DÁIL ÉIREANN

AN COMHCHOISTE UM GHNÍOMHÚ AR SON NA HAERÁIDE

JOINT COMMITTEE ON CLIMATE ACTION

Déardaoin, 29 Deireadh Fómhair 2020

Thursday, 29 October 2020

Tháinig an Comhchoiste le chéile ag 2 p.m.

The Joint Committee met at 2 p.m.

Comhaltaí a bhí i láthair / Members present:

Teachtaí Dála / Deputies	Seanadóirí / Senators
Richard Bruton,	Lynn Boylan,
Réada Cronin,	Timmy Dooley,
Cormac Devlin,	Alice-Mary Higgins,
Alan Farrell,	John McGahon,
Darren O'Rourke,	Pauline O'Reilly.
Christopher O'Sullivan,	
Jennifer Whitmore.	

Teachta / Deputy Brian Leddin sa Chathaoir / in the Chair.

General Scheme of the Climate Action and Low Carbon Development (Amendment) Bill 2020: Discussion (Resumed)

Chairman: Before we begin, I remind members that this meeting cannot go on for longer than the two hours scheduled, so may I have the committee's agreement that members' contributions will be limited to five minutes each, to include questions and answers? We will have second and third rounds if we have time. Is that agreed? Agreed.

I welcome to the meeting Professor Yvonne Buckley, professor of zoology in Trinity College, Dublin, and Dr. James Glynn of MaREI, the Science Foundation Ireland research centre for energy, climate and the marine in University College Cork. They are both very welcome. They are appearing remotely from outside the Leinster House complex. The format of the meeting is that they will be invited to make brief opening statements and this will be followed by a questions-and-answers session.

Witnesses are directed that only evidence connected with the subject matter of these proceedings is to be given and they are asked to respect the long-standing parliamentary practice to the effect that they should not comment on, criticise or make charges against a person or body outside the Houses or an official either by name or in such a way as to make him, her or it identifiable. I also advise the witnesses, who are giving evidence from locations outside the parliamentary precincts, to note that the constitutional protections afforded to witnesses attending to give evidence before committees may not extend to them. No clear guidance can be given on whether, or the extent to which, the evidence to be given is covered by absolute privilege of a statutory nature. If the witnesses are directed by the committee to cease giving evidence regarding a particular matter, they must respect that direction. I also advise them that any submission or opening statement they make to the committee will be published on the committee website after the meeting.

Members are reminded of the long-standing parliamentary practice 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 remind members and witnesses to turn off their mobile telephones or switch them to flight mode. Mobile phones interfere with the sound system and make it difficult for the parliamentary reporters to report the meeting. Television coverage and web streaming will also be adversely affected.

I now invite Professor Buckley to make her opening statement.

Professor Yvonne Buckley: I thank the committee for the opportunity to contribute. I am professor of zoology and co-director of Nature+, the centre for biodiversity and sustainable nature-based solutions at Trinity College, Dublin. My expertise lies in ecology, which is the distribution, abundance and function of natural and human-modified ecosystems. I serve as chair of the national biodiversity forum, which provides independent monitoring of progress in the implementation of the national biodiversity action plan. However, I am speaking today in my personal scientific capacity.

The first objective of the national biodiversity action plan is to mainstream biodiversity into decision making across all sectors. It is well recognised that we cannot tackle climate change without considering the contributions of biodiversity to climate change mitigation and adaptation. It is also well recognised that we are in the midst of a biodiversity crisis that threatens an

estimated 1 million species with extinction over the coming decades. This matters for climate change because biodiversity provides climate regulating services for the planet and provides us with the resilience we need for people, our economies and society to withstand the climate change shocks that we are already locked into.

Nature-based solutions can be implemented to help us achieve some of our climate action goals. The European Commission defines nature-based solutions as:

> "Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions."

Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services in addition to climate change mitigation and adaptation. Active restoration of biodiversity is a nature-based solution that, if done well, reduces greenhouse gas emissions, enables carbon capture and storage, and ensures the resilience of ecosystem service provision from our landscape and seascape to the disruptive effects of climate change.

I will make a number of recommendations. First, all policy instruments resulting from the Bill and the principal Act should comply with and actively support the implementation of the national biodiversity action plan. Instead of the rather vague wording of "enhance biodiversity", which is somewhat open to interpretation, the national biodiversity strategy should be explicitly referenced. The strategy is the touchstone of all biodiversity-related recommendations across the State's remit. Second, the purposes for which moneys may be paid out of the Climate Action Fund should include research on how best to deploy nature-based solutions and monitor their efficacy in order to inform carbon budgets and the projections of greenhouse gas emissions, storage and sequestration. Third, appropriate definitions of biodiversity and nature-based solutions should be included in the Bill, for example, the necessity for nature-based solutions to benefit biodiversity and support the delivery of a range of ecosystem services in addition to climate change mitigation and adaptation.

By reducing greenhouse gas emissions, as the Bill aims to do, we will be putting in place important future protections for biodiversity. By managing some of the shared drivers of biodiversity loss and climate change, we will gain some co-benefits for biodiversity. However, there is a risk that deployment of actions to reduce emissions and adapt to climate change may worsen existing drivers of biodiversity loss and introduce new drivers.

I am glad to see that expertise in biodiversity is specified for the advisory council. It is also useful to have the roles of biodiversity and nature-based solutions explicitly recognised in order to provide for the Climate Action Fund to be used to support projects that seek to increase the removal of greenhouse gases, in particular nature-based solutions that enhance biodiversity. However, there are some inconsistencies in the mention of biodiversity and nature-based solutions that support projects and research and in the utilisation of biodiversity and nature-based solutions for the removal of greenhouse gases and prevention of emissions that I recommend be resolved. Nature-based solutions such as the restoration of carbon-rich ecosystems can remove greenhouse gases from the atmosphere. Remediation of carbon-emitting land use, such as degraded peatlands, can reduce or prevent future emissions. The current wording in the Bill only recognises a role for biodiversity and nature-based solutions in the removal of greenhouse gases and not the reduction of emissions.

The efficiency and benefits from nature-based solution projects can be increased through targeted research as well as through implementation of existing solutions. The current wording recognises the utility of biodiversity and nature-based solutions in projects, but not in research.

To demonstrate the efficacy of nature-based solutions and get recognised value from their implementation, we need to measure and validate impacts as well as monitor effectiveness over short to longer timescales. Provision should be made in the Bill for support of research into adequate measurement and monitoring of the effectiveness of the nature-based solutions that are implemented. These data are critical for setting carbon budgets and projecting future carbon emissions, storage and capture.

We need the reduction in greenhouse gas emissions across the many sectors that this Bill seeks to enable. However, explicit recognition of the role that biodiversity and nature-based solutions can play in mitigating and adapting to climate change as opposed to trading biodiversity off to service climate actions will ensure that the climate actions we take will be win-win for climate and biodiversity.

Chairman: I thank Professor Buckley, and I invite Dr. Glynn to make his opening statement.

Dr. James Glynn: I thank the Chair and the members of the committee for the invitation to speak today and provide evidence on the role of carbon capture and offsetting in reaching carbon neutrality. I am an energy systems engineer and a research fellow at the Science Foundation Ireland, SFI, Marine and Renewable Energy Ireland, MaREI, Centre for Energy, Climate and Marine. I focus on energy systems analysis, and my team and I recently published research on national and global bases on the role of carbon capture and storage in zero carbon energy systems consistent with the Paris Agreement. I want to highlight the following key points from four of our published research paper, two technical reports and one discussion document in my evidence. They are included in the appendix I have submitted to the committee.

Achieving climate neutrality globally in 2050 means that 2050 is the year temperatures stop increasing. More important, cumulative greenhouse gas, GHG, emissions before reaching climate neutrality in 2050 dictates the temperature at which we stop. MaREI analysis shows that equitable carbon budgets for Ireland, based on the Brazilian rule to be compliant with the Paris Agreement, range from 638 million tonnes of CO2 to 225 million tonnes of CO2 from the year 2020 until when energy system CO2 emissions are reduced to net zero and temperature increase is stabilised at 2°C or 1.5°C.

MaREI analysis, applying these carbon budgets to the Irish energy system, shows that Irish CO2 emissions need to decrease by between 4% and 9% per year until 2030 to enable us to play our equitable part in keeping the global temperature increase below 2°C, and to reduce between 11% and 21% per year until 2030 to keep global temperatures below 1.5°C without overshooting that temperature ceiling. The majority of the scenarios that the 7% reduction rate in the programme for Government is based on assume the global temperature increase overshoots 1.5°C during this century and returns below 1.5°C by 2100.

