Climate Limits and Fossil Fuel Production

*Opening statement of **Greg Muttitt** to the Joint Oireachtas Committee on Communications, Climate Action and Environment, detailed scrutiny of the Petroleum and Other Minerals Development (Amendment) (Climate Emergency Measures) Bill 2018*

I am grateful for the opportunity to address the Joint Committee. I hope these remarks can help contribute to your considerations of the Climate Emergency Measures Bill.

I am Research Director of Oil Change International, a research and advocacy organisation that aims to facilitate and accelerate the transition of our energy systems from fossil fuels to clean energy. Oil Change International works with governments, investors, companies and civil society to help align energy decisions with climate limits.

The vital context is that, as the Joint Committee is aware, the world is not on course for achieving the Paris goals, to keep average warming *well below* 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit it to 1.5 degrees.[1]

Nor is Ireland on course for achieving either its short-term commitments within EU legislation, or its long-term target of reducing greenhouse gas emissions from the energy sector by between 80 and 95 percent by 2050, compared to 1990 levels.[2] The energy sector reductions are especially important to Ireland's contribution to the EU's target of 80-95 percent reductions of all greenhouse gases, given that Ireland has significant agricultural emissions, which are much harder to mitigate.

Put simply, the reason for being off course is an excess of fossil fuels in energy systems. As energy projections from the SEAI show in Slide 5,[3] Ireland's targets cannot be achieved without addressing the levels of oil and gas consumption. In turn, as I will show, doing so will be very difficult if supplies of oil and gas are not addressed.

I would like to share two pieces of my research with you. The first finds that achieving the Paris goals will require an end to development of new fossil fuel extraction projects, as the emissions arising from existing fields and mines over the coming decades will exceed available carbon budgets. The second finds that natural gas cannot act as a "transition fuel," as some people suggest: at this late stage of climate change, it is necessary to focus policy on moving directly to zero-carbon energy as soon as possible. In both respects, I will show you the global picture, and then suggest how it relates to Ireland specifically. I will also address two common objections to the Bill, related to the decline rates of oil and gas fields, and to the variability of renewables.

I will conclude from this research that Ireland's Climate Emergency Measures Bill is an important example of the leadership that is required for achievement of the Paris goals. I will describe the emerging trend in which countries and institutions are ending new fossil fuel development, and recommend that adoption of the Bill would help place Ireland among the climate leaders and help the country influence others to adopt Paris-aligned policies.

Too much fossil fuel

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change put a lot of emphasis on the concept of *carbon budgets*, reflecting the fact that temperature outcomes are directly related to the cumulative volume of carbon dioxide emitted over time.[4] Carbon budgets are

also a useful tool for policy making because they give a clear sense of what the limits are, and of the decisions that must be made to stay within them.

Carbon budgets may also be neatly compared to fossil fuel reserves, which give a measure of committed future emissions from the world's stock of fossil fuels. Previous researchers have shown that the majority of reserves must remain in the ground in order to limit warming to 2 degrees.[5]

The innovation in our research was to focus specifically on the subset of oil, gas and coal reserves that exists in fields and mines that are already in operation. In other words, this is what would be extracted if the fields and mines are operated for their full economic life, commonly two or three decades (but sometimes longer). This is important, because once capital has been invested and infrastructure built, emissions are *locked-in*,[6] as I shall explain shortly.

We took estimates of developed reserves from the energy industry, primarily Rystad Energy (an oil and gas consultancy) and the International Energy Agency. The results are shown in Slide 8, together with the most optimistic feasible estimates of future carbon dioxide emissions from non-energy sources, primarily land use change and cement manufacture.[7]

As you can see, the oil, gas and coal to be extracted from already-developed fields and mines would take the world beyond 2 degrees Celsius of warming. The oil and gas alone would take the world beyond 1.5 degrees.

If new fields and mines are developed, whether in Ireland or elsewhere, they will add to the left-hand column of the graph. Logically, this can do one of only two things (Slide 10): either they push the world beyond climate limits, or they require a greater amount of existing infrastructure to be closed early, at a cost of economic and social disruption: stranded capital assets and lost jobs. [8] With its prospective resources being high-cost, such disruption would likely be felt especially strongly in Ireland.

