity to share the key findings of the IPCC special report on global warming of 1.5° Celsius. I will begin by highlighting the four main messages of the report, which are that climate change is already affecting people, ecosystems and livelihoods all around the world; limiting warming to 1.5° Celsius is not impossible but would require unprecedented transitions in all aspects of society; there are clear benefits to keeping warming to 1.5° Celsius compared with 2° Celsius or higher; and limiting global warming to 1.5° Celsius can go hand in hand with other world goals such as achieving sustainable development and eradicating poverty.

The report is the outcome of the collective work of 91 authors from 40 countries who have assessed new knowledge based on 6,000 publications. The successive drafts of the report received more than 42,000 review comments from more than 1,000 expert reviewers.

Since pre-industrial times - the end of the 19th century with regard to temperature - human activities have caused approximately 1° Celsius of global warming. We are already seeing the consequences of this through, for instance, rising sea levels and more extreme weather. At the current rate of warming of 0.2° Celsius per decade, the global mean surface temperature will reach an increase of 1.5° Celsius in the climate sense, averaged over 30 years, between 2030 and 2050. Although past emissions will continue to cause changes in the climate system and rises in sea levels, they alone will not cause global warming of 1.5° Celsius. Thus, limiting warming to 1.5° Celsius is not geophysically impossible. It will depend on emissions from now on.

I will discuss the differences between global warming of 1.5° Celsius and 2° Celsius for climate-related risks. Climate models project robust differences in regional climate characteristics between global warming of 1° Celsius, 1.5° Celsius and 2° Celsius above pre-industrial levels. They differences include the level of warming in various land and ocean regions, hot extremes, heavy rainfall in several regions and the probability of drought in some regions. Sea levels are projected to increase. Limiting global warming to 1.5° Celsius compared to 2° Celsius would reduce the rate of sea level rise by approximately 10 cm by the end of the century. That would mean that fewer people would be exposed to the consequences of rising seas and that there would be more time for adaptation.

Limiting global warming to 1.5° Celsius compared to 2° Celsius would also reduce the transformation and degradation of marine and terrestrial ecosystems and the risk of irreversible loss of biodiversity. It would imply smaller reductions in yields of key cereals, including maize, rice and wheat, and lower risks for fisheries and associated livelihoods, especially tropical fisheries. It would also reduce the percentage of the global population exposed to water shortages.

Climate-related risks are disproportionately higher for some regions, particularly dry land regions, small island developing states, the least developed countries and the Arctic region. There is a close link between development and climate-related risks and limiting warming to 1.5° Celsius compared to 2° Celsius would reduce the number of people exposed to climate-related risks and susceptibility to poverty by up to several hundred million by 2050.

Our report shows clearly that limiting global warming to 1.5° Celsius compared to 2° Celsius is associated with lower climate-related risks for food and water security, health, human security, livelihoods and economic growth. Our assessment highlights the need for adaptation, even to a small amount of warming such as 1.5° Celsius at a global scale, and the fact that there is a wide range of adaptation options that can reduce climate risks. However, there are knowledge gaps associated with the co-benefits, costs and limits of adaptation. To sum up, each 0.5° Celsius matters.

What emissions pathways and systems transitions are consistent with limiting global warming to 1.5° Celsius? If we want to limit global warming to 1.5° Celsius, global emissions of carbon dioxide need to fall by about half by 2030 and reach a net figure of zero by approximately 2050. For the purposes of comparison, limiting warming to 2° Celsius implies reducing emissions by around 20% by 2030 and reaching a net figure of zero by 2075. Mitigation pathways also imply deep reductions in other emissions of substances that lead to warming such as methane and black carbon by 35% or more by 2050. Reducing these non-CO2 emissions has direct and immediate benefits for air quality and health.

Limiting global warming to 1.5° Celsius is not impossible, but it implies rapid changes on an unprecedented scale in energy, land, urban, infrastructure and industrial systems. It means

deep emissions reductions in all sectors, a steep decline in coal usage, the use of a wide range of technologies, behavioural changes on the demand side and an increase by a factor of five in investment in low-carbon energy and energy efficiency measures by 2050.

Rapid progress is being made in some areas, notably renewable energy. There is clearly a need to pick up this rate of progress in other sectors such as transport and land management.

Pathways also show that to limit global warming to 1.5° Celsius, we would need to start eliminating carbon dioxide from the atmosphere during the 21st century. Methods for doing this include land management, for instance, afforestation and reforestation; restoration of degraded ecosystems; agricultural practices linked with biochar and soil carbon sequestration; bioenergy combined with carbon dioxide capture and storage; and other approaches that are at the very early stages of research. Carbon dioxide removal on a large scale, for instance, with bioenergy, would have implications for food security, ecosystems and biodiversity through additional pressures on land.

Pledges made by governments under the Paris Agreement within the last three years are clearly not enough to keep global warming below 1.5° Celsius, even with ambitious and very challenging efforts after 2030. These pledges put us on track for 3° Celsius or more of warming if there is no increase in ambition. If we want to avoid overshooting 1.5° Celsius, or reliance on carbon dioxide removal later, carbon dioxide emissions would need to decline substantially on a global scale before 2030. To summarise, with 42 billion tonnes of CO2 emitted each year, each year matters.

What is the interplay with sustainable development and efforts to eradicate poverty? Climate change impacts and how we respond to them are closely linked with sustainable development. Our report shows clearly that each option and pathway has different synergies and trade-offs with other sustainable development goals. As part of limiting global warming to 1.5° Celsius, the report shows that it is a mix of measures to adapt to a changing climate and options to reduce emissions which, if carefully selected within each community, have benefits in meeting sustainable development goals. This reflects the notion of ethical and fair transitions. We also show that pathways with low energy demand, low material consumption and low carbon food carry the highest co-benefits, including for public health. Feasibility requires key ingredients - co-operation, governance, innovation and mobilisation of finance.

Each half degree matters; each year matters; and each choice matters. Limiting global warming to 1.5° Celsius is not impossible, but the political will to accelerate transitions is key. I thank committee members for their attention.

Dr. Pierre-Marie Aubert: I will not use my slides as it might take a bit too long. I thank the joint committee very much for the invitation. As the slide shows, I will focus in my contribution on the agriculture sector as it represents a key sector for discussion. It accounts for roughly one third of all Irish emissions and is an important economic sector for the country which will be massively impacted on by climate change in the coming years, given how it is organised. It has already been the case this year.

In my contribution I shall focus on shedding light on the propositions made by the Citizens' Assembly and putting them in the perspective of the special report on global warming of 1.5° Celsius. The Citizens' Assembly made three proposals. They were taxing greenhouse gas, GHG, emissions from the agriculture sector and rewarding agricultural practices that sequestered carbon; making the measurement of and reporting on food waste mandatory at every part

of food chains; and supporting land use diversification, with specific emphasis on afforestation and organic farming.

I would like to show that while the recommendations get right to the point, they are not enough in the light of the results of the special report. I have already explained what the results are, but I would like to stress what they mean for the agriculture sector. The special report presents three pathways to get to a carbon neutral world by 2050. On all three pathways the agriculture sector plays a key role in at least three ways. First, there is a need to massively reduce the level of emissions from the agriculture sector to zero in a maximum of one or two decades. Second, the agriculture sector has to contribute massively to carbon sequestration. The removal capacity of the sector must be increased. Third, the land and agriculture sector has to support other sectors through the production of biomass that can be used for either energy or material production. When taken together, all of these objectives will greatly affect land use, as Professor Masson-Delmotte said. This, in turn, will impact on at least three other aspects, namely, biodiversity and ecosystem services; food production, food security and food system organisation; and adaptation of the agriculture sector. The way in which we deal with these three objectives simultaneously will impact on the other three aspects.

What does this mean for the Irish agriculture sector? The sector has experienced a similar path to the rest of European agriculture, that is, intensification, concentration and specialisation. Since the 2008 crisis, the targets set for the sector have aimed to increase production, mainly in the ruminants and bovine sector. The targets aim to increase dairy production by 50% in volume and 20% in value by 2020. Following this plan which was issued in 2010 is unlikely to lead the Irish agriculture sector to neutrality in line with the special report's recommendation. It will probably lead to an increase in the size of the ruminant herd and, in turn, increase greenhouse gas emissions by 2030, when the idea is to bring the level of emissions to zero, offer sequestration potential for other sectors and produce biomass for energy and other purposes.

I will finish my remarks on the Irish agriculture sector by stressing that there are options to make it carbon-neutral at sectoral and national level, but in the light of the special report's results, this will not be enough.

There are a couple of implications for the sector if we are to be in line with the recommendations in the special report. First, there is probably a need to decrease the level of dairy production. Even if the efficiency level increases, it has to go hand in hand with a production decrease. We have to have both. Second, it will be dependent on the way in which domestic and international demand evolves. The Irish sector is very much export oriented. If there is still considerable international demand, why should the Irish sector not meet it?

Last but not least, it is important to point out that the aim in the report is carbon neutrality at global level, not at national or sectoral levels, meaning that, given the configuration of Irish agriculture, it is likely Ireland will have to contribute to offset for residual emissions from other parts of the world, especially highly densely populated areas where offsetting possibilities are low. This puts even more pressure on the way on which the land is used and on sequestration ambitions.

Chairman: I thank Dr. Pierre-Marie Aubert. I now call Professor Sonia Seneviratne.

Professor Sonia Seneviratne: I will keep my presentation short because I have a lot of material. I thank the committee for the invitation to attend. It is a great honour to be asked to present here.

I will talk about climate extremes at global warming of 1.5° Celsius and 2° Celsius. I shall provide a little more background on projected changes at those two levels of warming. I was involved as lead author on the chapter in the special report dealing with the impacts of global warming of 1.5° Celsius on natural and human systems.

I want to start with a point that Professor Valérie Masson-Delmotte made, namely, that we are living in a warmer world, with 1° Celsius of global warming. We saw very well this summer that the implications of warming of just this amount are substantial. There was a drought and heatwave in Ireland, and there was also a heatwave in the United Kingdom. There were forest fires in Sweden. At the same time, there was a drought in Germany and Switzerland, where I am from. There were fires in California, and more again recently. There were heatwaves in Japan and Canada. Any single one of those events would be difficult to attribute to climate change but it is unlikely that all the events would have happened at the same time without climate change.

I want to mention a point made that was quite striking for me. Often when we think of the impact of climate change, we think of developing countries but there were several deaths associated with heatwaves in developed countries, including in Japan and Canada, which are developed countries in high latitudes or mid-latitudes. Recently there were deaths in California. Even developed countries are not safe from climate change.

Members can view a slide illustrating the widespread heat wave. I believe Professor Stott mentioned this a month ago. In the past, there were areas that might have been as warm locally as this summer but what was very different this summer is that there was a global signal. It was not located only in Europe.

If we examine temperature anomalies this summer by comparison with the middle of the 20th century, we see that from April to July this summer, there was an anomaly of more than 2° Celsius. It means that even those there is warming of 1° Celsius, there can be much larger anomalies in a single location or in single months. One can see clearly that this was a very extreme summer.