In the Irish least-cost mitigation scenarios that I have modelled, the scenarios without carbon dioxide removal, CDR, technologies require immediate decarbonisation at rates approximately double the rates of scenarios without CDR. Reduction rates of 7% to 21% in CO2 emissions per year are required, as well as larger energy service demand reductions which impact on social welfare. In our analysis, typically, carbon capture and storage, CCS, technologies are

deployed early in gas electricity generation, as well as for process emissions capture in cement production, and in some cases with bioenergy CCS, BECCS, to provide negative emissions electricity, which offsets emissions from other hard to mitigate sectors. In scenarios without bioenergy imports, we typically need earlier and more CO2 capture. Residual fossil fuel emissions from CCS technologies can become inconsistent with scenarios with stringent net zero emissions targets. This means that fossil-fuel CCS plants without near 100% capture rates of CO2 are likely to be inconsistent with the Paris Agreement compliance targets in the absence of emissions offsetting elsewhere in the energy system.

Further MaREI analyses with global integrated assessment models, IAMs, also demonstrate a considerable reliance on CDR technologies to achieve the Paris Agreement goals and highlight the considerable cost increases in achieving those goals without CCS or other direct air carbon capture and storage, DACCS, technologies. Globally, the development of CCS, DACCS and CDR technologies are already far behind the technology readiness levels needed to meet the Paris Agreement goals, as per IPCC-IAMC, International Energy Agency, IEA, and industry scenario analyses. I draw the members' attention to the EU CCS directive and amendments and the Irish ministerial decision that Ireland has exercised its right, in accordance with Article 4 of that directive, to not allow for any storage of CO2 in the State. No area of Irish territory, therefore, is free to be used for CO2 storage. This issue is to be kept under review, however.

I welcome this Bill, in particular the attention paid to defining and implementing carbon budgets, but there is still room for improvement. I note that previous debates with evidence from legal experts highlighted the ambiguity in some of the language from a legal perspective. I repeat this concern, and add that from a scientific and engineering perspective the ambiguity in some of the Bill's language also means that it will not be possible to measure or define whether commitments in the Bill are being met. I recommend that scientifically-explicit language be used in the Bill. Particular attention should be paid to the definition of certain topics. I refer to carbon budgets, the gases to be included in them, the method to be used to calculate the warming of each GHG as a proportion of the carbon budget, which gases, if any, will not be included in the carbon budgets and the timeline of the carbon budget. The definition of "removal" should also include the removal of GHGs in energy combustion and industrial processes, critically, prior to release to the atmosphere.

Irish territorial waters should be included in the definition of "sink" and "climate resilient" and "climate neutral" should also be defined, and we should consider a definition of net zero increase in radiative forcing, being cognisant of differences between short-lived and long-lived greenhouse gases. The "decarbonisation range" in the long-term strategy should also be defined in something like per tonnes of each greenhouse gas per NACE category sector per year, which would be useful.

There are some recommendations in regard to the Bill that are worth considering. We should reinstate the language around pursuit and achievement of a minimum acceptable goal to be included for objective measurement of targets in the Bill. This is in line with the language of the Paris Agreement, which pursues a 1.5°C target, but the ultimate objective of the UN framework is to hold the post-industrial temperature increase well below a 2°C target.

We should consider a binding carbon budget for the period from 2020 until climate neutrality is achieved. We should investigate whether an overarching carbon budget should be included in the long-term climate action strategy time horizon of analysis bounded by the projected expected year of temperature stabilisation. Long-term information significantly affects short-term policy actions and our analysis demonstrates that myopia is extremely costly in long-term

energy systems planning.

We should explore whether sectoral carbon budgets could be allocated based on carbon intensity per value added per NACE category sector and acknowledge the role of early dialogue and societal buy-in. Behavioural change and demand reduction will be required and the national objective is unlikely to be met by technological means alone. We should implement the Paris Agreement rachet mechanism such that five-year carbon budgets should not be larger than the previous five-year cumulative emissions. Finally, the Bill could consider Ireland's offsetting and trade mechanisms, as well as multilateral responsibilities to developing nations' ability to decarbonise and to consider the impact of international aid in offsetting within Irish carbon budgets.

I thank the committee for today's invitation and I am happy to take any questions.

Chairman: I thank Dr. Glynn. We will take questions from members in the order in which they raised their hands.

Deputy Christopher O'Sullivan: I thank both witnesses for attending. Most of my questions or comments are for Professor Buckley. Much of my motivation in trying to get on this committee arose from my interest in biodiversity and how climate change is having an effect on biodiversity and wildlife and threatening species. Nature can be part of the solution so having the witnesses before us is very important for the committee.

I agree with most of the recommendations and with two in particular. There must be a definition of biodiversity and nature-based solutions in the Bill. Are there any other sections in the proposed Bill where references to biodiversity and nature-based solutions may be appropriate? Head 3 has 25 or so items that the Minister should have regard to, along with the advisory council, in compiling reports and recommendations. Should biodiversity be in there? It was interesting as there was a comment yesterday that there were too many items to have regard to but what is the opinion of the witnesses?

Is there a place in the Bill to address the idea that some alternative technologies for renewable energy may not be consistent with the protection of biodiversity? The same could be said for some adaptation technologies. For example, local authorities or Departments produce adaptation plans that may prevent future flooding, for example, but they may not be consistent with the protection of biodiversity. Is this the Bill to address such matters? For example, if there is overuse of concrete, nature-based solutions may provide an alternative. Offshore wind energy may also have an impact on marine biodiversity. It will be an incredibly important source of energy in future but should the Bill address such matters? That is pretty much it. All of my questions are for Professor Buckley.

Professor Yvonne Buckley: The first part of the Deputy's questions was on whether climate adaptation, biodiversity and solutions should be specified in section 3. I do not have that section in front of me, so I am going to not answer right now.

The second part of his question had two parts. One was on how alternative technologies for renewable energy may impact on biodiversity, so how things like offshore and onshore wind farms and the development of those on inappropriate soils - for example, on carbon rich soils or drained carbon rich soils - could impact on biodiversity and may be inappropriate in terms of carbon emissions into the atmosphere as well. The appropriate siting of both onshore and offshore renewable energy installations is very important. Actions to enhance or actions consistent

with a biodiversity action plan being implemented on onshore and offshore renewable energy facilities would be very important.

On change in land use, moving from agricultural land use to a wind farm is a change in land use. Whenever we change land use we need to think about the carbon that is omitted from that land use change. We also need to think about how we can build biodiversity and incubate solutions into the change in land use to make it better for biodiversity.

We need to be able to put in place actions that reduce the impact of wind turbines on biodiversity, bird strikes and things like that. Therefore, additional technology may be needed to reduce those impacts.

Appropriate siting, biodiversity enhancements on site and the mitigation of the known impacts that renewable energy installations have is important but so too is looking for new impacts as we develop larger scale renewable energy in the form of solar and wind. New impacts may arise as well so we need to keep an eye on all of those.

On the idea behind explicitly referencing the national biodiversity action plan in the Bill, everything in the Bill must take account of the effects of actions, either mitigation or adaptation, on biodiversity. Rather than specifying everything that may have some relevance for biodiversity, keeping in mind our duty to protect biodiversity whenever new developments are being put in place is the most important thing for us to do.

The Deputy's question has another part about adaptation plans, for which I have a similar answer. Nature based solutions should be considered as part of adaptation responses to climate action. Nationally based solutions have a part to play in things like flood mitigation. The combination of nature based solutions and technological solutions should definitely be considered. It is not an either-or situation as there are opportunities where we can use both. We are going to have to use both. Nature based solutions definitely deserve a much larger place than they currently get at local level. One of the problems is that we often look at short-term small special scale solutions for a particular part of a river - for example, to reduce a flooding impact when we should be looking at a whole river catchment and what kinds of nature based solutions can be put in upstream from the problem to reduce and slow the flow and to enable flood plains to be utilised. Things like that would reduce the need for hard engineering at particular pinch points.

Chairman: I thank Professor Buckley. She said she might return to the first part of her answer to the question on section 3. I wish to state that we have afforded witnesses the opportunity to send further observations to us before 6 November, if they wish.

Deputy Alan Farrell: I thank the witnesses for their presentations. I note, with appreciation, the manner in which they have both formatted their written submissions. They were very helpfully laid out for us.