Gas is not a "transition fuel"

Some oil and gas companies promote the idea that since combustion of gas releases less carbon dioxide than combustion of coal, it can be used as a stepping stone on the way to clean energy.[9] This narrative appears rooted more in a desire to find a use for all the fossil gas available, than a clear-headed analysis of how much gas use is compatible with climate goals. In reality, the "transition fuel" idea is fundamentally flawed in two respects.

First, if the idea of a transition fuel might have made some sense in the 1990s when the climate problem was less urgent, it does not fit within today's more depleted carbon budgets, following the rising emissions that have occurred since then. We saw in Slide 5 that rising gas consumption is not consistent with Ireland's climate targets.

We see the same in the global power sector in Slide 14, which shows IEA projections of power generation in 2040: even if all the world's coal power was replaced with gas, emissions from the power sector would still be more than five times the median of IPCC scenarios for a likely chance of keeping warming below 2 degrees Celsius.[10] The slide shows that all coal must be replaced with zero-carbon energy, not gas; and that gas use must be significantly decreased, not increased.

In those scenarios, the power sector must decarbonise by 2050 (Slide 13); this is earlier than other, more difficult sectors (such as agriculture, industry or aviation) because in power the alternatives are available and affordable today.

The recent *Bloomberg New Energy Outlook* echoed this, finding that even with optimistic technological assumptions, a complete phaseout of coal by 2035 would not be sufficient to get power sector emissions onto a 2-degree trajectory.[11] Gas must be phased out too.

Second, it is not just that gas does not go far enough in reducing emissions; it also makes the climate problem worse by undermining the transition to clean energy. While the costs of wind and solar power have fallen dramatically in recent years, their further growth is slowed by competition from fossil fuels. For example, power from renewable energy commonly[12] costs roughly the same as combined cycle gas turbines (CCGT), as shown in Slide 15.[13] Indeed, several recent studies have modelled the competition between different fuels, finding that greater supplies of gas tend to increase (or at least not decrease) total emissions, because the additional gas displaces zero-carbon energy as well as coal.[14]

Furthermore, once gas infrastructure is built, it *locks in* emissions over the lifetime of the infrastructure, which can be several decades. After capital has been invested, the incentives for operators are to continue operating even if they make a loss on their capital, as long as the commodity price exceeds the marginal cost of production and so reduces the loss. This is illustrated for UK power plants in Slides 16-17: when comparing newbuilds, the average wind plant is cheaper than a new combined-cycle gas turbine (CCGT) plant. But once capital costs have been sunk, an existing CCGT plant can produce power more cheaply than a new wind plant.

In Slide 18, we see the same for gas extraction, illustrated by the proposed Spanish Point project in the Porcupine Basin, where projected marginal operating costs are less than half of total costs.[15] Operator Cairn Energy would need a relatively high gas price to sanction the project. If subsequent climate policy causes the gas price to fall, it creates a lose-lose situation where the gas continues to be produced (with consequent emissions) but while the company makes a loss on capital it has invested, and the government loses revenue.[16]

This pace of transition is both necessary and possible

Two objections are commonly made to proposals to end licensing of new oil and gas: that without new projects, production will decline faster than an energy transition can keep pace with; and that renewables are too limited by their variability.

As oil and gas fields are depleted, falling reservoir pressures lead to a decrease in production rates. The global average decline rate varies according to economic conditions, generally in the range of 4 to 7 percent for conventional fields.[17] If no new fields are developed, there will be a flattening in global production for a few years while existing expansion is completed, followed by a decline at between 4 and 7 percent per year. While replacing oil and gas at this pace requires significant policy effort by governments, it is consistent with what is needed to achieve the Paris goals.