It is not only temperature that is affected; so too is the water cycle. There are impacts in the form of heavy precipitation. The link is that when there is warmer air, it can contain more moisture, which means that when it is raining, there is more rain. There were some floods in France in 2016. There were some in Japan in 2018. There were some in the United States associated with tropical cyclones. I have heard about flooding in Donegal. There is no specific study on this but with heavy precipitation increasing with warmer climate, it is probable that precipitation levels have also been affected.

To give members a general picture, the last IPCC report, from 2013, shows a likely increase due to human influence on climate. For heavy precipitation, the evidence is less strong but there is medium confidence that the trend since 1950 is also due to human influence. There was lower confidence in the evidence for drought and tropical cyclones but there is new evidence for the attribution of drought to human-induced climate change, for instance, in the Mediterranean region. This is also the case with heavy precipitation associated with tropical cyclones. We have more evidence for extremes being linked to human-induced climate change.

I refer to extremes associated with warming levels of 1.5° Celsius and 2° Celsius. I wish to demonstrate the direct link between carbon dioxide emissions and global warming. Members can see from the slide that, for a given warming target, there is an associated CO2 emissions level. We are speaking only of global warming, not of regional changes in extremes. A slide

shows the average change of temperature of the hottest days with average warming of 1.5° Celsius and the change on the coldest nights. On average, while there is average warming of 1.5° Celsius, it is much higher in many areas, especially land areas. Land areas tend to warm much more, to a factor of two or three. This is why, when one hears about warming of 1.5° Celsius, which sounds like a lot, one should realise, it can imply warming of 2°, 4° or 5° Celsius in some locations. Europe is strongly affected.

The same principle applies for warming of 2° Celsius but there are even greater changes on the hottest days and coldest nights. A slide shows the average warming is between 2° Celsius and 3° Celsius but it is up to 4° Celsius in some cases - for the hot extremes. In the high latitudes, there is warming of up to 6° Celsius or 8° Celsius.

We considered the difference between changes with warming of 1.5° Celsius and 2° Celsius in the report. We could identify robust and statistically significant differences. There are differences in the temperature of hottest days at the top and the number of hot days. In most locations, including Ireland, we find substantial differences in hot extremes based on warming of 1.5° Celsius and of 2° Celsius.

Another slide shows changes in mean precipitation. There is a trend towards a decrease in precipitation in the southern part of Europe, for instance, but an increase in the northern part of Europe. Ireland is located in an area where there is a substantial robust increase in mean precipitation with additional warming. Mean heavy precipitation is projected to increase compared to pre-industrial levels, both at 1.5° Celsius and 2° Celsius. It is the same with extreme precipitation, with an increase in heavy precipitation at 1.5° Celsius compared to pre-industrial levels and at 2° Celsius compared to pre-industrial levels.

There are some differences at 1.5° Celsius and 2° Celsius. The slide shows results aggregated for all of northern Europe, which includes Ireland. On one side, we can see different indices of heavy precipitation, and, for most measures of heavy precipitation, there is statistically significant increase in heavy precipitation at 2° Celsius compared to 1.5° Celsius.

I refer to some other impacts associated with global warming. We look at impacts on human, managed and natural systems above 1.5° Celsius. In some cases, we have irreversible changes. For example, in regard to coral reefs, we are at a warming level that is risky for the reefs and could lead to extinction if there are higher levels of warming. There are also irreversible changes between 1.5° Celsius and 2° Celsius with melting of ice around Greenland and some sea level rises.

To conclude, half a degree matters. Limiting global warming to 1.5° Celsius would avoid widespread increases in extremes, as well as heavy precipitation extremes in several regions and droughts in some regions. We are experiencing the impacts of global warming at 1° Celsius. We have amplification of regional changes in temperature extremes and there has been a much higher warming of extremes compared to the mean global temperature in many locations, as well as, for example, some irreversible changes for biodiversity and sea level rise. There are also substantial changes in heavy precipitation and in temperature extremes for Ireland and northern Europe. Of course, we need to model scenarios to have more information for Ireland. As was mentioned, limiting global warming to 1.5° Celsius is geophysically still possible but it would require unprecedented changes.

Chairman: I thank Professor Sonia Seneviratne. I will start with some questions before I go to members of the committee. The IPCC's latest report suggests the world needs to get to

zero global emissions by 2050 for us to stabilise at 1.5° Celsius. Ireland's long-term national policy position is for a reduction of at least 80% in emissions across the energy, built environment and transport sectors, and for carbon neutrality in agriculture and land use by 2050. In May of this year, the Environmental Protection Agency, EPA, indicated that Ireland is projected to fall far short of our 2020 targets and that, at best, we will achieve 1%. With that in mind, do the witnesses believe that Ireland's national policy of at least 80% reductions across these key sectors, and carbon neutrality in agriculture and land use, is compatible with the IPCC report with regard to achieving a reduction of 1.5° Celsius? Should we revise our targets? Given we currently way off course for 2050, where should our level of ambition be for 2030 if we are to really try to achieve these targets?

On a practical level, what are the key opportunities for Ireland in regard to reducing our emissions? Can the witnesses highlight two or three technologies and solutions that Ireland could adopt at scale to have an immediate impact on reaching those targets? What tax and policy framework would be needed to introduce those technologies and solutions at scale? Are there other countries that do this well? For example, there is the issue of retrofitting residential homes, for which there is a great deal of appetite among citizens, although cost is an issue. How do other countries finance this? The Government can finance some of this but it cannot pay for everything. Have models worked in other countries whereby the private homeowners could finance the deep retrofitting of their homes? Do the witnesses have practical examples or suggestions for us to lay out a pathway, given we will write a report in January? The suggestions may not work in an Irish context but it would be interesting to hear of other countries that do this well.

Professor Valérie Masson-Delmotte: On the first point, many countries are not on track. With respect to what has been achieved so far, approximately 50 countries have reached peak emissions and there is a decline, although often too slow with respect to what is at stake. What we observe is not just something for Ireland; it is much broader. This report was requested by delegates from countries during COP21. There would not have been agreement at COP21 if there had not been the indication to prepare this report, especially as some governments considered that the Paris agreement target of below 2° Celsius was not sufficient to avoid dangerous consequences in their regions. We have prepared this assessment. I have shared with the committee the key findings and there are 400 pages of more substantial information within the report, all of which is online. COP24 will be focused on dialogue but the same dialogue applies in each community and each country as to where we are, where we want to go and how we get there. Rather than thinking of climate change as a constraint, there is potential to see it as an opportunity to think of well-being for the future, for example, where we want to go, collectively, and how to improve health, transport or well-being within buildings. Climate is part of that, among many other aspects of sustainability.

The Chairman asked for examples. For land systems, our report shows the importance of thinking change as a whole, that is, to have adaptation and mitigation at the same time. For example, the agricultural system is resilient and can have a climate resilient development pathway. Options in the report are linked to conservation agriculture, sustainable intensification, livestock management, irrigation efficiency, agroforestry, managing food loss and waste, new technologies - for example, to reduce enteric methane emissions from cattle - ecosystem restoration, community-based adaptation and wetland management, and these are some of the key elements of a systems approach for land transitions. Ireland has significant potential for many of these aspects, so there are many opportunities. The key is thinking on the systems scale and integrating not just climate change but more particularly climate change in the context of diver-

sity and well-being for people up-front.

The report also shows that, in the discussion of what can be the transitions, key issues are associated with power and inequalities. What works is based on inclusive processes. There are examples from other parts of the world of successful transitions in the agricultural sector, and I have in mind a co-operative of Danish and Swedish farmers that produces dairy products. This big co-operative is engaged in a transition with evidence for the ability to continuously decrease their greenhouse gas emissions. These are examples that work and that could be inspiring.

Professor Sonia Seneviratne: The Chairman asked whether the 80% target was sufficient and the answer is "No". If we want to achieve 1.5° Celsius, the report suggests we would need zero emissions by 2050. However, this is a long-term goal, so it is probably better to focus first on 2030.

I do not know the numbers for here. From the report, the goal is to reach about 50% of the 2010 emissions by 2030. However, developed countries will need to make a bigger effort as they are developing.

In terms of the retrofit of homes, I am from Switzerland. The Swiss Government gave subsidies for people to retrofit their homes. The scheme was efficient so homes are relatively well insulated. Insulation is also good for the climate and saves energy. Retrofitting has many benefits and the initiative has been successful in Switzerland.

Chairman: It has been suggested to the committee that we introduce low-interest loans for retrofitting because the Government cannot provide such support. It has been stated here that it would cost €50 billion to retrofit all homes in Ireland, which the Government cannot afford. Therefore, we must find innovative ways to assist private citizens to retrofit their homes.

Dr. Pierre-Marie Aubert: Given that Ireland is a very rural country it will not only have to pursue neutrality at a national level but it will also have to help other countries to offset their residual emissions. That could be something that is thought about at a European level, as a political entity. That aspect is something we must keep in mind.

Regarding immediate political actions, looking from a food system perspective, there is broad consensus that diets must change. This aspect has been discussed for a couple of years in academic literature but it is not really a matter of political action. In terms of where one take immediate action, there are things to be done to better communicate to people that they can reduce their calorie intake, protein intake and intake of animal protein and replace it with vegetarian protein intake, and reduce sugar intake. These changes will be doubly beneficial as they will protect people's health and protect the climate.

Deputy Marcella Corcoran Kennedy: I thank the delegation for its presentations. The report is a wake-up call, as if we had not enough of those already, and raises a red flag in a way that previous reports have not done.

It has dawned on this committee that we need to adopt a whole-of-government and whole-of-society approach to tackle climate change and communicating with citizens will be crucial. I believe that we have failed to communicate with citizens to a great degree. A national dialogue on climate action has been established but an enormous amount of work remains to be done to tackle the complex problem of climate change. Can the witnesses list the actions that other countries have taken to communicate with citizens that have proven to be successful? Are meteorological services in other countries used to communicate with citizens? Met Éireann, the

Irish national meteorological service, communicates weather information several times every day. I firmly believe such communication is an opportunity for the State broadcaster and Met Éireann to work together to promote climate change. I ask the witnesses to express their views and cite examples.

Can the witnesses recommend a set of climate principles that all political parties could take on board? Regardless of which party is in power, we must ensure that the principles underpin climate action into the future.

The witnesses made a reference to the impact climate change would have on islands. Ireland is vulnerable to climate change due to being an island nation. What will happen if temperatures are not kept in check globally? What will happen to this island in a catastrophic situation? At what point will a situation be declared catastrophic? What adaptation measures have been successful in other countries? I would like to know that so that we might add them to our climate action plan.

The Citizens' Assembly recommended a tax on greenhouse gas emissions generated by the agricultural sector. How do the witnesses view the imposition of a greenhouse gas tax on agriculture in Ireland? Would the initiative have a net benefit on global emissions or displace production to somewhere less efficient? That latter issue has arisen and we must take it into consideration.

Should methane be added to the emissions trading system? Are there examples of methane sequestration available?

As much as 20% of the land in Ireland is covered in peat. Is there a potential for using peatlands for sequestration and as a carbon sink? Do the witnesses have a calculation on the re-wetting of bogs and whether it is successful?