My question relates to the engineering and biodiversity impacts of both onshore and offshore wind farms, which were touched on by Deputy Christopher O'Sullivan and, to a certain extent, covered by Professor Buckley's response. If either witness wants to offer any further insights into or point us in the direction of research they or others might have completed in recent years, that would be very helpful, particularly from an international perspective. Although they are not prevalent in Ireland, solar farms and the potential impacts of those from a biodiversity perspective and the impacts they have on surrounding environments are also relevant. Have the witnesses or others studied or have studies on those which they could recommend to the com-

mittee for reading in advance of our pre-legislative report that we will no doubt put together in the coming weeks?

My only other query is on the definitions Dr. Glynn recommended in his closing remarks on gases. Again, notwithstanding the responses he has already made, could he point us to another jurisdiction that has done this? It would be helpful to the committee in defining what additional steps we might need to take in terms of recommendations for additions to this Bill at a later point in the process.

Chairman: We might put that first question to Professor Buckley as it is very much to do with the biodiversity impacts.

Professor Yvonne Buckley: I can refer the Deputy to the SIMBIOSYS project's Sustainable development of wind energy in Ireland – challenges of biodiversity and ecosystem services, which is very relevant to his question. That is a report by some of my colleagues. If it would be helpful, I could send the reference to that report to the committee, so it can have a look at it.

Dr. James Glynn: On the second question, it is not my area of expertise but there are research areas within MaREI that are monitoring offshore reactions from seals and from offshore birds and doing different studies on the impacts of offshore construction and offshore activities. I can definitely point the committee towards those researchers' publications and their research. I am not that familiar with it but I know it is ongoing.

Chairman: There was a question on the definitions of gases from Deputy Farrell. Would Dr. Glynn like to address that?

Dr. James Glynn: Looking at the list of gases, my main point around the definition of the list of gases is that it does not look complete. There is international evidence from the Intergovernmental Panel on Climate Change, IPCC, on the full list of gases from the old Kyoto Protocol and then more recent legislation around specific gases from United Nations Framework Convention on Climate Change, UNFCCC, agreements. More recently, there has been increasing debate around the suitability of carbon budgets and the role of short-term versus long-term or long-lived gases and their use in carbon budgets. As such, the suitability of some gases to be used in long-term carbon budgets is questionable. There should be a list of short-term gases that are appropriate for a five-year carbon budget and then maybe a different list of gases appropriate for longer-term carbon budgets.

Deputy Richard Bruton: I have a couple of questions for each witness. Professor Buckley makes a very valid point that on tapping into nature's capacity to provide its own solutions that can really supplement man-made solutions. Does Professor Buckley envisage many sharp trade-offs being made? How should these be made? For example, there is a choice between conifers and hardwoods. If one were to look at a narrow carbon reduction, one would always pick conifers. If one were to look at wider biodiversity concerns, one would want a healthy balanced mix or whatever. Is that just one example of many? How are those trade-offs - oft they be made in creating a framework Bill - to be handled?

The second point is that land use, if included in our inventory, would put us badly into the negative. It is another 4 million tonnes negative of CO2 that we create each year. Does that hamper our ability to seize opportunities from better land use and biodiversity as part of our response? In other words, we go 4 million tonnes of CO2 backwards before we start to make any progress.

On Dr. Glynn's questions, this goes to the matter of what we are trying to do in legislation. Dr. Glynn seems to be arguing for a preference for CO2 capture and storage in legislation because it has been undervalued to date. He also pointed out that there is no territory where CO2 capture and storage can occur in Ireland. Are these legislative barriers or are there legislative provisions that would change that? From an economists' point of view, one would be inclined to pick the cheapest thing, whatever that is, and take a long view. Maybe policymakers have been too myopic and have not looked far enough ahead.

I was also intrigued by his reference to territorial waters and whether that represents an opportunity. I have heard the Minister for Foreign Affairs and Minister for Defence, Deputy Coveney, for example, who would not be living 100 miles away from Dr. Glynn, articulate the potential of our marine assets to be a sink and to grow marine products. Is there an untapped potential there and does it have implications for the legislative provision we ought to be making here?

Chairman: I invite Professor Buckley to answer the first question.

Professor Yvonne Buckley: The first part of the question was around trade-offs and how sharp and common are the trade-offs between climate action and how those actions impact on biodiversity. There will be trade-offs throughout the system. There will be some places where it is inappropriate to site a wind farm or a solar farm because of the impacts on biodiversity. One of our challenges is trying to figure out where in the landscape to put these different land uses. We must examine where the best place is and where we will get the lowest amount of trade-offs between biodiversity and climate action. This could be framed as a dynamic optimisation problem. If a wind farm is put in a certain area, we must examine how that impacts on where we put forestry or other land uses that may have positive or negative effects on biodiversity. The Deputy gave an example of monocultures, namely Sitka spruce versus a diverse native species mix for woodland. If we are purely planting for CO2, those trade-offs may not be so sharp. We may choose the native woodland because the CO2 will stay in that system, particularly if we are talking about the long term. How long the CO2 stays in the system completely depends on the use of the wood products at the end. If the wood will be used just for pulp then all that CO2 will be lost straight away, whereas the native woodland will store the CO2 long term. Having CO2 budgets in place and having timelines for those will help to guide those solutions. There is no doubt the native woodland would be far preferable as a means of CO2 sequestration and storage with biodiversity benefits than wall-to-wall Sitka spruce, particularly on some soil types.

There will be trade-offs. We will not always have easy solutions but being aware of those trade-offs enables the Government to make decisions on where easy wins for CO2 and biodiversity can be found and where more difficult situations arise. It is then up to decision makers to decide what kind of trade-offs they are willing to accept. If we do not consider the impacts on biodiversity, however, we could go blindly into climate actions that have negative effects that are not accounted for and that limit our opportunities to put in place nature-based solutions in the future. It is important for it to be on the table and for biodiversity to be visible and a part of the decision-making process. We need to be able to model those trade-offs in order to understand and to go in with our eyes open on what kinds of trade-offs we are willing to accept.

The second part of the question was on emissions from land uses. I am not sure I fully understood the question. There are emissions from land use which are unaccounted for and when those come on the balance sheet, they will lead to higher emissions nationally. We need to be reducing those emissions. We need to be doing things like rewetting peatlands to reduce emissions from those land uses. How that is accounted for is a separate problem I am not going to

get into. Emissions are emissions, and should be reduced regardless of where they arise.

Chairman: I thank Professor Buckley.

Dr. James Glynn: In MaREI we do not advocate for specific technologies within our analysis. The need for carbon capture and storage or CO2 removal emerges by the dynamics of trying to minimise the amount of CO2 we create in our energy system. CCS, as defined across the different technologies in our model and the international models, is one of the cheapest options. As I said, without some sort of carbon dioxide removal in our national analysis and within the analysis of the IPCC, meeting Paris agreement targets becomes sufficiently more expensive and means that earlier and near-term mitigation needs to be much more ambitious and faster.

On the question of legislation, there is a note from the then Minister in the Department stating that CO2 storage cannot occur within the Irish State. Storage cannot happen, but it can be changed by, as far as I know, a ministerial decision. It is not within EU legislation. CO2 cannot be stored in Irish territories, but that does not mean it cannot be captured and exported. One of the plans is to export carbon dioxide from some industrial plants in Ireland to North Sea offshore fields like the Northern Lights project in Norway. There is a barrier to storing CO2 on Irish territory that would need to be addressed, but there is no barrier to capturing CO2 here.

On the definition of including territorial waters, I wish to acknowledge some of the ambiguity in the language. The ocean is already a carbon sink. It sinks a lot more carbon dioxide than is held in the atmosphere. There is also ambiguity around where carbon dioxide sinks in the geological sense. In Ireland, the most obvious places are the offshore depleted oil and gas fields such as in Kinsale. To include that definition of the marine environment in sinks is important.

Deputy Jennifer Whitmore: I thank the witnesses. I also have a huge interest in ecology, nature-based solutions and biodiversity.

My questions are for Professor Buckley. I note she recommends incorporating two definitions, one for biodiversity and one for nature-based solutions. Will that give sufficient emphasis to or acknowledgement of the need to ensure there is no impact on biodiversity as a result of tools and mechanisms to address climate change? That is where I would like to see us going. If we strive to address climate change while continuing to heap huge pressures on our populations and systems that is still a losing situation. There are ways to get that balance right. Should that be more explicit in primary legislation rather than pointing to the biodiversity action plan?

One of the main issues with the concept of nature-based solutions and biodiversity is that the language is not widely understood or known. It is a relatively new way of looking at our systems. Does Professor Buckley think there is enough information and research to enable us to point to maritime areas and state how much storage capacity we could get out of the sea grasses in an area or what the specific result of wetting a bog would be? Should there be more focus on getting that information and drawing up the required maps and models?