When some people argue that this pace is faster than can or should be achieved, that is commonly by reference to the International Energy Agency's Sustainable Development Scenario, which proposes a 1 percent per year decline in oil consumption, and an increase in gas consumption up to 2040.[18] But that scenario is not aligned with the Paris goals (Slide 20): it aims only for a 50 percent probability of keeping warming below 2 degrees Celsius, which does not reflect the goal of keeping "well below" 2 degrees and aiming for 1.5 degrees.[19]

The IEA has suggested the Sustainable Development Scenario could set the world on course for 1.7 or 1.8 degrees of warming,[20] but this claim is based on an assumption that emissions will be later sucked back out of the atmosphere, by technologies that so far exist only in theory and have never

been tried in practice. Even if these technologies work, the levels indicated by the IEA could require bioenergy to be grown over a land area up to twelve times the size of India.[21] While such technologies might ultimately help us to reduce temperatures further, it would be unwise to rely on such unknowns to avoid dangerous climate change.

If instead we make the precautionary assumption that such technologies might not become available, then staying within the carbon budget for a likely chance of keeping below 2 degrees would require an annual decline in emissions of about 5 percent; aiming to limit warming to 1.5 degrees would require a decline rate of 13 percent (Slide 21).[22] Indeed, Ireland's own target of reducing emissions by 80 to 95% from 1990 levels by 2050 requires an annual reduction of between 5 and 10 percent.[23] While certainly challenging, a transformation at a pace within this range is both technically and economically feasible.

An influential paper by Johan Rockström and colleagues in the journal *Science* recommended a roadmap to achieving the Paris goals, based on a "carbon law" of halving global emissions every ten years. This is equivalent to an annual decline of about 7 percent. This would require a doubling of zero-carbon shares in the energy system every 5 to 7 years, which the paper observed is consistent with the trajectory of the last decade. It enables an end to oil use by 2040.[24]

Two recent studies using integrated assessment models have shown how the world can keep warming to 1.5 degrees with limited reliance on negative emissions technology, and at limited cost.[25] Coming from a more engineering perspective, others have shown that 100 percent renewable electricity is feasible by 2050.[26]

As for the variability of renewables, with current penetration of 27 percent,[27] Ireland is not close to the technical limits for renewable energy on comparable electrical grids. For example, the operator of the electrical grid in northeast Germany says the grid can handle up to 70 to 80 percent wind and solar even without additional flexibility options such as storage.[28] Australian grid operator TransGrid goes further, saying that 100 percent renewable energy is both affordable and practical using a combination of existing technology for storage, demand management and efficiency.[29]

By the time Ireland approaches those current technical limits, energy storage and grid management technologies will be significantly cheaper than today, and capable of further increasing renewable energy's share. The cost of lithium-ion batteries has declined 79 percent since 2010, making them already cost-competitive with coal and fossil gas generation,[30] and are projected to decline a further 67 percent by 2030. As Bloomberg New Energy Finance recently stated, "The economic case for building new coal and gas capacity is crumbling, as batteries start to encroach on the flexibility and peaking revenues enjoyed by fossil fuel plants."[31]

A review of past energy transitions at a national level found that wholesale transitions have happened within less than two decades where governments enabled them, through measures such as subsidies, establishing pilot programs, retraining workers and regulation.[32] What makes the difference to feasibility of rapid energy transitions is the existence of political will.

The new climate leadership

Traditionally, climate policy has focused on the point at which carbon enters the atmosphere rather than at which it leaves the ground. However, elementary economics tells us that the volume of a product sold is determined by the equilibrium between its supply and demand curves (Slide 11). That volume can be reduced by restricting either demand or supply (although the two measures will have opposite impacts on equilibrium price). Several recent studies have found that in many cases,

emissions can be more effectively reduced by restricting fossil fuel supplies than by tackling fuel demand or end-of-pipe emissions.[33]

135 economists have signed the Not a Penny More Declaration, which calls for an immediate end to investments in new fossil fuel production and infrastructure, and for a dramatic increase in investments in renewable energy.[34] In December 2017, the World Bank Group announced that it would cease lending to oil and gas extraction from 2019, in order "to align with the Paris goals."[35]

Increasingly, the role of limiting fossil fuel supply is recognised in cutting-edge policy making, as governments remove production subsidies, restrict production from sensitive areas, and apply a climate test to new infrastructure proposals. Ireland's ban on onshore hydraulic fracturing and the expectation that it is set to divest its Strategic Investment Fund from fossil fuels are noted internationally.