The Republic of Ireland has a very mixed agricultural policy. Some farmers are interested in afforestation but some are not and view the planting of trees as a waste of good land. Are there good examples of afforestation? If so, we can incentivise farmers to increase afforestation. What types of trees are the best choice?

Chairman: I will allow the Deputy to comment again later, if she so wishes.

Deputy Marcella Corcoran Kennedy: Yes.

Professor Valérie Masson-Delmotte: The first point was about communicating with citizens. Education is key. School programmes should start early in the lives of children and be structured to provide tools for future citizens to understand what is at stake. The programmes should also focus on providing solutions. Such education should provide tools for younger generations in order that they can act when they graduate from the education system. Why not use schools as places for experimentation? One could implement projects in schools and then base them in communities. There are powerful examples all around the world, in both developed and developing countries, that have the potential of giving a strong base for climate action within communities.

The second point was about governance, issues like methodology for the climate proofing of all types of projects. One would not just look at the usual administrative rules or the cost but also the systematic assessment of the resilience of the project in a changing climate, and the implications of the project during its lifetime for greenhouse gas emissions and the consistency

with the pathway that the country wants to follow.

With respect, one can also see Ireland as a large ocean country. Next year, the Intergovernmental Panel on Climate Change, IPCC, will release a Special Report on the Ocean and Cryosphere in a Changing Climate, which deals with the frozen parts of the world. The special report will have a specific chapter on coastal areas and a specific chapter on marine echo systems and the livelihoods that depend on them. Those chapters will be very relevant to this country. There are examples of adaptation strategies for coastal areas in many places around the world. There are also examples of decision processes and democratic approaches that discuss what one wants to protect and at what cost. That includes very high investment that blocks some adaptation processes or provides a more flexible approach that allows one to revise an adaptation strategy as well as provide nature-based solutions.

In terms of the last question, there is a potential to eliminate carbon dioxide from the atmosphere using peatland restoration. The report shows that afforestation and the restoration of eco-systems, and some agricultural practices, are the least costly approaches for carbon dioxide removal. However, there is a need for more knowledge on the true potential for extracting carbon dioxide and the durability of the storage as well, so that it is not dependent on drought or fires that would risk putting CO2 back into the atmosphere. There is a need for more knowledge on the true potential of how much CO2 can be extracted and the durability of the storage that is independent of drought or fires that would risk putting that CO2 back into the atmosphere. That is the potential in many ways. Nature-based solutions such as this one offer multiple advantages through ecosystem services and recreational activities.

Professor Sonia Seneviratne: Different things can be done on communication. The Deputy mentioned the meteorological services. There are specifically two topics on which the meteorological services could do more communication including here in Ireland. I mentioned whether this summer was related to climate change. On the level of communication it is important to do climactic attribution so that whenever there is an event we should look at what was the contribution of greenhouse gas forcing to those events. Some countries are considering doing some operational event attribution, for instance in Germany. It may be difficult to develop a new system in Ireland; maybe it could be done in collaboration with other weather services. It would be very powerful to be able to say that a particular event may have been made stronger because of climate change, for example identifying it was three times more probable as a result. In terms of communications it gets the message across very quickly.

What I was showing in climactic analysis is very coarse. As it is based on those global scenarios, we do not have a focus on Ireland. We cannot really provide country-based information. I was trying to extract the information I could. For instance, we recently developed climate scenarios for Switzerland where we co-ordinated with MétéoSuisse, the Swiss weather centre. As the Deputy said, the weather centres have a good reputation among the population. It would be useful to have them more involved in the development of this type of information and also having the scenarios targeted for a country because then people can basically consider what the actual implications for the country would be. This would also be a useful development.

The Deputy asked what the impacts for Ireland would be. Of course, the report contained a really broad assessment. I cannot speak specifically to Ireland. It is clear that all locations have an increase in temperature extremes. In high latitudes to mid latitudes, such as here, we have an increase in heavy precipitation, which is also associated with more flooding. I do not know about droughts, which is a difficult topic. We see that the probability is higher. We would not expect such an increase, but there was a summer drought so maybe we are not sure yet. Of

course, a sea-level rise could be relevant for coastal regions.

Dr. Pierre-Marie Aubert: On the agriculture sector, the Deputy asked whether we should tax emissions from the agriculture sector. She mentioned the problem of potential emission displacement. We need to consider what the basis for taxation would be. Would it be on the basis of the level of efficiency or on the basis of absolute level of emission? The choice makes a big difference. Taxing on the basis of efficiency might be a better option if we are to consider that at the global level the most efficient production systems have to be favoured. In any case, as I said in my introductory speech, we need to go for both efficiency improvements and overall reduction in the production if we are to meet the target that we have set.

If the current technologies to increase the efficiency level in agricultural production are implemented at scale, they might have some impact on the way landscapes are managed in Ireland. In order to complement feed and use methanogenesis approaches, cattle need to be kept under shelter at least for a certain number of hours. It will be necessary to change completely the way Irish cattle are raised and they will no longer be totally grass-fed. That will have a significant impact and needs to be carefully considered.

There are two other things related to the potential displacement that could result. If the approach is in terms of absolute levels of emission, the question would be to what extent farmers at an individual level or the collective level would decrease the size of the herd. If the size of the herd decreases, with what can it be replaced? Ireland is import-dependent for its food in the sense that it does not cover its needs with most staple products coming from other countries. If Ireland replaces bovine herds by something else allowing it to meet the needs of its population, that might also be something interesting. The country could re-diversify the production at the national level which might also be a very good option.

I wish to discuss the symmetric option which would be to reward good practices. The options are to tax greenhouse-gas emission or reward sequestering practices. That leads to the Deputy's question on afforestation and how to favour afforestation practices at farm level. In considering the types of incentives to favour sequestration at the farm level, it is important that the kind of practices favoured to sequester carbon will not change over time. To put it simply, if people sequester carbon and build carbon stocks in soil by grazing in a particular way or by growing crops without tilling so on, if at some point in time there is a change in that practice, all the carbon that has been sequestered in the soil will be released. There is a big issue. If it is decided to favour practices to store carbon in agricultural soil, it is necessary to ensure that practices will not change over time, otherwise it will be totally missed.

It is similar with afforestation in the sense that it depends on what the trees that are planted will be used for and when. I do not have clear examples of countries where agroforestry practices have been highly incentivised. As we discussed over lunch with Professor Masson-Delmotte, agroforestry might be one of the best options to store carbon in agricultural land. I do not know the exact potential in the Irish context given that one of the main interests of agroforestry in France or Mediterranean countries is that it limits the drying effect of sun. I do not think that is an issue here where the level of precipitation is expected to increase rather than decrease.

Professor Valérie Masson-Delmotte: There is also the opportunity to use timber in building which is a way for long-lasting storage of CO2. It is not just an issue in terms of farming practices, but also in terms of the link to local supplies for the building sector instead of the use of concrete or other options. We see major progress in this direction in other European countries with multilevel buildings being developed using specific types of wood. It would also be

interesting to think not just about the farm level, but also about the ultimate use of the wood at the country level.

I wish to comment on the methane side at the global level. We compare today the effect of greenhouse gases by looking at how much heat they trap at the top of the atmosphere. We call it the radiative forcing. For the well-mixed greenhouse gases, it is altogether 2.8 W per sq. m approximately, 1.8 W from CO2 and we estimated for methane about 0.5 W for the direct effect and there is also an indirect effect because when methane interacts with atmospheric chemistry it creates near-surface ozone, which is a challenge in the context of air quality. It creates water vapour in the high atmosphere that has a warming effect and then it finally gives way to CO2. The indirect effect is about the same amount, so altogether it is around 1 W per sq. m, which is very significant after the CO2. Recent studies show that the direct effect might have been underestimated. There are a couple of studies in the literature which show that new knowledge on how methane interacts with visible radiation, short-wave radiation, suggests the direct effect to be perhaps 25% greater than previously assessed. That is important, but I am not aware of any specific trade scheme. I have seen very theoretical studies of potential chemical reactions that could interact with methane in the atmosphere but nothing close to a sequestration approach.

Chairman: I thank Professor Masson-Delmotte. I will move on to Deputy Bríd Smith. She has ten minutes. I will indicate after three minutes to give her an indication of the time.

Deputy Bríd Smith: If it is okay with our guests, I will ask individual questions. I framed the questions based on the submissions as I read them. It is a very welcome report. It has utterly transformed the narrative on climate change and what needs to be done. It is very interesting that it was followed quickly by the Living Planet report from the World Wildlife Foundation, which backed up everything that was being said in terms of the urgency and what is required to get us out of what could be a catastrophic extinction event, as well as catastrophic climate change.

Professor Masson-Delmotte might find this an odd question. I think the language in the report is good because it talks about a rapid, unprecedented transition. For that to happen she went through the list of changes that are required on an unprecedented scale in energy, on land and urban areas, infrastructure and industrial systems. Does she think that would also require unprecedented change in the political systems? She might not want to comment on that. We met representatives from the Departments of Finance and Public Expenditure and Reform. One of the recommendations of the Citizens' Assembly is to establish an overarching independent body that would have legislative back-up to ensure that the recommendations we make will be implemented. Professor Masson-Delmotte should have heard the resistance from the Department of Finance. We were told it would not work and the Department completed disagreed with the recommendation. Are we saying that a revolution must happen before we implement what is required in order to keep us out of trouble?

My second question is whether Professor Masson-Delmotte would agree that market mechanisms that were introduced as a result of the Paris Convention - such as offsetting, carbon trading and carbon taxes - have failed to stop climate change in its tracks. The market is the biggest contributor to global warming due to the way we produce industrially and agriculturally, how we make profits and how we trade. Does Professor Masson-Delmotte agree that market mechanisms have failed and that we must consider the type of recommendations that have been made by the witnesses?

My final question for Professor Masson-Delmotte is one that we were recommended to ask

by the committee and I think it is a very good one. In terms of taking a blank canvas approach, how would she recommend we progress for a national parliamentary system such as Ireland's? That is in some way related to my first question. Could she refer to just transition for workers and communities, because that is a real challenge for us now with Bord na Móna closing down peat production? Does she believe the European Union is doing enough to contribute to what is going on? We do not hear much from the European Parliament about legislation in this area.

Should I continue to ask questions, Chairman?

Chairman: Does Professor Masson-Delmotte want to take those questions first?

Professor Valérie Masson-Delmotte: Yes, I can try.

Chairman: Otherwise, the Deputy might not get answers to all of her questions.

Professor Valérie Masson-Delmotte: I can try. The Deputy can see that she is putting me outside of my comfort zone in that the IPCC reports are policy-relevant but they have to be neutral. In a way, she asked me to provide advice or recommendations. I just want to make that clear.

The first question was about the political system and the changes that are needed to facilitate the transitions. What is really interesting about our report is that in chapter 4, Strengthening the Global Response, it looks at the systems transitions, integrating adaptation and mitigation, not separated, and then for each big option for adaptation or mitigation it looks at six dimensions of feasibility - geophysical, environmental, technological, economic and socio-cultural in terms of the notion of acceptability and finally the institutional part. This effort was based on scientific literature and it helps to identify where the barriers are. For many options available today, the barriers are on the institutional side. As a result, what is really relevant is to identify where the barriers are. In many ways, they are in how administrations operate in silos rather than having an integrated approach. There are options for thinking about differently how political systems work to facilitate the implementation of transitions where we see they are feasible in terms of technology and the economy but sometimes it is governments that are not ready to deploy them at the scale on which they could be deployed.