Professor Yvonne Buckley: The question is around whether the ambition or the targets for biodiversity need to be embedded in this Bill or if reference to the biodiversity strategy is sufficient. There is absolutely no doubt we need to slow, stop and then reverse biodiversity loss. If we are going to write it into this legislation, we should write into every single piece of legislation that everything we do from now on should be slowing, stopping and reversing biodiversity loss and the new global biodiversity strategies that will be announced next year put some real tough targets on the table in terms of global ambition. We have missed every single biodiversity

target that has been on the table until now so targets alone are not getting us where we need to be. There is no doubt we need to have the implementation of things like the national biodiversity plan, the EU biodiversity strategy and the global biodiversity strategy better resourced and better supported.

I am not a legislator, so I do not know where that ambition needs to be. I do not know whether it should be written strongly into this legislation at the start that actions taken for climate mitigation and adaptation should not impact on biodiversity. I would love to see that in every piece of legislation that goes through the Dáil. That will be part of the national biodiversity strategy, so it will be rewritten or redone for next year and will take the EU and global diversity strategies together with their targets into account when it does that.

The real problem here, however, is not the targets. We can have all the targets we want. The implementation is the problem, so if we can find ways of better implementing things like our national strategy, that is where the challenge is. If it helps to have those strong targets in legislation like this, then I totally support that.

The second question was around implementation and if we know where carbon is currently and where we have the capacity to store more carbon through nature-based solutions. I do not believe we have those maps yet. More needs to be done to figure out where we have the capacity to reduce emissions in the landscape through remediation of land, land use and coastal and seascape use, and where we have the capacity to put in place nature-based solutions to sequester additional amounts of carbon, either blue carbon in the sea or green carbon on land. We definitely need those measures in place and those maps on that data.

Senator Lynn Boylan: I thank the speakers. I wish to elaborate a little further on Professor Buckley's point around the land mapping and whether to write it into legislation. I am not sure if Professor Buckley is familiar with the New Zealand Act. It makes a specific reference to being cognisant of the ecosystems, including marine ecosystems, and biodiversity in its recital but then in its adaptation and its risk assessment, it requires the Minister to take account of any ecological impact. If Professor Buckley is not familiar with it, she might look at it and, perhaps, in her written follow-up response, she might say if she thinks that is something we could work with. It is important to realise that climate action benefits biodiversity, although not always. In this country, we have had a utilitarian approach to nature. Only today we have seen that our forestry programme is actually a net emitter of carbon, so I would be interested to hear if Professor Buckley thinks that New Zealand model could work for us.

Will Dr. Glynn elaborate on the point in his presentation on how the development of carbon capture technologies are already far behind the technology readiness? Do we need to have a sort of cap in the Bill or a limiting of the reliance on technology and have more of a focus on the efficiencies whereby we must reduce the amount of carbon we use in the first place rather than relying on a technology that has yet to catch up?

Professor Yvonne Buckley: I am not familiar with the New Zealand legislation. I will have a look at it and get back to the committee. It sounds like a good model.

Chairman: Will Dr. Glynn respond to the second question, which relates to point No. 10 in his statement?

Dr. James Glynn: The statement largely reflects what is going on in terms of the global analysis of the state of technology development in the area of carbon capture and storage.

There are different types of technologies for the five main chemical processes and some other CCS technologies, including the likes of direct air capture technology. The International Energy Agency monitors the technology readiness level of these technologies. There are some 18 different plants globally that are capturing nearly 30 million tonnes of CO2 which is approximately equivalent to 70% of Irish emissions annually. The problem is that, according to most of the global analysis, the amount of CO2 being captured from some of these technologies - even in the near term, by 2025 or 2030 - is in the order of 1 gigaton, which is only some 8% of certain global emissions.

There is a risk involved in focusing on the technologies. I recently co-authored a paper, published in *Nature Communications*, on the risk of relying on yet to be fully commercialised technologies like CCS and DAC. There should be a two-pronged approach. We should hope for the development of effective technology and encourage research and development with a view to accelerating the availability of a good suite of technologies but, equally, we should hedge our bets and not expect the technology to deliver, certainly not in the near term. As I said in my opening statement, if we do not have CCS or CDR technologies available in Ireland in the short term, then we need to look at more rapid mitigation. Reducing our CO2 emissions faster means more ambition, which means more efficiency, more energy to non-production, more retrofitting and more additional measures. Unfortunately, I do not think an either-or approach is the right one. We need to be ambitious and to carbonise as quickly as possible while also looking to invest in research and development for CCS. That may help us out in the long term because it is likely that we will be required to have some level of negative emissions from some sort of bioenergy CCS, either to produce hydrogen or to produce negative transport fuels using the initial development of CCS. It is likely there always will be residual emissions from the energy system. Cement production is something that really stands out in Ireland. It will be very difficult for some companies to produce cement in the long term without this kind of technology. That sector will come under increasing pressure as we get closer and closer to net zero emissions.

I am not sure a cap on reliance is something we should be looking to put in place. Good practice in energy systems analysis and uncertainty analysis across decarbonisation pathways would say that one does not pick one path but, instead, one should try to explore all the uncertainty across all the paths that will get us to our compliant pathway, using good practice in risk management. Capping the reliance on CCS does not come up in international best practices.

Deputy Réada Cronin: I thank the witnesses for giving of their time to the committee. My first set of questions is for Professor Buckley. We all realised during the first wave of the Covid-19 pandemic how important our natural world is to us. We learned that we humans are lucky to be a part of it but we are not the owners of it. In this context, the Bill's neglect of biodiversity - as Professor Buckley noted, it is only mentioned twice - is a worry. I have three issues to raise in this regard. First, there is a centrality of research on natural solutions to our emissions. How might the Bill best support that? I am thinking in particular of urgent research into actively managing the hydrology and revegetation of our wetted peatlands. Second, and I know this is quite specific, how can the Bill address with necessary urgency, the remediation of our degraded peatlands? Third, how can the Bill see us best live up to our international obligations and protect territories and ecosystems around the world? I am thinking here about cheap beef, the Mercosur deal and the destruction of the priceless rainforests.

I will address Dr. Glynn. I note the use of the phrase "equitable integrity emissions". He mentioned the early dialogue and societal buy-in, but just transition is notable by its absence

from this Bill. People are going to struggle to pay carbon taxes and are going to feel that despite their best efforts and their desires, they are not going to be able to meet demands with any necessary comfort. How can we address just transition in the Bill at both national and global levels? Does Dr. Glynn think we should try to enshrine just transition into the Bill? Will he expand on his point on international aid and offsetting.

Chairman: Before Professor Buckley responds, I remind members that our guests are invited for very specific reasons and they may not be experts on some the issues raised. Members should allow for that. However, if the witnesses wish to speak to those issues, they are welcome to do so.

Professor Yvonne Buckley: The Deputy's first point related to the importance of research for nature-based solutions, such as the rewetting of peatlands, in particular. This a very important area on which we need more data. Nature-based solutions are local context dependent, so we need to know how different actions that we take, such as the retwetting of peatlands or planting forests on different kinds of soil types, perform in our conditions, climate and soils with the kinds of species in the ecosystems around them. Therefore, we need research funded in Ireland in order to make these nature-based solutions better, and to effectively monitor them, and be able to demonstrate the impact of these nature-based solutions-----

Chairman: I am sorry, we have lost the audio. We can hear Professor Buckley again. I ask her to go back over the last 20 seconds of her answer.

Professor Yvonne Buckley: I was speaking about the importance of research for figuring out the effectiveness of nature-based solutions and being able to demonstrate the impact of those nature-based solutions. I was making the point that there is no point in rewetting a peatland or planting some trees, unless we can effectively monitor how that is doing, respond to the monitored data and put in place adaptive management as that ecosystem develops. We need local funding for that in Ireland because of the local context dependence on the performance of natural ecosystems. I may have missed the second part of the Deputy's question, but I hope that my answer was sufficient.

The third part of the Deputy's question to me was around our international obligations. The environmental protections that are written into food production regulations in Ireland and across the EU are very important. They obviously need to be strengthened, and I am aware of ongoing discussions around the new Common Agricultural Policy. They need to be strengthened in terms of biodiversity protection. However, it is also important to retain the protections we currently have around the environment for food production, and I strongly support them. If they are going to be undermined by the importation of goods from outside of the EU, which have weaker environmental protections, then that is a real problem. I absolutely believe that if we are going to impose costs on our farmers in respect of environmental protections, then we need to support their production, but we also need to strengthen those environmental obligations. We must also compensate people appropriately.

Chairman: That second question concerns just transition. I do not know if that is Dr. Glynn's area of expertise but he is welcome to comment on it.