There is now an emerging trend towards ending new oil and gas licensing. France legislated a ban in December 2017, joining Costa Rica and soon after Belize joined too. In April 2018, New Zealand ended offshore licensing of oil and gas. Like Ireland, these are all relatively small producers of oil and gas. We know from private conversations that several governments are considering following suit. It is common sense that those with smaller indigenous fossil fuel industries can be the first to move. This is critical to building wider momentum.

As the number of such jurisdictions grows, it will put increasing pressure on the largest producers, in many of which there is already an active debate. In Norway, an opinion poll last year found 44 percent of respondents favoured curbing oil production to protect the climate, compared to only 42 percent opposed;[36] the oil question became central in Norway's election debates.[37] In Canada, public opposition to pipelines that would expand tar sands production has created a political crisis for the Trudeau government.[38] In California, over 750 environmental, labour, health and social justice groups have called on Governor Jerry Brown to stop issuing permits for oil drilling and begin the phase-out of fossil-fuel production within the state.[39]

If Ireland passes this Bill into law, it will not only help the country achieve its own climate targets, but will have a significant international influence, helping build the global ambition needed to deliver on the Paris Agreement.

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[1] United Nations Environment Programme, *Emissions Gap Report 2017*, pp.11-18, http://wedocs.unep.org/handle/20.500.11822/22070

[2] Department of Communications, Climate Action and Environment, *Ireland's Transition to a Low Carbon Energy Future 2015-2030*, White Paper 2015, pp.32-35, https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Initiatives/energy-policy-framework/white-paper/Pages/White-Paper-on-Energy-Policy-in-Ireland-.aspx

This built on the previous target, set in the National Policy Position of 2014, of reducing carbon dioxide emissions from the power, buildings and transport sectors by at least 80 percent by 2050.

[3] Energy projections from Sustainable Energy Authority of Ireland, Energy Data Portal, Primary Energy Supply, https://www.seai.ie/resources/seai-statistics/energy-data/

Emissions factors from IPCC, *Guidelines for National Greenhouse Gas Inventories, 2006*, Vol.2, Chapter 1, Tables 1.2 and 1.3, http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

[4] IPCC, *Climate Change 2013*, Working Group 1 report, sec.12.5.4, pp.1108ff, http://ipcc.ch/pdf/assessmentreport/ar5/wg1/WG1AR5_Chapter12_FINAL.pdf

[5] Malte Meinshausen et al, "Greenhouse-gas emission targets for limiting global warming to 2°C", *Nature*, Vol. 458, 30 April 2009

[6] Karen Seto et al, "Carbon Lock-In: Types, Causes, and Policy Implications," *Annual Review of Environment and Resources* vol 41 (2016); pp.425–52,

Gregory Unruh, "Understanding carbon lock-in," *Energy policy* 28 (12), 2000, pp.817-830

[7] We take 180 Gt as the most optimistic feasible amount of non-energy emissions over the remainder of the century. This comprises 20 Gt of land use change emissions, the median of IPCC scenarios leading to a 66% chance of 2°C (which requires significant reforestation); plus

160 Gt from cement calcination, which based on the IEA's technology roadmap assumes limited growth in cement consumption and maximum technological progress. For more details on these assumptions, see Greg Muttitt, *The Sky's Limit: Why the Paris Climate Goals Require A Managed Decline of Fossil Fuel Production,* Oil Change International, September 2016, p.49 http://priceofoil.org/2016/09/22/the-skys-limit-report/

[8] A third logical possibility, promoted by some, is that technology may be invented to suck carbon back out of the atmosphere, such as through bioenergy combined with carbon capture and storage (BECCS). Such technologies are proposed in some theoretical models, but have never been tried in practice, and it is very uncertain whether they would work at scale and affordably. We therefore adopt the precautionary approach of focusing on what must happen if such technologies do not become available.