The second point was about market mechanisms. That is really outside my area of expertise. I am not sure I am the right person to comment on that part but it is clear that free markets without governance cannot help deploy solutions at the scale at which they are needed. What is really important is governance. There is experience from various regions of the world showing that a number of tools are available, including, but not only, carbon prices,. Then there are lessons learned from what works in many different contexts.

I share the Deputy's view regarding the notion of a just, fair or ethical transition. Our report is very explicit on that in the framing chapter and in the last chapter on the sustainable development pathways. It means for each choice paying specific attention to those who are most exposed and vulnerable to climate change or to the policy response options and considering their interests upfront. It is reversing the power structure in a way to make sure that the policy decisions protect the most vulnerable people. That is really a key ingredient. There are many lessons learnt from many other changes such that if transitions are not designed to be just and fair then their implementation will fail because of the public perception of not being involved in the decision-making or being disproportionately affected by the decisions, especially for the poorest.

Chairman: Does the Deputy have other questions?

Deputy Bríd Smith: I have at least two for Professor Seneviratne, or at least one big one. I will try not to go on about it for too long. She refers to "human-induced global warming" a great deal in her submission. She repeats that phrase all the time. I want to ask her a direct question that will help us a lot as parliamentarians. I brought forward a Bill - I hope it will go through Parliament - to end the issuing of licences for offshore fossil fuels exploration. It has met great opposition from the oil industry and vested interests. Ireland does not have oil tycoons in the same way as Iraq or Saudi Arabia, because we do not have big oilfields. However, the head of Providence Resources, Tony O'Reilly Jnr., recently levelled the accusation that the Bill is short-sighted in nature and makes no sense. He said it would force Ireland to turn its back on its own hydrocarbon potential. Earlier, I noted feeds on Twitter concerning a website for business people - proactiveinvestors.com - which states that Ireland's great opportunity is now closer than ever as new drilling comes into view. If one drills down into that, so to speak, what they are proposing is a partnership with China on further oil exploration off the Irish coast. On a national and a global scale, do the witnesses believe it is wise for a country like Ireland to ban further exploration of fossil fuel given that if we manage to do it, we would be the fifth country, including France, to declare a ban on issuing more licences? The witnesses ended their presentations by stating it is not just a local responsibility but a global responsibility. We may not be very oil rich but it would be part of a global effort to deal with a very serious crisis. I would like the witnesses' opinion on that issue because I am very annoyed with the way the business class is responding to this Bill.

Professor Sonia Seneviratne: It is a good point. Like Professor Masson-Delmotte, in terms of my position, we are supposed to be policy relevant and not policy prescriptive. The main issue is CO2 emissions in the atmosphere. We have to make every effort not to add additional CO2, therefore, going into oil exploration is not a solution. What the Deputy said makes sense. As we know we have to make this energy transition, it would make sense for Ireland to turn away from that source of fossil fuel. From that point of view, any additional CO2 that is emitted will contribute more to the problem.

Deputy Bríd Smith: I thank Professor Seneviratne, and I will quote her.

My final question is for Dr. Aubert because he spoke a good deal about food production and diet. I am fascinated by this subject because I believe it is one of the biggest challenges we face. The witnesses took a look at the Irish agricultural sector, which is all about producing more cows for both beef and dairy production, and exporting them, interestingly, to places that traditionally never ate beef or dairy, such as the Middle East and China. The chief executive of Bord Bia, the Irish Food Board, boasted recently about going to China where they had a great time promoting the consumption of dairy products. In a world where climate change is happening, it is obscene that we would promote the consumption of more dairy and meat, particularly in terms of health. How do the witnesses view the role of the Common Agricultural Policy, CAP, either in terms of intervening or having a discourse with those in the Irish agriculture sector on the way they do their business and the need for joined-up thinking in our Government, which needs to tell the agricultural sector to stop producing more cows and more food in the manner in which it has been? Have they looked at a policy area that might help to do something about this problem?

Dr. Pierre-Marie Aubert: I thank the Deputy for the question; she got straight to the point. I will take the end of the question first, namely, the CAP. We have to keep in mind that the agrifood sector in Europe is the first economic sector in terms of GDP creation. I am not say-

ing I am for or against it; it is a matter of fact. In that context, another aspect has to be kept in mind. According to the Directorate General for Trade, it is expected that 90% of the economic growth in the agrifood sector will come from exports to third countries. One of the key options at the Directorate General for Agriculture and Rural Development is to make sure that Europe remains the top agrifood exporter in the world and that it increases its market share worldwide in terms of the products for which we are the best placed. Irish production of dairy and meat is seen as a sector in which we have good competitive advantages. I do not believe there is the political will to stop that. On the contrary, we will say that we are able to produce dairy products and meat in Ireland that are climate efficient. The best option will be to make sure that is the produce that is consumed worldwide rather than other products that would be less carbon efficient. That is basically the narrative.

On the 1.5o Celsius in the IPCC report and any links, we talk constantly about the need to change the demand and so on. I do not know the position in China, India or elsewhere but we have been working at a European level in different countries and it is clear that the way dairy consumption has evolved has been driven by the supply. The fact that French people, and I guess it is the same in other countries, now consume 400 g of dairy products a day is partly the result of a deliberate strategy on the part of processors and farmers who saw that for the production to be sold on the market, they needed French people to eat more dairy products. My point is that if we have been able to drive people towards more dairy produce consumption, we shall be able to drive them towards less dairy produce consumption. Who will do that and on what basis? We foresee some potential, which needs to be quantified, to reduce the overall consumption and production at EU level while keeping farmers' incomes constant if we go for quality, climate-friendly production. For example, as the food share has declined to approximately 10% of the annual household budget, there is room for improvement. It is possible to increase that to 15% or 18%.

Furthermore, in some areas - I am talking about France - an organic farm of 300 ha in arable crops can have up to seven persons employed full-time whereas another family in the same area may employ only one person. I am not saying that organic farming is necessarily better for the climate. That will depend upon the specific practices that are implemented at farm level, and we have to be cautious not to equate organic farming with climate-friendly farming. That is a very sensitive topic.

Chairman: I thank Dr. Aubert. I allowed him go over the time because it is an important issue-----

Dr. Pierre-Marie Aubert: I am so sorry.

Chairman: -----which probably will be raised again by other members. Professor Masson-Delmotte wants to come in briefly on that, and I will then call Deputy Lahart.

Professor Valérie Masson-Delmotte: I will be brief. The Intergovernmental Panel on Climate Change, IPCC, is also preparing a special report on climate change and land. It will be released next August. It is currently under expert and government review. It includes aspects related to food systems, food and nutrition, including the mitigation potential of healthy diets. There are multiple types of healthy diets with various environmental co-benefits, including for climate but also biodiversity preservation. My remark on that is that it is deeply related not just to local and national aspects but to global trade. There is a key issue in addressing climate policies within trade systems.

Deputy John Lahart: I welcome the witnesses and thank them for the work they do in the service of the planet and our future. There is an issue that is worth clarifying. All of us raised interesting questions. I found the witnesses' presentations stimulating. They were far too short, so we will have to do some reading outside this committee. Agriculture production methods have been transformed and that has led us to where we are now, but Dr. Aubert asked who will give us the reverse transformation? It is important to say it will be innovators, entrepreneurs and business people who will do it and lead.

I am particularly taken by one of the last points Dr. Aubert made about household budgets and food. One of the figures given in a presentation indicates that we waste 30% of the food we produce, which is a horrifying statistic. I am very taken by the suggestion that household domestic expenditure on the weekly food basket has been dropping. I presume it is being replaced by spending on consumer items, including the plasma television screens or iPhones. It would be a useful exercise for the committee to focus on that. The suggestion is there is a price to be paid for the changes we must make and there is scope to pay the price if we change our consumption habits. It is really important.

Our President was recently inaugurated. I will not ask any political questions of the witnesses but I was very taken by a couple of the points that the President made in his inauguration speech. He spoke about a generation younger than mine made up of "post-consumers". They are not as absorbed by consumerism as my generation and the one immediately following mine has been. They do not want plastic or disposable items. They want food and products of integrity far more than my generation would have been used to. They are demanding it and certainly pushing change. He also spoke about intergenerational injustice. While I champion and support these perspective, they also sound very western. We want to deny emerging economies all the things we have taken for granted as consumers over decades just as they are growing. Perhaps the three witnesses could comment on that. Dr. Aubert mentioned four contrasting pathways and I am sure there is much detail in the paper. Will he summarise those four contrasting pathways to the 1.5° Celsius figure and give us a little more information on it?

We are quite deep into the debate at this committee, which arose from the Citizens' Assembly, to which the witnesses have referred. The bulk of the early presentations was almost an attempt to convince us once again that climate change is happening. I know we moved from global warming to the term "climate change" but is even more language needed to convey the importance of the matter and the potential catastrophe that awaits? The witnesses are speaking with the converted here and my thinking is there was no need to reinforce the idea as to what happens if we hit the 1.5° Celsius or 2° Celsius increase; there clearly is such a need. Even with the United States, the issue of climate change converges with economics and politics, leaving major challenges. There are questions in those comments so will the witnesses respond to them?

Dr. Pierre-Marie Aubert: I have a feeling the Deputy made many comments with which I would agree on the food budget and waste, as well as the fact that transformation will be led by innovators, entrepreneurs and businesses. That must be acknowledged but the incentives must be correct for those businesses, entrepreneurs and innovators to do their job. This is a policy perspective. There are policy options with the food budget issue that would allow people to dedicate a larger share of their budget for healthy and climate-friendly food. Professor Masson-Delmotte will deal with chapter five of the special report, dealing with sustainable development and climate change.

Professor Valérie Masson-Delmotte: There is much potential for action on food waste,

probably including regulation, reuse and innovation. There are examples of compulsory distribution of foods that might be wasted by supermarkets to charities, typically, and this works well in other contexts. There are innovative approaches using applications. For example, restaurants could make available food that would be wasted at a late hour in the evening, for example to students who cannot afford to buy a meal in a restaurant. This is being explored in many places but regulation is an incentive for the deployment of these types of solutions. Many of them come from the private sector. There are many opportunities to avoid food poverty through dealing with food waste and possible reuse.

The Deputy spoke about post-consumers and the concept also emerged in our discussion this morning with younger persons involved in the ECO-UNESCO initiative. There is potential for shifting from owning things to sharing things, which is an opportunity for social innovation. This is facilitated by numerical transitions as well.

Deputy John Lahart: What is that?