Dr. James Glynn: It is not my area of expertise. Recommendation No. 17 of my submission notes that the rate at which we can decarbonise and invest in different technologies will depend on public buy-in and acceptance. In light of the radical infrastructural change required in the energy system, failure to engage early, which has been known to happen in large-scale

energy projects, will not end well where the acceleration of our decarbonisation rates is concerned.

I have done a lot of work on carbon tax analysis. Recommendation No. 19 in my submission refers to our international responsibilities, with particular regard to Irish Aid. There is a common misunderstanding that carbon taxes are regressive by their very nature. Our analysis shows that there are many ways in which they can be progressive, providing a net benefit to working class households and lower income deciles. This requires well designed redistribution. I do not agree with the contention that carbon taxes are necessarily regressive or difficult.

Recommendation No. 19 stems directly from parts of the text of the Paris Agreement concerning capabilities and responsibilities. It also reflects a joint publication with international colleagues on the capital transfer required for developing nations to meet their decarbonisation goals. The global carbon budget required to keep warming below 2°C amounts to about 3.2 trillion tonnes. Ireland has already spent its fair share of that budget on a per capita basis. This point is relevant to future Irish carbon budgets. We may mitigate our emissions as quickly as possible on a territorial basis, but developing countries will need capital transfers and financial aid to leapfrog the fossil fuel benefits that have assisted with our industrial development. This will be necessary to meet the Paris Agreement's global goals. It might be also more economically efficient. With regard to Ireland's responsibility to developing nations and its capabilities, I note that Irish Aid already has a strong international footprint. Some of the State funds that go to Irish Aid could be considered relevant insofar as the aid is spent on offsetting emissions globally. Taking into account that offsetting effect in Irish carbon budgets could be defined as leakage. Leakage can thus have both positive and negative impacts on the Irish carbon budget.

Deputy Darren O'Rourke: I thank the witnesses. My question is for Dr. Glynn. Recommendation No. 12 in his submission calls for the Bill to explicitly define the method used to calculate the warming effect of each greenhouse gas as a proportion of the carbon budget and which gases, if any, will not be included in the carbon budgets. The Climate Change Advisory Council has recommended a split national target for 2050, with net zero emissions of long-lived gases and a separate volume of biogenic methane. Will Dr. Glynn comment on which gases he thinks should or should not be included? Should they be explicitly outlined in the legislation before us? He also referred earlier to gases which are appropriate for inclusion in short-term five-year carbon budgets but not in longer-term budgets. Will Dr. Glynn comment on those points?

Dr. James Glynn: I thank Deputy O'Rourke. With regard to the Intergovernmental Panel on Climate Change, IPCC, guidelines around how we convert carbon dioxide and other greenhouse gases into carbon dioxide equivalents so that their warming impact can all be added up and understood, to compare apples with apples and oranges with oranges it has come up with different methodologies. I am sure the Deputy has heard of the global warming potential, GWP, 100 and the GWP* methods to aggregate these different greenhouse gases into the same level of warning and the same level of units. The traditional method of GWP 100 is fine when we are talking about annualised targets, in other words, what is the annual impact of this bucket of gases all in the same units? However, when we start to try to create carbon budgets over different timescales, be that five, 50 or 100 years, the impact of warming from each of those gases is different. Both are dependent on each of the gases and on the timescale of that carbon budget. While we can have a five-year carbon budget, and I think we are specifically talking here about biogenic methane, it may make sense to include biogenic methane in a very short carbon budget but it does not make sense to include it in a very long carbon budget because biogenic methane

is a short-lived gas in comparison to carbon dioxide, which is a much longer-lived gas. They do not accumulate in the atmosphere at the same rate, nor do they have the same warming impact, which therefore impacts on the temperature increase.

With regard to my point about which gas is to be included in the carbon budget system, it is more to accurately reflect the current state of the science and the state of the art of understanding ultimately the impact on warming for each of these gases and how that warming is measured. If we were adding up different gases over different timescales and accumulating them in different budgets, ultimately, the warming impact can be different. The method that should be used should reflect the state of the art of the science, and the state of the art of the science has probably changed in the past five to ten years. It has been more reflected in the IPCC's special report on 1.5oC. If we were to have long-term carbon budgets beyond the lifespan of some of the short-lived gases, they probably should not be included in five-year carbon budgets and some other method that reflects the state of the art of the science should be used. The appropriateness of that method should be outlined.

Deputy Darren O'Rourke: As the nature of the science is to change over time, is there an argument that to be prescriptive at the outset is to leave ourselves in a position where we might be revisiting this legislation or be hostages to fortune in the future?

Dr. James Glynn: The legislation should be explicit around what we understand as the science. It is not so much that the science has changed or that it will hold the legislators as hostages to fortune. The methods with which gases were being aggregated into carbon budgets was no longer appropriate with the original method being used in the IPCC. The use of carbon budgets has emerged over the past five to ten years since the IPCC fifth assessment report and the old use of those methods. It would be appropriate to use the current state of the art of the science.

Senator Pauline O'Reilly: I thank both witnesses. Professor Buckley has been very persuasive in her arguments and statement. I thank her for her significant expertise. I certainly agree with her that nature-based solutions and biodiversity have to be part of the Bill. I take on board everything she said in answer to the other members. Professor Buckley made a comment that it is not just about targets but implementation.

With that in mind, I turn to Dr. Glynn to ask specifically about point 17, on social dialogue. I feel very passionately that we must be able to bring the public with us in anything we do if we are to be successful. Throughout these opportunities to engage with witnesses, public participation has come up to a certain extent but we have not really had anything concrete on what it might look like. From Dr. Glynn's background in MaREI or research he might know of, could he make a recommendation on what might be useful or successful in Ireland, whether it goes into the Bill or it is part of the council or the work of local authorities. Has he any suggestions in that regard?

Dr. James Glynn: That is a critical point. Social dialogue is not my area of expertise but there is a lot of research ongoing in MaREI, led within our research area on mitigation and just transition. There are a few key projects that are ongoing. I do not believe I can identify who is working on them but the Dingle project is examining the adoption of advanced mitigation technologies on a community basis with a lot of early-stage stakeholder engagement regarding how such technologies would impact on life and the benefits of adopting them. There is a range of other experts within MaREI who would be far better placed to give evidence on this. I can revert to the Senator with publications and the names of those better suited to giving evidence

on the matter.

Senator Pauline O'Reilly: I really just wanted to ask about that because I believe Dr. Glynn has given comprehensive answers on most of the other points. It would be very helpful if he could revert to me with a few points of research to examine. He will have an opportunity before the next occasion. I would be really grateful for the information. It would be helpful if it were given to the committee as a whole rather than to me personally.

Dr. James Glynn: Absolutely. I am very confident there is some key research that should be on the record.

Chairman: I thank Dr. Glynn. Could both witnesses send on additional information to the secretariat, which will circulate it among all members of the committee.

Senator Alice-Mary Higgins: I thank both witnesses. Professor Buckley suggested explicitly including the national biodiversity action plan. To future-proof it, might it be useful to say something a little broader, such as "national biodiversity action plan and other biodiversity obligations". This might encompass the EU habitats and birds directives and the national pollination plan, if it ever gets on a statutory footing, which I hope will be the case some day. I refer also to such other biodiversity legislation as is being considered. If we had a slightly wider framework, it might address what comes afterwards because I am aware that the plan is due to expire in a couple of years. Naming specific obligations is a positive suggestion. Does Professor Buckley believe they should be named not simply in terms of the budgets, or how much we are going to be reducing by, but also in terms of the sectoral plans, which concern the policy on how we achieve our targets? Should the obligations be in the sectoral plans, by Department, as well as in the overall budget?

I am interested in another area of proofing. Professor Buckley does not need to comment on the specific example I am choosing, that of the Porcupine Basin in Cork. The impact of drilling on the habitat was examined but the impact on climate was to be examined separately. Together, they may have added up to a reason not to proceed. The environmental impact assessment was split into separate procedures, whereby the biodiversity impact was determined to be so much and the climate impact was to be determined later, after possible extraction. There is almost a split process. How important is it to tie together the assessments of climate and biodiversity?

On the pollinator plan, we are focusing on the nature-based solutions. I am interested in Professor Buckley's take on offsetting. Forests can burn down and things can change. How important is it not to bank on any one solution because of the changeability of circumstances? As a reminder of the negative consequences, if there is a massive loss of pollinators, for example, how will that accelerate climate change? What are the dangers if we do not act on climate biodiversity, as well as the solutions?