Kevin Anderson and Glen Peters, "The trouble with negative emissions," *Science* 354:6309, 14 October 2016

[9] Oil and Gas Climate Initiative, *Catalyst For Change*, October 2017, pp.17-19, http://oilandgasclimateinitiative.com/wp-content/uploads/2017/10/OGCI-2017-Report.pdf

[10] We use the IEA New Policies Scenario for 2040 power sector emissions. IEA, *World Energy Outlook 2016*, p.552, http://www.iea.org/newsroom/news/2016/november/world-energy-outlook-2016.html

We use the median of IPCC scenarios for 2040 power sector emissions based on likely keeping warming below 2 degrees Celsius. IPCC, *Climate Change 2014*, Working Group III report, Fig 7.9, p. 555. http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter7.pdf

[11] Bloomberg New Energy Finance, *New Energy Outlook 2018*, summary at https://bnef.turtl.co/story/neo2018?teaser=true, p.2 of 'Coal, gas and impact on emissions'.

[12] The only exceptions are in countries with limited air pollution regulations and cheap domestic coal reserves, such as China and India

[13] Lazard, *Levelized Cost of Energy 2017*, https://www.lazard.com/perspective/levelized-cost-of-energy-2017/

[14] Energy Modeling Forum. "Changing the Game? Emissions and Market Implications of New Natural Gas Supplies," September 2013

Christine Shearer et al, "The effect of natural gas supply on US renewable energy and CO_2 emissions," *Environmental Research Letters*, Vol. 9, 24 September 2014

Haewon McJeon et al, "Limited impact on decadal-scale climate change from increased use of natural gas," *Nature*, Vol.514 No.7523, 23 October 2014, pp.482-5

[15] Rystad UCube, accessed 1 July 2018. Breakeven gas price and average operating expenditure per thousand cubic feet over first 15 years of production

[16] This situation is described by the IEA as a "disjointed transition," arising from a delay in governments implementing adequate climate policy. IEA and IRENA, *Perspectives for the Energy Transition*, March 2017, pp.112-113, https://www.iea.org/publications/insights/insightpublications/perspectives-for-the-energy-transition.html

[17] IEA *World Energy Outlook 2016*, p.147

Robert Perkins, "Analysis: Decline rates, spending crunch fuels fresh oil industry concerns," *Platts*, 29 July 2016

Wood Mackenzie, "Non-OPEC decline rates remain stable until 2020," 26 September 2017, https://www.woodmac.com/news/feature/non-opec-decline-rates-remain-stable-until-2020/

[18] IEA, *World Energy Outlook 2017*, p.645

[19] See Greg Muttitt, *Off Track: How the International Energy Agency Guides Energy Decisions towards Fossil Fuel Dependence and Climate Change*, Oil Change International, April 2018, pp.24-26, http://priceofoil.org/iea-off-track/

[20] IEA, "Sustainable Development Scenario: A cleaner and more inclusive energy future," http://www.iea.org/weo/weomodel/sds/

[21] Pete Smith et al, "Biophysical and economic limits to negative CO_2 emissions," *Nature Climate Change*, 7 December 2015, p.5.

[22] Based on carbon budgets from IPCC, *Climate Change 2014*, Synthesis Report (SYR), table 2.2, p.64, http://ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_All_Topics.pdf and subsequent and present emissions from Corinne le Quéré et al, "Global Carbon Budget 2017," *Earth System Science Data*, Vol.10 (2018), pp.429-430

[23] Assuming the 80-95 percent reduction occurs over 30 years (as Ireland's current emissions are somewhat higher than in 1990).

[24] Johan Rockström et al, "A roadmap for rapid decarbonization," *Science*, 355: 6331, 24 March 2017, pp.1269ff.

Our slide shows the slightly more ambitious of two options proposed by Rockström et al: the other would have global emissions declining from 40 Gt/yr in 2020 to 24 in 2030, 14 in 2040 and 5 in 2050.