Professor Valérie Masson-Delmotte: Information technology solutions. There is much potential for thinking differently about things. This is also related to the assessment of life cycle emissions. If one shares the use of something that causes emissions to be produced, the use of that product will be optimised. Typically, this is exemplified with car sharing or other options. There are many different ways of thinking about it. The Deputy touched on the idea that this mode is only from rich countries but that is not the case. It can act against marketing pressure as well as peer pressure. There is an issue with looking at the grounds of consumerism with young people, which is related to mental well-being as well. There are many different issues that go deep in the values of people and why consumerism is perceived to be contributing to a person's well-being. This is partly explored in our last chapter, which is on sustainable development and which looks at different approaches in different contexts. The Buen Vivir approach is grounded in South American cultures, building on local and indigenous knowledge, and it is interested in thinking of well-being upfront rather than in other dimensions of development.

Deputy John Lahart: The last point is very important and I will read that chapter. One of the challenges facing us is how we make it possible for everybody to do their bit. Those last few thoughts are very stimulating. It concerns not just younger people but how people can adapt.

Professor Sonia Seneviratne: I wanted to comment on climate justice and I will give a presentation on the topic this weekend. I was invited to do so by churches of different denominations. This is a really important dimension. There are three main parts and perhaps this would also help to frame the social discourse on climate change.

One concerns developing versus developed countries. Some countries are already developed. There is a limited budget and as some countries have not developed, is it fair they have a limited amount of emissions? There are other related aspects, such as where there are rich and poor regions in the same country. This relates to adaptation. Persons in the West tend to emit more as they might travel more but they could possibly adapt more by moving elsewhere; poorer people would have more difficulties in adapting. The last point about intergenerational injustice is really important. Perhaps we should communicate more about the fact that, in some ways, it is a problem we are leaving to younger generations. There is an association in Switzerland, Grandparents for the climate. In terms of communications, perhaps these are areas where we do something.

Chairman: Does Professor Masson-Delmotte wish to comment?

Professor Valérie Masson-Delmotte: In respect of the four pathways, the report assessed many pathways, some with no overshoot above 1.5o Celsius and others with overshoot. There are four illustrative pathways with more details given in the summary for policy makers. The only one that avoids large-scale deployment of bioenergy with capture and storage is the one with low demand - the sobriety pathway. There is a sustainable pathway, a middle-of-the-road pathway and one with a larger degree of consumerism. That is the one that relies on very large-scale bionenergy with capture and storage and implies an overshoot and return to 1.5o Celsius, with a risk of irreversible effects on ecosystems and people in the case of an overshoot.

Deputy Brian Stanley: I thank our guests. I have to keep my questions short. My first question is for Professor Masson-Delmotte. She stated that pledges by Government made over the past three years are not enough to keep warming below 1.5o Celsius, even with ambitious and challenging efforts after 2030. I think she said that they allow for an increase of 3o Celsius. Could she confirm that?

My other question concerns reducing greenhouse gas emissions for transport and the haulage industry, particularly freight. The haulage industry would argue that there is no alternative. While we have talked a lot about agriculture today. Obviously, transport and haulage are other major contributors.

Professor Valérie Masson-Delmotte: I will provide one point of context regarding the statement about the gap between today's pledges and the pathways compatible with climate stabilisation well below 2o Celsius or to 1.5o Celsius. That was the most challenging point for the approval process relating to the 1.5o Celsius report with government delegates. That is one element of the context.

The Deputy's point concerns the potential for decarbonisation of transport.

Deputy Brian Stanley: Is Professor Masson-Delmotte saying that even with the pledges the Government made over the past three years, we could still reach an increase of 3o Celsius in global temperature?

Professor Valérie Masson-Delmotte: These pledges imply a growth of aggregated greenhouse gas emissions by 2030 so they are not on track with any pathway that is compatible with limiting warming to 1.5o Celsius even if we imagine very large-scale changes after 2030. If the same level of ambition remains - if we extrapolate that level of ambition in the coming round of pledges - it would imply around 3o C or more in global warming.

(Interruptions).

Professor Valérie Masson-Delmotte: I confirm that.

Deputy Brian Stanley: What can be done about haulage and freight?

Professor Valérie Masson-Delmotte: What we see in the pathways is a very sharp and immediate decline in the use of coal and the phasing out of coal without capture and storage, which makes it much more challenging economically compared to other options. There is a decline in the use of coal even by 2030.

Deputy Brian Stanley: I was thinking more of the haulage industry. Hauling goods by truck involves using diesel oil.

Professor Valérie Masson-Delmotte: Oil is still used. There is a continuous decline. What is challenging in the context of transport is full decarbonisation, which is why there are negative emissions in many pathways so there are options to take CO2 from the atmosphere and store it durably. Some aspects of transport are very hard to decarbonise - not only maritime transport but airline transportation. There are multiple options. My view is that the pledges from the international aviation and maritime sectors are not on track with the well below 2o Celsius pathway.

Deputy Brian Stanley: I have a question for Dr. Aubert concerning the use of biomass in agriculture. In the context of sustainability and land use, this requires using land that might be used for growing food. What is the science behind the benefits of it? Does it stack up? There are emissions from using biomass.

My other questions relate to agricultural waste. We have a large agricultural sector in this country. Does Dr. Aubert see a lot of potential in terms of using agricultural waste to generate biogas? What are the best plants and trees for sequestration? Do they include willow, miscanthus or sugar beet, which is grown in France but which is no longer grown in Ireland?

Dr. Pierre-Marie Aubert: I am not an expert regarding the questions asked by the Deputy. There is some potential to use waste to generate biogas. We must keep in mind that in most cases, we cannot run a biodigester with waste only. We also need residues from crops like straw or even maize silage, as is the case in Germany. This must be quantified. If not quantified, it was at least approached in the Teagasc report from 2013 so there should be some data. Regarding the best plants or trees for sequestration, it depends on the paleoclimatic conditions of Ireland, which I do not really know.

Deputy Brian Stanley: Wet.

Dr. Pierre-Marie Aubert: Yes, wet.

Deputy Brian Stanley: My final question is for Professor Seneviratne. In terms of technology, what would be the big game-changer? What would be a major win-win in terms of a country such as Ireland that has significant carbon emissions? We are producing about 60% more per head of population than the rest of the EU. What are the two or three major things we need to do now?

Chairman: Did Professor Seneviratne address that at the beginning of the meeting? Does she wish to repeat the technologies Ireland could use?

Professor Sonia Seneviratne: There are different technologies. I do not know if this applies to Ireland but one area we did not discuss is the shift from combustion engines to electric vehicles. This is a big game-changer. Under the most ambitious scenario, more electric vehicles would be sold in 2025 than combustion engines. That would be a major game-changer. There would be other benefits, such as less air pollution.

Deputy Tom Neville: I thank our guests for attending. I have a few questions about the agricultural side of things. I represent a rural constituency. Regarding innovation in agriculture, the witnesses spoke about carbon neutrality over a number of years. What innovations exist with regard to agriculture? What innovations are out there to make agriculture carbon-neutral? What is their take on the forced downsizing of agriculture compared to the displacement of agriculture or agricultural production to less carbon-efficient jurisdictions? We could have carbon leakage whereby if there is a forced downsizing in agriculture in Ireland, which is quite

carbon-efficient relative to other countries, that slack in food production could be taken up by other less carbon-efficient countries.

I do not believe there is any kind of technical short list or relatively technical solutions out there relating to accounting for the likes of gases differently under greenhouse emissions - the likes of methane given its short life cycle. Will there be a different type of accounting of that in the future? If a carbon tax was introduced, would it exacerbate the displacement of agriculture from relatively carbon-efficient jurisdictions to less carbon-efficient ones?

Dr. Pierre-Marie Aubert: On the question of innovation, we have to think about how we envision the agriculture sector ten to 15 years down the line. Are we talking about improving the existing sector or reshaping it? If it is the former, then we have a series of technological improvements that, if not already available, will probably soon be available in terms of methanogenesis to reduce the enteric fermentation from ruminants, and in terms of changing feed structures to reduce enteric fermentation. Those are two things that are about to be taken up on farms and they will lead to emissions reductions of 20% to 25% on average at farm level for the same herd. This will not bring us to carbon neutrality, however. Keeping the sector the same overall, even if we apply all the technologies we know, will not lead us to carbon neutrality or even sufficient reduction. We have to think about reshaping the sector. Innovations are not easy to discuss ahead of time. I must admit that, as I do not know enough about the Irish sector, I cannot really make any pronouncements. I am aware of a couple of things that can be done in respect of arable crops, but they are not ones that are grown here. I have some difficulty in this regard.

The risk of carbon leakage is another, less-efficient aspect. It all relates to the discussion we had regarding the real demand and the extent to which we create the demand that is needed for our economic development, speaking as European citizens. Keeping in mind that 85% of dairy production in Ireland is exported, 70% of it to the European market and the rest to third countries, the strategy is to increase Ireland's market share in third countries such as India and China. Frankly, I do not know anything about what a sustainable diet is there but for European people, we could easily cut our dairy consumption by a third or even by half without any consequences for our health. Those are the nutrition recommendations of the European Food Safety Authority; they are not coming from NGOs or advocacy people. On that topic, if the level of demand remains constant or even increases, which is what is foreseen by the international network of dairy production, then taxing countries that are the most efficient - Ireland is among the most efficient countries regarding dairy production - might lead to some displacement in other countries that are less efficient-----

Deputy Tom Neville: Is Dr. Aubert referring to countries that are less carbon-efficient?

Dr. Pierre-Marie Aubert: Yes, but as Professor Masson-Delmotte said, one of the points is how we work on the demand side. How can people be made less demanding while remaining healthy and happy? That is the key point.

Chairman: Did Professor Masson-Delmotte want to come in?

Professor Valérie Masson-Delmotte: I just gave the example of those organisations from Denmark and Sweden. My understanding is that they moved from the food system assessment of emissions - farm and supply chain - to having a clear strategy to reduce them. It is also driven by the demand of their consumers. It is about having both sides working together, so they are basically exemplary in a way. The second point was about accounting for different

gases. There are different ways of aggregating gases that have a long lifetime in the atmosphere like CO2 and N2O and those that have shorter lifetime such as methane. It depends on the time horizon. The committee may be familiar with CO2 equivalence, where it is calculated over 100 years, but if we look at 1.5° Celsius warming, which may happen in a few decades, it does not work. That is why, for the 1.5° Celsius report, we were very clear. We have CO2 on one side. Then we measure the other elements by their aggregated radiative forcing and we show that it is necessary to act on both; CO2 emissions to go to net zero and then a decrease of the radiative forcing of the others. That gives flexibility. It is hard to get out of N2O emissions due to the need for fertilisers for food production but there is strong potential for many aspects related to methane, including waste and other elements in addition to livestock. Due to the fact that methane has a short lifetime in the atmosphere of about ten years, there is also potential for almost immediate benefits of acting strongly on methane.