Turning to Dr. Glynn, I was interested in the ratchet clause he suggested. It seems to be in line with Article 4 of the Paris Agreement, which provides that we should seek the highest possible ambition and that must be increasing all the time. The EU precautionary principle may be also relevant. Will Dr. Glynn comment on that and on ensuring we plan in a safe way for the future? There was much in his presentation that interested me. Compared with the 2008 climate talks, which I attended, at last year's climate talks many more accountants were offering clever accountancy solutions. What are the dangers when offsetting? What do we need to watch out for in respect of the question of numbers being moved around? I am concerned that emissions would end up being counted twice as removal, when in fact it is just emission reduc-

tion technology.

As for the international aspect-----

Chairman: I apologise to the Senator but there will be a second round of questions. We need to be fair to our guests and there have been many questions.

Professor Yvonne Buckley: I mentioned the national biodiversity action plan, which has always taken into account our international obligations and has been always consistent with our EU and global obligations. While there would be nothing wrong with including in the Bill the international obligations for biodiversity, such as the global biodiversity strategy and the EU biodiversity strategy, the national biodiversity action plan will be consistent with those obligations. I agree that would be useful and would shore up the point. Everything in the Bill needs to be consistent with, and support, the national biodiversity action plan.

The Senator asked a question about much of the detail being in the sectoral adaptation plans. There is a biodiversity sectoral adaptation plan, which strongly recommends implementation of the national biodiversity action plan and many other actions. It goes through the significant potential climate change impacts on biodiversity in that sectoral adaptation plan for Ireland.

The Senator gave a reminder of what is at stake and what will happen if we lose all our pollinators, for example. There are two factors. First, climate change will have significant impacts on biodiversity, which underpins food security, our mental and physical health and well-being, and so many other aspects of our lives. Much is at stake and we have to act on climate.

On the other hand, biodiversity itself is currently under threat from many other drivers, such as agricultural intensification, extraction and utilisation of our natural resources. The more at threat biodiversity is from these other factors, the less able it will be to withstand the additional threat of climate change. If the biodiversity system is brittle or fragile, putting it under further stress could have serious implications, which is why we have to act on climate change now. If we do not do anything about our biodiversity loss, our capacity to adapt to and mitigate climate change will be severely impacted. I cannot specify a number for what would happen in respect of our emissions if pollinators disappeared but they are fundamental to the appropriate and healthy functioning of forest and grassland ecosystems. Without pollinators, many plants will not produce seeds. They will not be able to reproduce or persist. That affects pot plants as well as natural plants in the wild. These are fundamental to the functioning of our ecosystems.

On how important biodiversity and land use is in terms of climate change emissions, the Intergovernmental Panel on Climate Change, IPCC, special reports on land degradation stated that it is responsible for 23% of global emissions. By remediating that degradation, we can put in place nature-based solutions to reduce a significant amount of emissions which come from land degradation.

Dr. James Glynn: The clause around implementing a ratchet mechanism is correctly identified in Article 4 from the Paris Agreement. It means that within the legislation that Ireland maximises its ambition, as is consistent with what we agreed to as part of the European Union. It will also enshrine in legislation that every five years we will legislate, at some level, that our emissions will go down cumulatively. The ratchet mechanism is just recognising what is in Article 4 in the Paris Agreement and puts it into the Bill.

On the dangers of offsetting from the Senator's conversations with accountants at the climate change conference, certain technologies produce a problem with double accounting. There is

an overlap here with my expertise in carbon capture and storage and Professors Buckley's expertise on nature-based solutions. There is this conflict between, ultimately, what would be not just CO2 removal but negative emissions technologies. This conflict is between nature-based solutions to remove emissions and then bioenergy solutions. There is this problem, correctly identified, that we need better understanding of what are, ultimately, the emissions intensity and the amount of emissions that are captured from bioenergy production. This must be then accurately represented within integrated assessment models and the amount of CO2 captured from the growth of bioenergy correctly represented in policy. There is ambiguity in some of the global models as to the accuracy with which bioenergy, in combination with carbon capture and storage, is represented. Bioenergy, carbon capture and storage could be a big vulnerability in the IPCC models. Double accounting should be taken into account.

In the short term, I do not believe that is an issue for Ireland. I am not sure how it would be legislated for. Scientifically, it is certainly something we need to be aware of in our analysis that would go into the Climate Change Advisory Council's deliberations.

Chairman: We have time now to have a second round of questions.

Deputy Richard Bruton: Yesterday, the committee heard from Professor John FitzGerald. In the course of an interesting presentation, he said there is a tension between listing a whole range of elements which we must regard. We now have 25. These will create a process within the Climate Change Advisory Council of having to trace these individual items. This could throw one open to fairly constant litigation versus trying to find a framework with guardrails along it which would prevent Ministers and Governments from ignoring their responsibilities. The latter would not tie up either the Climate Change Advisory Council or the Government in endless visits to the courts. I wonder how our guests view that. To some degree, both their presentations present many new things to which we must have regard. I worry that every time we add another item to that list, we add to the woes of people who are trying to turn this into climate budgets and policies that will make a difference in our world.

Chairman: I think that question was intended for Dr. Glynn.

Deputy Richard Bruton: Whoever thinks they have an answer is welcome to reply.

Professor Yvonne Buckley: My thinking in asking for the national biodiversity action plan to be explicitly referenced was to leave the detail to that specific plan and strategy where much thought will be given and work will be done to make sure that the objectives we outline in the plan are appropriate and based on science. There is an awful lot of detail there.

Deputy Richard Bruton: I am not really talking about any specific plan. It seems that our list of criteria, to which we must have regard, is getting longer. We have short-lived gases versus long-lived gases and a need to measure our timescales over five-year budgets or 50-year perspectives. It seems that we are putting more straws on the camel. I am not saying that biodiversity should be the straw that is dropped, but speaking generally, how should we try to deal with this? Should we have some sort of catch-all statement of what the world ought to be like and expect the Climate Change Advisory Council and Government to take that into account, rather than a list of 40 items that must be considered?

Professor Yvonne Buckley: I would agree with some general principles being laid out, some of which might be around biodiversity and no net loss, or something in line with all the policy instruments that arise from this Bill and supporting the biodiversity action plan. We

could use a broad statement like that, rather than the specific biodiversity-related actions embedded in this Bill.

Deputy Richard Bruton: Does Dr. Glynn wish to respond to the same question?

Dr. Ronan Glynn: I was not trying to add to the Climate Change Advisory Council's woes. The point in my submission to the committee is really asking for clarity around some of the language that is being used. To some readers, it might look as if it is clear what each of those statements means but, from a scientific perspective, some of them are quite ambiguous and can be interpreted in different ways. Like Professor Buckley, I think some guiding principles might temper some of the difficulties for the Climate Change Advisory Council. I think, equally, that if the text is not explicit enough, it leaves too much room and things will not be achieved. Ultimately, we are trying to start to bend the decarbonisation curve.

If some of the critical targets are numerically, scientifically or legally ambiguous, I understand that has political benefits but, speaking scientifically, it makes it difficult to measure if we are meeting our targets. The point in my submission is seeking clarity over the things we already have.

Deputy Christopher O'Sullivan: I thank the witnesses for their statements and contributions. It is safe to say that on the back of their contributions, we will have much stronger legislation, particularly around the issues of biodiversity and nature-based solutions. That is my hope anyway.

I will touch on the points made by Deputy Bruton on what is included in the items and issues to which we must have regard. If we are to have regard to issues such as the economy, sustainable development, agriculture and climate justice, I would certainly feel that biodiversity should be another of those elements. There is a task there in trying to accommodate everything.

My question probably does not apply to the Bill and will not change anything in it in terms of how it is made up but it relates to the science and it is for Professor Buckley. We were talking about the impact technologies would have on biodiversity. We talked about offshore and onshore wind farms. I will give an example. Professor Buckley may not be able to give an answer but she may be able to point to some body of work. She mentioned the SIMBIOSYS project earlier. If ten acres of dairy land was earmarked for a solar or wind farm, would it be safe to say that the net impact of that on biodiversity would be positive? Obviously, the net impact on emissions would be positive but would it be safe to say that the net impact on biodiversity would be positive because we know dairy land is not the richest when it comes to biodiversity as opposed to ten acres of wind farm on raised bog? Would it have a net negative impact on biodiversity? Are there any studies on this?