[25] Arnulf Grubler et al, "A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies," *Nature Energy*. Vol.3 (2018), pp.515–527

Detlef van Vuuren et al, "Alternative pathways to the 1.5°C target reduce the need for negative emission technologies," *Nature Climate Change*, Vol.8 (2018), pp.391–397

[26] Manish Ram et al, *Global Energy System Based on 100% Renewable Energy – Power Sector*, Lappeenranta University of Technology / Energy Watch Group, November 2017, http://energywatchgroup.org/wp-content/uploads/2017/11/Full-Study-100-Renewable-Energy-Worldwide-Power-Sector.pdf

[27] 2016 data. Sustainable Energy Authority of Ireland, *Energy in Ireland 1990-2016*, 2017 Report, p.21, https://www.seai.ie/resources/publications/Energy-in-Ireland-1990-2016-Full-report.pdf

[28] *TagesSpiegel* interview, clipping summarized in *Clean Energy Wire*, "Grid operator says 80% renewables no problem," 6 June 2016, https://www.cleanenergywire.org/news/grid-operator-says-80-renewables-no-problem-environment-ministry-turns-30

[29] Giles Parkinson, "Transgrid: 100% renewables is feasible and affordable," *RenewEconomy*, 20 July 2017. http://reneweconomy.com.au/transgrid-100-renewables-isfeasible-and-affordable-92062/

[30] Elena Giannakopulou et al, '1H 2018 LCOE Update Global'. Bloomberg New Energy Finance, 28 March 2018, p.6

[31] Bloomberg New Energy Finance, *New Energy Outlook 2018*, Levelized Cost of Energy, https://about.bnef.com/new-energy-outlook/#toc-download

[32] Benjamin Sovacool, "How long will it take? Conceptualizing the temporal dynamics of energy transitions," *Energy Research & Social Science*, Vol.13 (2016), pp.202–215

[33] Fergus Green and Richard Denniss, "Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies," *Climatic Change*, 12 March 2018

Taran Fæhn et al, "Climate Policies in a Fossil Fuel Producing Country: Demand versus Supply Side Policies," *Energy Journal*, Vol.38 No.1, 2017, http://www.frisch.uio.no/publikasjoner/pdf/2016/Formatert/Faehn_et_al_Climate_Polocies_Energy_journal_2016_CREE_Cri1380439.pdf

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[34] http://notapennymore.info/declaration/

[35] World Bank Group, Announcements at One Planet Summit, 12 December 2017, http://www.worldbank.org/en/news/press-release/2017/12/12/world-bank-group-announcements-at-one-planet-summit

[36] Arnhild Aass Kristiansen, "Nordmenn vil la olje ligge for å spare klimaet," *Dagbladet*, 3 August 2017, https://www.dagbladet.no/nyheter/nordmenn-vil-la-olje-ligge-for-a-spare-klimaet/68556735

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[37] Mikael Holter, "Threat to Oil Becomes Real as Climate Crashes Norway Election," Bloomberg, 6 September 2017, https://www.bloomberg.com/news/articles/2017-09-05/threat-to-oil-becomes-real-as-climate-crashes-norway-election

[38] David Ljunggren, "Canada's Trudeau faces election risk after firm's pipeline surprise," Reuters, 16 April 2018, https://www.reuters.com/article/kinder-morgan-cn-pipeline-surprise/rpt-canadas-trudeau-faces-election-risk-after-firms-pipeline-surprise-idUSL1N1RR0HX

Susan Martinuk, "Trudeau has failed to resolve pipeline crisis," *Calgary Herald*, 17 April 2018, http://www.calgaryherald.com/opinion/op-ed/susan+martinuk+trudeau+failed+resolve+pipeline+crisis/17301980/story.html

[39] David R. Baker, "Gov. Brown urged to phase out state's fossil-fuel industry," *San Francisco Chronicle*, 11 April 2018, https://www.sfchronicle.com/business/article/End-oil-drilling-permits-in-California-groups-12826051.php