Deputy Jack Chambers: I apologise for missing parts of the presentations. Picking up on a point Deputy Neville made in respect of reshaping agriculture, we had officials from the Department of Agriculture, Food and the Marine before the committee in the past week or so. There is a research organisation within that Department whose projections are for carbon emissions to remain the same or to increase despite mitigation measures. Is that being mirrored elsewhere? It is very aspirational to say we will change dietary intake in society; it would take centuries, not decades. Can the witnesses correct me on that? Could they give examples of how societies have changed their dietary requirements? How does that fit into dairy and meat consumption? Is there any evidence of a transition to increased processed food consumption in certain societies where the poorer groups could be more reliant on food that is not fresh or that is processed? A shorter supply chain is obviously healthier. How does that fit into the societal context in terms of health? We could flip dietary requirements and increase the cost of dairy and meat but that could have a deeper impact on poorer people in society. I am interested in a policy sense in how we transition towards what is the right aspiration for the environment. The Taoiseach is on record as saying we are behind relative to most of the other European countries. Can the witnesses pick an example of smaller economies that are showing excellent leadership? How can we innovate and be leaders in this area?

Dr. Pierre-Marie Aubert: I will start with diet because it is one of the most important things. The changes in diets that are forced in most scenarios are the same order of magnitude as the changes we have experienced in the past 40 or 50 years in Europe. We are not talking about a revolution in diet. We are talking about gradual changes that are basically of the same order of magnitude as we have experienced. For example, in meat and dairy consumption, at European level, the amount of dairy produce quickly increased from the 1960s to the 1990s and then stabilised a bit, although I do not have the figures to hand. The same goes for meat. For chicken meat, for example, the rise has been very quick and now it is stabilising, and it is the same for pork. The kind of changes we have experienced are quite important. We tend to minimise them as a way of suggesting that the changes scientists are talking about are impossible because they would take centuries. No. It can take 20 or 30 years. It has already happened and is already happening. For example, the rate of consumption of meat in France has been decreasing slowly over the past ten years. That trend will probably continue. Change is already taking place and we need to make that change visible and desirable. To do so, we need to invest a bit more in public action and advertising. That is on diet.

On reshaping the agricultural sector, I will not talk about the Irish case but I can talk about the French case. We have a lot of ideas and proposals on the table and these are being discussed with the major farming unions. These include reintroducing ligneous crops in rotation, length-

ening rotation again and reconnecting the livestock and crop sectors. Those things are being discussed now. It means we must not only change practices at farm level but also reshape all food chains. Reshaping food chains means reterritorialising them, which is to say that if one diversifies and lengthens crop rotation, one has to have a market for the farmer. It means one has to have processors, buyers and so on in place. These are people who are not there any more and that means having to think about getting people to hear about and buy the production from the farmer. As to which countries have changed quickly and are leaders in that space, Switzerland is a really good example. I am not kidding. It has developed. I am not an expert about Swiss agricultural policy but I have a call next week with key people there. I understand Switzerland has moved strongly to shift policy towards climate-friendly and biodiversity-friendly agriculture in an amazing way.

Professor Valérie Masson-Delmotte: It is striking how much innovation one can get when actors in the sector take ownership of climate change issues. It is striking that in New Zealand and among farming organisations in Australia there is currently a demand for action on climate change as farmers there are the ones facing the consequences of a changing climate. It is striking when that demand comes from the professional organisations themselves and how much innovation can be available there. Revenues can be increased for farmers by building on innovation and thinking beyond dairy and meat.

Deputy Thomas Pringle: This is a very interesting session and I thank our guests for their presentations. What I take from what has been said is that ownership of the problem is key. We have a real problem in Ireland in that none of our farm organisations take ownership of the problem and our Department does not either. How do we address that? That is probably where I want to go. I will quote a submission the Department of Agriculture, Food and the Marine made here to provide an example to our guests. It states:

> Methane, which is [the] predominant emission from the agricultural sector at approximately 60%, has a 12-year cycle after which it breaks down. The knowledge relating to that involves identifying that if this is the case in practice, provided that methane emissions do not go up, it does not have an additional global warming potential as a consequence. That is why the primary focus of our interventions is on carbon dioxide, etc.

Can our guests comment on that and say whether it is reasonable? Given that it comes from the Department with direct responsibility for dealing with this situation, it demonstrates the scale of the problem we face. I ask our guests to talk a bit more about the French example and changing production. Who is saying that? Is it the relevant Ministry in France? Is that who can start the conversation we need in Ireland? Dr. Aubert referred to the requirement to provide ways to off-set residual emissions from other areas of the world which are more densely populated. That is the responsibility of Irish agriculture. Can he talk about that also? It would be horrific for Irish farmers to have to think that.

Dr. Pierre-Marie Aubert: The question of ownership is a good way to link with what we are doing in France. We have been teaming with the French Ministry of Agriculture and Food which is in charge of designing the agricultural part of France's low-carbon strategy. The Ministry says the emissions are not very high because it is only a cut by 50% of greenhouse gas emissions by 2050. We have not calculated the amount of bioenergy that could be produced but it would be a lot. We are nearly reaching carbon neutrality under this scenario for the sector. That does not mean we can reach carbon neutrality for the whole national economy. I will follow Professor Masson-Delmotte. We are currently leading stakeholder groups made up of representatives of French farmers, major food-chain actors, NGOs, consumer organisations and

the Ministries with responsibility for agriculture and the environment, respectively. We have taken the broad scenario at national level and are exploring what it means concretely at the farm level and for food chain actors. As Professor Masson-Delmotte said, those people were unwilling to engage in that process two years ago. However, following the many extreme events they have had to face over the last two years, they are clearly aware that they have to move. They are happy to find a seat in such a dialogue to express ideas, suggestions and propositions. That is what I can say about the French example. While I could go deeper into the technical details, I do not think that is the point of this discussion.

Deputy Marcella Corcoran-Kennedy took the Chair.

Deputy Thomas Pringle: Can something more be said about the possibility of Ireland offsetting the emissions of other countries?

Dr. Pierre-Marie Aubert: We have the same problem in France. France is a large country and it is less densely populated than other European states. The possibility exists in the natural world to offset the emissions of other countries. This is not something that has been brought into the debate, but it will have to be. I do not have clear ideas on it but while I am sure there will be some reluctance and resistance, it will have to be put on the table, at least to make choices and to be aware of what those choices mean.

Professor Valérie Masson-Delmotte: There is huge potential for thinking differently and having spaces of innovation and practical research which include people from academic and research centres working together with farm practitioners. That is very important for the idea of ownership and to create a bridge between practitioners' knowledge, which is broad, and academic knowledge. There are multiple examples of this, albeit farming is a very good one. It is the same for urban innovation. One also needs people with practitioner knowledge within cities to work with people in the academic sector to think together about pathways to change the urban system. It is very similar in a way. One needs practical spaces for that work and transparency on the lessons learned from experimentation that can inspire others.

Deputy Thomas Pringle: The problem we have is that farmers and the Department of Agriculture, Food and the Marine do not agree that they are part of the problem. Who is going to do it? As far as they are concerned, they are not causing any problems.

Professor Valérie Masson-Delmotte: The second point I wanted to make was on the use of peatland in Ireland. There is a huge potential to restore peatlands for the value of the services they provide like water management and recreational activities. They can also work with sectors that find it hard to decarbonise, like the airline industry, and which work on carbon offset schemes which are often located on the other side of the world and are difficult to supervise. There are opportunities to provide services to companies which need to store carbon, with strong monitoring so that it is verified.

Deputy Thomas Pringle: Can our guests comment on the Department of Agriculture, Food and the Marine's quote on methane?

Professor Valérie Masson-Delmotte: I have expressed how much methane is important in trapping heat that does not escape to the space.

Deputy Thomas Pringle: It is trapping more, which is the problem.

Professor Valérie Masson-Delmotte: It is the second major greenhouse gas. It has direct

and indirect effects. It also acts on air quality. Our 1.5o report shows clearly that, if we want to stabilise global warming, then one needs to act on CO2 because of its cumulative effect, and emissions of methane need to be reduced globally, typically by about 35% or more by 2050.

Dr. Pierre-Marie Aubert: On that point there is currently a methane strategy under discussion in the European Parliament.

Senator Máire Devine: I thank the witnesses for their presentations. I have just a few observations. I have asked this question before but I did not get a straight answer. Dr. Aubert spoke about trees as carbon sinks. I am interested in trees or plants that are most effective as carbon sinks. In Ireland we have forests of conifers. I do not believe they are as effective as carbon sinks. Have any studies been done to promote more broadleaf trees or hedgerows, not just as carbon sinks but also for the attraction of wildlife for which broad leaf trees are more friendly? Are we planting the wrong sorts of trees?

On the issue of cattle and livestock, farmers here would shudder at the idea that not only are the cows causing problems and are the second contributor to the problem but also that we might also have to consider our landbank to offset for other countries that are not as populated. While we need to look outside of ourselves and see it globally, it would be quite scary for all of us in the State to have the double whammy of responsibility.

Is it an urban myth that if seaweed were to be mixed with the cattle feed it can reduce 99% of the-----

Dr. Pierre-Marie Aubert: I did not get that.

Senator Máire Devine: The University of California-----

Dr. Pierre-Marie Aubert: I have no clue.

Senator Máire Devine: Is it an urban myth that they promote this as evidence-based research in the University of California and in Australia?

The change of lifestyle is also very important. Agriculture is not just about livestock. It is also about horticulture and the production of good quality vegetables and fruit that can be our main diet if we change our lifestyles. The next generation coming up is much more open to less meat and more vegetarianism, along with a significant increase in veganism. This will have an impact, but currently nobody knows how much. Perhaps studies need to go on with that.

Dr. Pierre-Marie Aubert: Regarding the tree species acting as carbon sinks, there is a key issue. I will address this on a general level and not specifically for Ireland or France. It must be kept in mind that if a region goes for afforestation for the sake of increasing the carbon sink, it will be at the expense of agricultural land and of permanent grasslands. Biodiversity issues are key. At the moment, more than one quarter of all species and habitats that the European Union set out to conserve according to the 1992 habitats directive, are in direct or indirect relationships to permanent grasslands. If a region chooses to afforest those grasslands for the sake of increasing the carbon sink, which may a very good idea, we must think of the kinds of biodiversity an area would lose because of that measure. Thought must be given to the kind of afforestation that is to be done to limit the biodiversity loss that would be inevitably linked to this afforestation.

In that sense one might consider fast-growing species when planning afforestation for car-

bon sinks. Those fast-growing species such as the Douglas fir species grow 30 m3 per ha per year of growth during the first years. They are very good for carbon sink but are a nightmare for biodiversity. I have another background in forestry before, and it is clear that at the moment we really lack experience and knowledge about what to do and how to do a biodiversity friendly large-scale afforestation scheme. We need to invest in that area if we want to have afforestation and carbon sinks without harming too much biodiversity. That is a key point.

With regard to the question on seaweed and methane, I do not have a clue.

Professor Valérie Masson-Delmotte: Diverse forests are also important to increase resilience to a changing climate with heatwaves, the risks associated with storms and the risks around potential wildfires. A diverse forest is usually more resilient, including to ecosystem changes and to insects and other aspects.

On the diet aspect, it will be a core element of the Intergovernmental Panel on Climate Change, IPCC, report on climate change on land, which is now under review, including review by governments. The report will include the health benefits as well as the environmental benefits of diverse types of diets such as flexitarian, vegetarian, Mediterranean, or pescatarian, which is rich in seafood, and other options.

Senator Máire Devine: I thank the witnesses.