Professor Yvonne Buckley: That is a really interesting question. Those are the kinds of land use changes we must assess in terms of their impact on biodiversity and the climate change impact of that land use transition. It really depends on what existing biodiversity is present in the land use one is moving away from and whether that would be retained and enhanced in the new land use or whether moving from one land use to another involved the destruction of biodiversity. In the case of a dairy farm changing to a wind farm, it is not clear what the land would be used for. One has the footprint of the turbines but then there is the question of the management of the land around the turbines, that whole block going up into the air and how animals and plants use that area once it has been converted. One would need to carry out quite a careful study to make the call regarding whether the conversion from a dairy farm to a wind farm was

net positive or net negative for biodiversity in that moment. One would take into account the change in emissions - the climate warming involved in going from dairy farm land use to wind farm land use and the potential impact of that reduction or increase in emissions depending on how it is calculated on biodiversity. Again, that is another question. Scientifically, it is hard for me to answer that question without looking at exactly what biodiversity is there before and after the land use change, how the land is used and how measures can be put in place in the new land use to support biodiversity and reduce the negative effects of those land uses on biodiversity. I am sorry I cannot be more specific. I will give a scientist's answer, which is more research.

Deputy Christopher O'Sullivan: I know; I gave a vague example. As Professor Buckley said, it depends on what the land use in and around the turbine is.

Professor Yvonne Buckley: Yes, but it is a great question. It sounds like a fascinating research question.

Deputy Christopher O'Sullivan: An example would be if one covered the place with a wildflower meadow underneath the turbines. It depends on the land management.

Professor Yvonne Buckley: Absolutely. If a land use is put in place underneath the turbines that was biodiversity-friendly and reduced any negative effects of the turbines on things like birds and bats, with appropriate land use and mitigation measures, it could be made much more biodiversity-friendly. Going from a perennial rye grass monoculture to something more diverse across wind turbines could be more positive for biodiversity.

Senator Alice-Mary Higgins: I am certainly happy to say that I think carbon leakage is one that should just go if we are really trotting down our 25. I think that is the third or fourth different interpretation of what it might mean that we have heard. Again, that is not on Dr. Glynn. It is just an example. Around that issue, it might be referring to that question of non-territorial emissions so I was quite concerned with that idea of exporting carbon. When we are looking within planetary limits in the end and if Ireland has, as Dr. Glynn mentioned, effectively used or come close to using up its fair share, the question arises as to how we reflect and account for non-territorial emissions. For example, Japan is importing coal from Japanese-owned factories in Bangladesh. How do we ensure that we factor in non-territorial emissions? I believe that in both its aid and one of its other policies, Ireland has that common and differentiated responsibility. We have a responsibility under the Paris Agreement to support mitigation and adaptation in developing countries. I would suggest that is not necessarily aid but that there is an obligation, for example, as to adaptation financing. Is it fair if we effectively owe a duty of support for mitigation and adaptation but we use that to offset against what we do ourselves? Should it not be the case that we are literally supporting mitigation and adaptation within the budgets of other countries? I am worried about an offsetting dynamic being used where very wealthy countries start using the development capacity of other countries as an offsetting mechanism and how we can avoid that.

This point also relates to the same issue because one of the other strands in the United Nations Framework Convention on Climate Change, UNFCCC, as well as mitigation and adaptation, is that question of technology transfer. Our witness from the Marine and Renewable Energy Ireland, MaREI, which is at the cutting edge of technology that is happening, knows the technology transfer has been a blocking point in how we make those public-to-public partnerships. We are straying a little bit into this area but I realise this because one of the points pointed to looking at how Ireland fits into that wider picture. I would really appreciate if our witnesses commented on that point.

Can I ask for a comment on the long-lived and short-lived gases? Dr. Glynn mentioned that there might be a case for a real focus on some of these gases - presumably methane is an example and nitrogen might be another - in the five-year strategy. It is also important that we look at not just how long these last in the atmosphere, the intensity of particular gases and the higher impact they may have in the short term. While those specific gases may be gone in 100 years, if we have intensified output in the next five years, we may hit tipping points. We are seeing that right now, for example, on the ice sheets in the Arctic.

Chairman: I will ask Dr. Glynn to comment on that.

Dr. James Glynn: That is quite a suite of questions.

On the export of CO2 emissions, in the United Nations Framework Convention on Climate Change, the inventories that are used in gases are all production-based, that is where the emissions are produced. There are other accounting frameworks on consumption-based emissions and there is quite a difference. Generally, the developed OECD countries have higher consumption-based emissions than they have production-based ones because they are service-based economies rather than industrial manufacturing-based economies where industrial manufacturing is far more energy and CO2 intensive than service-based economies.

In recent legislation in the UK, it is still using the UNFCCC inventories around production but is also acknowledging and tracking consumption-based emissions in the UK. I am unsure if this is in any legislative targets but it is being acknowledged, tracked and accounted for within the Climate Change Committee, CCC, in the UK.

On the issue of producing carbon dioxide and a carbon capture and storage, CCS, plant in Ireland and then exporting it for sequestration in the North Sea, this is a matter I am unsure of between production and consumption because it is being produced in Ireland but is being stored off the island. That is an interesting case that perhaps needs to be explored if that becomes a common occurrence which is possible to probe, given the terms within Europe.

On the investment and technology transfer question, within more international circles and not necessarily within Irish research but within the green climate fund and inter-development banks, there has been a shifting trend in using international aid that would have been given more towards development and humanities projects and are now going into the development of low-carbon technologies in developing countries. I do not see this as a get-out-of-jail in the reduction of our ambition in the developed world. The developed world needs to be mitigating as ambitiously as possible while again acknowledging capacity and responsibility within the Paris Agreement. Globally, we need to reach net zero and stabilise temperatures by 2°C probably by 2050. That means that developing Africa and Asia might reach net zero by 2060 or 2070, but the developed world, in global analysis, should reach net zero before 2050.

Access to capital and finance is a big issue in the developing world. International banks, even inter-development banks, and rating agencies put a higher risk on investing in low-carbon infrastructure in developing countries than they do in the developed world. That access to finance is difficult. Ireland has a role to play in maximising our ambition as we agreed in our nationally determined contribution, NDC, in the context of the European Commission, to the Paris Agreement. There is also a role with international aid being properly accounted for in terms of its original purpose within development and security and within future security for mitigating climate change and all the risks to developing countries that have received aid in the past.

It is difficult to explain technology transfer within that. Some of my colleagues might be more expert in the area. It has a role to play in educating and giving capacity to developing countries. We have given international energy systems in carbon market analysis to Vietnam last year, for example, and some South American countries, in our area of expertise and that is ongoing. Knowledge transfer is useful for them to develop their own policies, carbon targets and carbon taxes. Technology transfer is not my area of expertise so I will not comment.

Could the Senator remind me of her question on long-lived and short-lived gases?

Senator Alice-Mary Higgins: Apologies if this strayed a bit wider, but I had a question specifically about methane and possibly nitrogen. Dr. Glynn mentioned long-lived versus shorter-lived gases. I am also thinking about heightened intensity of such gases. If one is just counting the gas itself, on a longer term calculation, it may not be there in 100 years but the impact of its increased intensity over a five or ten year period could lead to a tipping point whereby that intensification, which I think Dr. Glynn called the radial increase, could lead to a feedback or tipping point loop, almost like the biodiversity issue, which we have seen recently in the Arctic.

Dr. James Glynn: The point was about radiative forcing which is ultimately what drives up temperatures. I agree with what I am interpreting the Senator as saying about intensity. What matters for short-lived gases is the flow rate, which is similar to what the Senator said about intensities, compared with long-lived gases so it is the accumulation that matters. The slow rate of temperature increase is driven by long-lived gases such as carbon dioxide. When one gets very close to achieving temperature stabilisation, say within 15 years of stabilising temperature, that intensity or flow rate becomes very important. When further from temperature stabilisation, those short-lived gases might not be as important but when very close to temperature stabilisation, significantly reducing those intensities and the radiative forcing from those gases becomes very important. It is the last mile effect.

Chairman: We have only about 15 minutes left and three members are indicating to speak. We should try to keep questions and answers to five minutes.

Deputy Cormac Devlin: Professor Buckley and Dr. Glynn have made some important points and we have had a good discussion. Professor Buckley touched on offshore wind farms and their appropriate location. I think Professor Buckley mentioned soil types as well. Is she saying onshore or offshore is a more appropriate place for wind farms or is she just highlighting where they are placed, irrespective of whether onshore or offshore? She also referenced the national biodiversity action plan. What are her thoughts on the role, when this Bill is passed, of the local authorities in actioning the national plan and in actions from this Bill?

I have two questions for Dr. Glynn pertaining to his opening remarks and the recommendations he made. He highlighted Irish territorial waters in the definition of "sink". Will he elaborate on that point? He acknowledged the role of early dialogue and societal buy-in. I think that is crucial in anything we do. He said behavioural change and demand reduction will be required and the national objective is unlikely to be met by technological means alone. Will he expand on that point?