Deputy Sean Sherlock: I apologise for missing the first part of the witnesses' engagement with the committee. We have other committees to attend also, but I apologise. I thank the representatives for being here today because it is so important that we have the weight of academic opinion in respect of what needs to be done. It will greatly assist us in trying to form a report that responds to this crisis. I am grateful for the witnesses' attendance today.

What are the representatives' views on carbon budgets whereby governments or the Department of Agriculture, Food and the Marine, the Department of Finance, and the Department of Transport, Tourism and Sport are allocated a carbon budget and there is also a universal view on what each Department is emitting through its agencies or activities?

Dr. Pierre-Marie Aubert: I do not have a strong view on that but I will share the French experience. It is exactly what we do. We share the carbon budget between each administration and each ministry. We see who is able to do what and then we bring everything together and see to what extent it is enough to reach our commitments. If it is not enough, then there is interaction and we go back to each sector and say that we have to do more. That is basically what we do.

Deputy Sean Sherlock: So there is a precedent whereby-----

Dr. Pierre-Marie Aubert: In 2015, we published our first low-carbon strategy.

Deputy Sean Sherlock: That is very useful. If there is some paper that would help this committee, it would be very useful for us to see if there is a translational effect into an Irish context.

Dr. Pierre-Marie Aubert: In late September this year we published an assessment of the effectiveness of this first low-carbon strategy. It concluded that we have failed on most of our commitments in three years.

Deputy Sean Sherlock: Does Dr. Aubert believe that it is a good model that should be

used? I ask the other witnesses to respond also.

Dr. Pierre-Marie Aubert: I think the revision process of the low-carbon strategy in terms of governance has been very good at least for the land and the agricultural sector in that we engage properly with all major stakeholders and we are still working with them. We did not stop with the main recommendation in the report, which will be published in a couple of weeks. We are still working on the implications of this and how we are to move forward. It can be considered as a model. We will publish in a couple of weeks, probably in January, a short report explaining the process for the agriculture sector.

Professor Valérie Masson-Delmotte: It is important to have CO2 to one side and maybe the other gasses on the other side and so try to avoid ambiguities in metrics. That is one point. I have also been exposed during the IPCC conference on cities and climate change science to examples of cities that implement a carbon budget at the city scale. I think it is the example of the city of Oslo in Norway that is a long way forward compared with other non-state governments in also using a carbon budget that is voted each year, together with a spending budget.

Deputy Sean Sherlock: This is very interesting because again there is a clear example of a city, perhaps we could call it a city state, with autonomy in respect of its own governance. It is clearly working on this topic. Professor Masson-Delmotte states that there would have to be a clear disaggregation between CO2 and other emissions. For people who may be watching these proceedings, what is the reason for that?

Professor Valérie Masson-Delmotte: It is because, depending on targets, different weight may be given to the way the overall emissions are calculated.

Deputy Sean Sherlock: I see.

Professor Valérie Masson-Delmotte: It may be aggregated over 100 years or a shorter time period.

Dr. Pierre-Marie Aubert: Greater weight given in the method used to produce the scenario Professor Masson-Delmotte referred to.

Professor Valérie Masson-Delmotte: That is correct and also because probably-----

Dr. Pierre-Marie Aubert: It more than 27 times one tonne of CO2.

Professor Valérie Masson-Delmotte: I know. For the 1.5°C reports, we provide globally aggregated CO2 budgets, which are completely separated from the non-CO2 factors. That helps to focus on CO2 only.

Deputy Sean Sherlock: Does that mean that policy interventions can be designed once a weighting has been given? Would it be possible to say that this is what we need to do in transport, this is what we need to do in agriculture or buildings and whatever it may be?

Dr. Pierre-Marie Aubert: Can I make it a bit more explicit?

Deputy Sean Sherlock: Yes, that is fine.

Dr. Pierre-Marie Aubert: For methane, the relative forcing potential over 100 years is 27 or 28. I do not remember exactly. If we are working on a scenario to 2050 instead, then the relative forcing potential is doubled. Depending on what timescale we are working to, we can

give a different weight to the different gases. That is the reason there can be separation.

Deputy Sean Sherlock: Is that not the point? We have line Departments reporting to this committee. I do not get a sense of that type of urgency, given the timescales involved, in Ireland moving towards carbon budgeting. Perhaps that is something this committee could include in its recommendations. I am also interested to hear the views of Professor Seneviratne on carbon budgeting.

Professor Sonia Seneviratne: It is not so much my area. I am working on climate extremes. What has been discussed, however, makes sense to me from a general point of view. Looking at the different budgets will also make sense. One point missing was possible synergies, which we sometimes have between sectors. I wonder to what extent this might need to be considered as well.

Deputy Sean Sherlock: On that, if we establish the principle in the first instance, then we can roll it out. It is important that there are examples in Zurich and France that we can look towards.

My next question is on the Common Agricultural Policy, CAP. That is the big beast. In respect of the witnesses' interactions with other governments, academics and entities such as the European Commission, is there a sense that the next CAP will deal with agricultural production in a way that will allow farmers to reshape food chains, to use witnesses' term? Will it also be dealt with in a way that will allow us, in any Irish context, lessen our dependency on intensive farming and move towards policies such as afforestation or horticulture? Do the witnesses have a sense from the early workings on CAP that the European Commission is moving in a particular direction with climate change and agriculture?

Dr. Pierre-Marie Aubert: This is a complex question. I will try to make it as simple as possible.

Deputy Sean Sherlock: I thank Dr. Aubert.

Dr. Pierre-Marie Aubert: The most important aspect of the new CAP, being discussed at the moment, is the new delivery model. What does that mean? It means that under the new CAP, if the European Commission's proposal is approved, subsidies will be allocated on the basis of a strategic plan designed at the member state level but which will have to be approved by the European Commission. All in all, there will be much responsibility in the hands of member states. That is my first point.

My second point is to ask if it will be enough to go in the direction mentioned by Deputy Sherlock. There are two safeguards in that regard. One is that in the European Commission's proposal, there is the necessity that 40% of the subsidies allocated by a member state go for climate action, under either Pillar 1 or Pillar 2. The second safeguard is that under Pillar 1, each member state will be asked to devise an eco scheme but the boundaries, the amount of money and the type of practices that could be awarded through this eco scheme are still a bit blurred and under discussion.

There are opportunities in this new delivery model. We should not overlook that. In the meantime, there are also huge risks. Where member states are competing with each other in both the internal market and the export market, there is a risk of a type of race to the bottom in environmental and social requirements. If it is up to the member states to devise and design the criteria for subsidy eligibility, then there is a temptation to lower the environmental and social

requirements to minimise production costs to be more competitive both in the internal market and the export market. We do not know exactly what will be the European Commission's position and its capacity to make sure that member states, in their strategic plan, will raise environmental and social ambitions rather than lowering them.

Deputy Sean Sherlock: Is Dr. Aubert hopeful about the schemes being devised by the European Commission? I understand what he is saying about the member states' application or implementation of those schemes. I would have thought, however, perhaps naively, that the European Commission is realistic now about the challenges member states are facing in respect of climate change. The European Commission, as an entity in and of itself, notwithstanding any critiques I might have of it on other issues, has no other choice now but to make sure there is a proofing mechanism to ensure there is not, as Dr. Aubert put it, a race to the bottom.

Dr. Pierre-Marie Aubert: I know people at the European Commission working on that. For most people working there, this new delivery model was seen as the only way forward, given the political situation in Europe and the demand expressed by many member states. It was also seen as a way to make sure environmental measures will be adapted to specific contexts that are very different across Europe. The Commission is very willing to move forward with climate ambitions. It is keen on that. It remains to be seen, however, how it will be able to negotiate, concretely, the content of the strategic plans.

Deputy Sean Sherlock: I thank Dr. Aubert.

Chairman: I thank Dr. Aubert very much. I call Deputy Eamon Ryan.

Deputy Eamon Ryan: We have gone back over the same issues but it is very important. Yesterday, a senior agricultural representative was trying to convince me that methane is not a problem. That cannot be said tomorrow. That has to stop now, today, and never be suggested again. The second big issue is at the centre of our debate. It is claimed that Irish agriculture is saving the world. We are exporting infant formula instead of breast milk to China. We are also exporting meat to China. The consumption of meat in China has increased greatly over five or ten years, never mind 40. We are saying that we in Ireland do not have to reduce our emissions in this area. We are more carbon efficient per kilogramme of that beef than the Brazilians or the Argentinians. I wish to clarify something Dr. Aubert said. From the IPCC perspective, is that argument not credible, particularly following the recent report?

Dr. Pierre-Marie Aubert: It is a little hard. I would not say it is not at all credible, but it is an argument which must be handled with much attention. It is true that we need to ensure that products that are needed somewhere are produced in the most efficient way. I do not know anything about Brazilian, Chinese or Indian diets and, therefore, I do not have anything to say about that, but we can assume that it might be the case that those people will need to consume more dairy products for whatever reason. In the time between when they increase the level of carbon efficiency of their dairy production and now, it might be useful to export dairy from Ireland, but this must be temporary. If it is only a way for the Irish farmers to increase their market share on the world market, that is not credible. It depends on the pathways of the exports and role of Irish production. It is not an absolute term. It is a relative term regarding where we are now and where we want to go.

Deputy Eamon Ryan: I do not quite understand the idea of temporary versus long term. Why would that make a difference?

Dr. Pierre-Marie Aubert: If we say dairy products must be produced where there are the most carbon efficient techniques, and if at the moment Chinese producers are not efficient enough, we can say that while they are improving their efficiency level, part of the milk needed in China can come from Ireland, but it must be a temporary measure because at some point Chinese farmers will be efficient enough to supply their market with their milk.

Deputy Eamon Ryan: Are there any differing views on that?

Professor Sonia Seneviratne: I am not an economist and these are just my thoughts. Global solutions need to be found. If there was some type of CO2 tax, the meat that is produced at the same time, which leads to higher CO2 emissions, would be more expensive and, therefore, it could be one way to solve the issue. As always, it is an interconnected problem. I do not know if it is realistic to have a global CO2 tax.

Chairman: When Professor Seneviratne says "tax", does she mean on agriculture to ensure the agricultural industry produces more efficiently? I take her point that she is not an economist.

Professor Sonia Seneviratne: I am not an economist or a politician but I know that in Canada, for instance, a CO2 tax has been introduced. It seems promising because it is a CO2 tax where money is given back to the population. Some type of transfer mechanism is needed to encourage production which does not lead to high CO2 emissions.

Deputy Eamon Ryan: I fully support that. On the land use in the biomass area, we are considering using biomass here for electricity power generation. We were considering importing 3 million tonnes per annum of biomass from forests in Canada or elsewhere. Is that a sustainable use of biomass?

Dr. Pierre-Marie Aubert: Not at all. There is no point in bringing wood from Canada or Russia just because they are areas where wood will come from, given the transportation costs in terms of money and CO2, and given the biodiversity impacts of harvesting forests in Russia or Canada. We have the same problem in France. We have just transformed a former coal power plant into a wood power plant. We do not have enough wood in France to supply that power plant and, therefore, we are importing wood from Canada, but it does not make any sense. The question is how to lower the demand for energy.

On biomass, there is potential for biogas production in Ireland to avoid relying on wood imported from all over the world.

Deputy Eamon Ryan: I know it is difficult to make political assessments. The IPCC has good wording where it considers predictions to be "likely", "less likely", "more likely", "very likely" and so on. For a country like Ireland, where there is a target of an 80% reduction in emissions by 2050, everything the witnesses are saying suggests that it must be a 100% decarbonisation. What is the likelihood of us facing that reality in a regulatory political assessment before 2030? If we set out on a less ambitious path for 2030 and, halfway there, the international rules and the political environment in Europe and elsewhere change, what is the percentage of probability that would happen? Assuming at some stage we will have a higher target within the international mechanisms to which we are a party, what is the advice for us?

Professor Valérie Masson-Delmotte: My point was that the need to stabilise warming at 1.5°C to be net zero by 2050, or 2075 for 2°C, is on a global scale. We spoke about the notion of justice and fairness, or the fair share of the load and effort. One must also consider that developed countries have more cumulative emissions than other countries. In aiming for net

zero, there might be a need for developed countries to act earlier than emerging economies or the least developed countries, which also have a right to develop. These are all elements to consider and, in any case, reducing carbon emissions by 80% by 2050 is not on track with the target of 1.5°C.

Professor Sonia Seneviratne: To return to the target of net zero emissions by 2050, there is a scenario where there is almost no carbon captured in storage and, therefore, all the negative emissions are removed by afforestation. There are also scenarios where the carbon capture is in storage, which is a more technologically advanced development we do not have at the moment. This matter is under discussion in Switzerland, where a company is working on carbon capture although it does not yet do the storage part. When we talk about the responsibility of developed countries, we must also bear in mind the responsibility to work on solutions. One possibility is carbon capture and storage while another is more renewable energies, which we did not speak about much, such as wind energy and so on. We should also consider research and development to find new solutions.

Deputy Sean Sherlock: I have grappled with carbon capture. Is it ethically sound to use it as a policy intervention?

Professor Sonia Seneviratne: I am not an ethician, either.

Deputy Sean Sherlock: I accept that. I would like the professor's opinion.

Professor Sonia Seneviratne: The main concern that is raised is the question of moral hazard, that is, if carbon capture is considered as a solution, it might lead to less investment in mitigation. As Deputy Eamon Ryan suggested, the 80% goal for 2050 is already challenging. Most of the 1,000 scientists who reviewed the 1.5°C report, although not all of them, include carbon capture and storage because it is so challenging. Without it, it might in some cases be a matter of reaching 1.5° or 2°C. It is not, therefore, one or the other. One cannot gamble on it or guarantee that it will work. It is a question of research and development, and we cannot be sure it will work. It is worth making the effort to try to see if a solution can be found.

Dr. Pierre-Marie Aubert: To make a parallel, which might not be fair for people working on bioenergy carbon capture and storage, we have waited for second generation biofuel for 20 years but we still not do have anything. I would not bet on it, for many reasons.

Professor Valérie Masson-Delmotte: There are three main risks facing us, the first of which is a lack of ambition in dealing with climate related risks which are increasing gradually and committing younger generations to greater adaptation to an unknown climate. The second is the risk of reliance into the future, following potentially, an overshoot, on the large-scale deployment of very risky options for food security and biodiversity preservation. The third is the risk of a rapid transition now.

Deputy Sean Sherlock: I do not understand the third point.

Professor Valérie Masson-Delmotte: There are risks associated with ramping up ambition for mitigation now. It is a risk associated with, for example, negative effects of ambitious mitigation for specific sectors and people. There is the risk of stranded assets in the economic world. As the report shows, we are at a crossroads in dealing with these risks and it is important that we examine them and identify the risks, in respect of which we understand the consequences, and those that are uncertain. For me, large-scale use of bioenergy, with capture and storage, is uncertain.

Chairman: Another risk is that a country will invest in or choose a particular technology that ultimately will not work or produce results such that money will be lost.

Professor Valérie Masson-Delmotte: Yes. We should not put all aspects of carbon capture and storage in the one basket. There are other options that would have side benefits. There are also options that work with industrial system efficiencies such as carbon capture, re-use and storage. There is a spectrum of other options. It is important to examine costs, scale, real potential and risks.

Chairman: As well as societal impact.

Professor Valérie Masson-Delmotte: There are lots of opportunities in that direction in being very lucid about some of the risks.

Senator Grace O'Sullivan: I thank the delegates for their presentations. For me, the risk lies in Ireland not taking action, which is what we have been doing for the past few years. We import most of our oil and gas energy supplies. We also import most of our food. We export a huge amount of beef and dairy products. In the past few years,this small country has intensified the production of beef and dairy products in the face of the report. We have not been taking notice or action. Professor Aubert spoke about proposed changes in the food chain. As I said, we are importing most of our food and not taking opportunities to change. On renewable energy, we have been told that we have opportunities in terms of the use of the oceans and seas around us, but we are not taking them. The big risk for us lies in non-compliance, which will hit us in the face in the imposition of fines. Ireland faces a dilemma.

Will the delegates point to examples of best practice that we should consider in the context of large-scale housing retrofit? Transport has not been mentioned much. Again, Ireland is a disgrace in the provision of public transport. Will the delegates also point to examples of best practice in active travel such as walking and cycling, in food choices and peatlands re-wetting and restoration.

Professor Valérie Masson-Delmotte: On housing retrofit, of particular importance is the availability of almost zero interest loans, in respect of which which people can be reimbursed when they get the benefits of investments in energy efficiency. There are multiple examples of such actions. It works best when it is done at community level and administrative procedures are as simple as possible. It fails when people have to go through multiple entry points to avail of the supports available from local government. Simplicity is important. Initiatives must be targeted at the most vulnerable people, in particular those facing energy poverty. For example, in the city of Grenoble people have been appointed to certain jobs to work on the bills of others and help them to understand how they can reduce them and the other things they can do. There are differences between owning and renting housing. It is important to target the two approaches. Based on the experience in France, what is really important is that there is a system in place to control the quality of the work done, with people being paid once there is proof that a particular level of avoided energy usage has been reached. Practice shows that even with goodwill, the implementation of retrofitting can be of poor quality, if not done well. Having in place a system whereby payment is based on quality of service puts pressure on those who implement the retrofitting and may help to ensure the savings expected are achieved. France is late in its commitment in that regard also.

On transport, I recently examined an interesting piece on the life cycle of various types of vehicle. The weight of vehicles for private transportation is key. Electrified transport and super

heavy cars do not work well when one examines the life cycle emissions from production to dismantlement. As I said, the weight of the vehicle is very important. The added value of electric vehicles depends on the way the batteries and the vehicle are produced. If it is using coal, it is different from other options. Also, it depends on the carbon content of the electricity used when using the car. It is important to remember that while electric vehicles produce zero emissions during use, they still produce emissions over their life cycle. The best option in travelling distances of 10 km or less as is the case for many people on a daily basis is to use bicycles, including electric bicycles. This requires public investment in secure transportation pathways, in respect of which Switzerland is leading the way, together with other countries.

Dr. Pierre-Marie Aubert: On food choices, we recently published a scenario whereby European agriculture would be organic by 2050 and in which we would feed all European people by 2050, while reducing the amount of greenhouse gas emissions by 40%, which would not be enough to reach neutrality. This points to the question of whether organic agriculture is compatible with a carbon free diet, which I do not believe it is, because for organic agriculture, one needs to have bovine ruminants, for many reasons. To develop this scenario, we took all of the recommendations for diets from researchers and NGOs and national and international agencies. On this basis, we built a typical diet which would be in line with European habits, at least in the way in which they have evolved in the past 40 to 50 years. As I mentioned previously to other members, the diet we proposed, for which we implemented a scenario for the calculation, is not that different from the current diet, although it cuts by half the amount of consumption of animal products. There is also an increase of more than 50% in the consumption of fruit and vegetables for the sake of intake of fibre and vitamins, as well as a slight decrease in total calorie and protein intake, with the replacement of animal protein by additional proteins.

All in all, as I said, the order of magnitude of the changes we foresee in this scenario is totally compatible with what we have experienced in the past 45 to 50 years. As has been said, from a health point of view, there are millions of diets that are compatible with nutritional recommendations expressed in terms of proteins, lipids and carbohydrates. The way in which the nutritional recommendations are translated into an actual diet based on concrete elements and agriculture production depends on cultural habits and the type of environmental target one wants to reach. For example, because ours is an organic scenario, red meat remains quite important by comparison with other scenarios. We need the animals to maintain grasslands and for fertility transfer.

A scenario has just been published by Dr. Marco Springmann and other colleagues in the EAT consortium and the Resilience Alliance. The diet proposed is much more radical in the sense that the amount of animal protein is down to 20% of total protein intake. In our scenario it is at 40%, while in the current situation, it is 65% or 66%. The total calorie intake decreases a bit more than in our scenario. However, it is much more compatible with carbon neutrality than ours.

Chairman: I know that the delegates are under pressure to be out by 5 p.m. Would Professor Seneviratne like to contribute?

Professor Sonia Seneviratne: I would like to make a few points. I want to go back to the question of renewable energy. We have not discussed it much today. Obviously, agriculture is a big issue in Ireland. A big element of the 1.5° Celsius scenario is the electrification of energy use. Moreover, electricity production should be carbon-neutral. That is an essential element. As has been said, there is a lot of potential for development in that regard. It is also an area we pursue quite a bit in Switzerland. The use of solar panels may be a possibility, but I do not know

if there is enough sunshine in Ireland. Germany produces a lot of solar energy. It is a good example of a country that produces quite a lot of energy from renewable resources.

There is a point we did not discuss at all. I know that it is relevant in Switzerland, but I do not know if it is relevant in Ireland. I refer to finance. Investment is a big issue, that is, whether there is investment in fossil fuel companies. As Professor Masson-Delmotte said, at some point there might be stranded assets. There are also systemic issues. A whole economy is dependent on CO2. The whole system must be changed. In Switzerland there is a lot of thought about this aspect.

Professor Valérie Masson-Delmotte: I wish to make one point about food choices. It is important to make invisible greenhouse gas emissions visible to consumers. There are tools to visualise the nutritional profile of food products. One could also imagine displaying the greenhouse gas emissions profile of food products in order that consumers could make well informed choices.

Senator Grace O'Sullivan: The issue of peatland re-wetting or restoration has been raised. Does Professor Masson-Delmotte have examples of such initiatives?

Professor Valérie Masson-Delmotte: I know of examples of small-scale restoration projects in Alpine areas that were also used to support tourism developments. However, they are small-scale initiatives. There might be other examples in Nordic countries, with which I would be less familiar, as well as in central Europe. I know of current wetlands restoration projects, but I am not directly familiar with them.

Chairman: I thank our visitors. I know that it has been quite a lengthy meeting, but it has very valuable in the committee's work and the preparation of our report. I genuinely thank all of the delegates for coming before us.

The joint committee adjourned at 4.55 p.m. until 6.15 p.m. on Tuesday, 4 December 2018.