Professor Yvonne Buckley: I was referring to the appropriate siting of onshore and offshore wind farms within their own realms. Regarding onshore wind farms, there may be areas in which it is more appropriate to place them than others. That depends on the land use it is being converted from, what kind of management goes along with the wind farm in that area and

whether there are species of particular concern in the area. One would not want to put a wind farm somewhere where it will have a really negative effect on the hen harrier, the white-tailed eagle or something like that. That is what I meant by appropriate siting. One needs to have regard to the biodiversity in the area one intends to develop. That goes for offshore as well as onshore. There are many species of cetaceans and birds which use areas offshore that could be impacted by wind farms. It will require work to ensure appropriate siting of wind farms so those impacts on biodiversity are minimised and measures put in place to protect the biodiversity in those areas.

Regarding the question on the role of local authorities in implementation of the biodiversity action plan and of climate action, local authorities have a strong role to play, but it is a matter of scale. Some actions and decisions can be taken at a local authority level or even on a smaller scale at the level of individual landowners or groups of landowners in a particular area while other decisions and actions will have to be taken at the national and international levels. It is a question of what decision is being made and what scale it can appropriately be made at but I would love to see local authorities being appropriately resourced to carry out biodiversity and climate actions in their own areas or at regional scale as well as resourcing at national and international levels for such actions.

Dr. James Glynn: Regarding the inclusion of Irish territorial waters as a sink, one of the other committee members asked about this already. It is to reflect the scientific reality that Irish territorial waters are already absorbing carbon dioxide. There are also geological reasons that to sequester CO2 in offshore gas fields should be included as a sink. Natural solutions around algae production and seaweed production are also possible solutions to sequestered CO2 and that should be acknowledged in the Bill. From my reading of it, only land-based sinks were included in the definition.

On early dialogue and societal buy-in, I think we have already discussed this. It is not my area of expertise. From my area of expertise, I know that early dialogue ultimately will help accelerate mitigation through accelerating the transition by the adoption of energy efficiency, retrofitting of homes and other more radical technology changes, as well as the expansion of onshore and offshore wind farms. Without early dialogue and acceptance from Irish citizens, ultimately, the decarbonisation rate will slow down and we will probably miss our Paris Agreement targets. As I said earlier, there are a few ongoing projects, including the Dingle project, being run by colleagues within MaREI, looking at this on a very person-by-person or household-by-household basis, and there are a few other projects ongoing within MaREI. I am happy to put the relevant project leaders and principal investigators, PIs, in contact with the committee to talk a bit more about that.

Chairman: We will probably not have a chance to meet with Dr. Glynn's colleagues. He might ask them if they are willing to send in briefing notes or papers as we would certainly be interested in receiving those before 6 November.

Deputy Jennifer Whitmore: I will take a step back and ask a very high-level question in regard to nature-based solutions and biodiversity. If we do not use this Bill to incorporate or consider the impact of biodiversity on our wildlife - the plants and animal species - what are the risks associated with that, whether it is through opportunities lost or actual pressures on our systems?

Professor Yvonne Buckley: If we do not consider biodiversity at all in this Bill, or leave it as it is currently worded, then we run the risk of losing the capacity to respond to climate change

shocks that are coming down the road at us over the next 20 or 30 years. We know that Ireland is going to be in line for drier summers, for example, and wetter, more waterlogged, winters. If we lose biodiversity from the system, we may lose the ability to have food systems that are resilient and that can recover from those kinds of shocks. For example, if we are still in the market for pasture-based livestock production, we will need pastures that are able to cope with summer drought and winter waterlogging in the same year, and we need biodiversity to help us to do that. One species cannot cope with those kinds of conditions, so we will need a suite of species to be able to do that. We will need a number of different species in our hedgerows, woodlands and forests so that, given the very variable weather conditions, we can still maintain carbon sequestration over the long term. This will mean that even if some species do poorly in one year or other, other species will do well. We can only get that kind of resilience through a biodiverse, healthy, functioning ecosystem.

If we continue to degrade biodiversity, we lose that ability for ecosystems to be able to resist the kind of shocks we are going to throw at them in the future. This will threaten our ability to put in place nature-based solutions over the long term and to maintain the kinds of carbon sequestration rates that are going on in our natural ecosystems now. That is one area of significant risk.

Deputy Jennifer Whitmore: I would see biodiversity and climate change adaptation and mitigation as tied together. I am quite nervous that in the rush to address climate change, we are going to do it through technological adaptations and technological innovations, while biodiversity always tends to be the poor cousin and can get forgotten. It is going to be very important for us to hardwire biodiversity into everything we do, whether it is in this particular Bill or in the climate plans of the councils.

In the rolling out of the work on biodiversity, the councils have not been funded to do this properly. Where would Professor Buckley see as the best place for us to invest to ensure that the issues of biodiversity are managed properly? Is it at a council level or is it at a higher level, looking at research and mapping? Is it a case of being able to point to a document that states, for example, this seagrass will hold this much carbon, and if we manage to do this, it is the equivalent of taking 20,000 cars off the road? If not, is it going to be a jigsaw of all the different things we need to address to make sure we do this properly?

Professor Yvonne Buckley: I believe it is the latter. Again, there is the question of scale. There are some things we can only do at national or international level. Some of that research has to be done. We must be able to put forward the most efficient and least-cost, best solutions we can, and I mean not just economic cost but also social and environmental cost. Research is necessary to inform that, as well as the appropriate mapping and data. On the implementation side, we need to know the best methods for doing that and how to get the most bang for our buck at the implementation stage, such as what species, where, how much of it and at what quality it will do the best job for us. Some of that information will come from research, some will come from implementation and some will come from the interplay between research and implementation. We learn as we go along here.

I would love to see the connection between implementation and research hardwired in somewhere. We have to do action research, which is research that is not divorced from implementation but which is knitted in with implementation, so we can learn as we go along with these nature-based solutions. In addition, we can change course if necessary. If we find better solutions, we can adjust and move with those. It takes a long time to improve the quality of functioning ecosystems and to restore ecosystems. Decisions we make now will potentially be

with us for hundreds of years. I believe it is a jigsaw or a web of solutions from the local scale all the way up to the national and international scales. I would like to see an ecosystem of research, implementation and multidisciplinarity, to be honest. The Deputy is correct that climate and biodiversity must be addressed together in terms of both the research and the implementation phases. I am using the word "ecosystem" here in two ways: one, in a biodiversity sense and, two, in a healthy ecosystem of researchers and practitioners working together to get the solutions we need.

Chairman: There is one more member to contribute. We will be out of time in five or six minutes. I call Deputy Cronin, and we will try to conclude within that timeframe.

Deputy Réada Cronin: My question is to Professor Buckley. The climate emergency is awash with fake news and is disfigured and defaced by greenwashing by huge polluters with massive amounts of money. These days, one would almost think that these fossil fuel producers were going to chain themselves to the trees they are planning to plant, so powerful are their advertisements, PR and marketing. They are spending hundreds of millions of euro to persuade us that they are the good guys. Will Professor Buckley comment on how worrying greenwashing is in the emergency we are facing?

Professor Yvonne Buckley: Greenwashing is a threat to proper implementation of and gaining the benefits from what we are doing here. This is related to one of the points I made in my submission. We must have effective monitoring of what we are doing. It is all very well to say one has planted many trees, but if those trees do not survive, are in the wrong place, grow too slowly or they do not accumulate the benefits we assume they are accumulating, it may be pointless. Saying one is taking that action is insufficient. We need appropriate monitoring and auditing of the solutions we put in place, with data transparency. There is nowhere to hide these days with remote sensing. We can count individual trees and monitor their growth from year to year. It is getting harder to make claims that are unsupported by data.

We must put in place the mechanisms and processes now to ensure we keep everybody honest in the claims they are making about what they are doing in regard to nature-based solutions, in particular, and in terms of actions for biodiversity. There should be no dark corners in which to hide with regard to our monitoring and auditing of the effectiveness of these solutions.

Deputy Réada Cronin: I thank the witnesses for their submissions and for the time they have given the committee.

Chairman: Every member has contributed a number of times. We are almost out of time. On behalf of the committee, I thank Professor Buckley and Dr. Glynn for attending today's meeting and for the worthwhile and informative engagement with the committee. It will assist us as we go forward and consider the draft Bill. The committee stands adjourned until 11.30 a.m. on Wednesday, 4 November, when we will resume pre-legislative scrutiny of the Bill.

The joint committee adjourned at 3.55 p.m. until 11.30 a.m. on Wednesday, 4 November 2020.