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February 25, 2022

Via email to oilandgasconsultations@beis.gov.uk

Oil and Gas Exploration and Production
Department for Business, Energy & Industrial Strategy
1 Victoria Street
London
SW1H 0ET

Dear Department for Business, Energy & Industrial Strategy:

We write in response to the open consultation for “Designing a climate compatibility checkpoint for future oil and gas licensing in the UK Continental Shelf”. In particular, we are responding to Question 20 regarding how a test that considers the world’s “production gap” could be designed.

We are responding as individuals who have served as the lead authors of the chapter on the production gap analysis of the 2019, 2020, and 2021 Production Gap Reports. One of us also served as a coordinating lead author of the 2021 Production Gap Report. The comments expressed here do not represent the views of our organization.

We are grateful for the opportunity to provide these comments and would be happy to answer any questions about them.

Sincerely,

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Comments on how the global production gap can be considered in assessing the climate compatibility of UK's future oil and gas licensing

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The UK's Department for Business, Energy and Industrial Strategy (BEIS) has launched a consultation on the design of a new climate compatibility checkpoint for new oil and gas licensing rounds. As part of that process, BEIS is considering how the global "production gap" can be considered as one of six potential checkpoint tests. Specifically, the consultation posed the following question:

Question 20: How would a test that considers the world's "production gap" be designed? Please detail your proposed methodology and state sources of data and projections that would be required.

We have conducted the research on tracking and analyzing the global production gap¹⁻³ and would like to offer some perspectives to inform this question. Below, we lay out the technical details and assumptions behind the global production gap analysis, and suggest how this understanding could be applied to design a "checkpoint" to assess whether or not future oil and gas licensing rounds are compatible with the UK's wider climate objectives. Given that the UK government has set a legally binding net-zero target by 2050 in an effort to help limit long-term global warming to 1.5°C⁴, and with the UK COP26 Presidency having strongly backed this goal⁵, we focus on this temperature limit in our response. We do so on the presumption that it is reasonable to infer that the climate compatibility checkpoint is effectively asking whether the production resulting from new oil and gas licenses would be consistent with a 1.5°C-warming pathway.

1. The global production gap: the scientific basis

Under the Paris Agreement, Parties have committed to "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels", guided by principles including "the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances"⁶.

To inform how the world could achieve these global warming limits in an optimal and feasible way, scientists and economists have developed a suite of tools known as "integrated assessment models" (IAMs). These are computer models that analyze a broad range of physical, economic, and social data in order to assess how the world's energy and land-use systems would need to transform – given underlying constraints and assumptions such as cost-effectiveness and the future potential of carbon dioxide removal (CDR) technologies – in order to achieve the temperature limits of the Paris Agreement⁷. At present, around 75% of global greenhouse emissions derive from fossil fuels¹.

These mitigation scenarios, such as those compiled for the Intergovernmental Panel on Climate Change (IPCC)'s *Special Report on Global Warming of 1.5°C* (hereafter referred to "IPCC SR1.5")⁸, chart out, for example, the pathways of global coal, oil, and fossil gas demand and supply that would be consistent with emission pathways that limit warming to 1.5°C or to 2°C (the models assume equilibrium between energy demand and supply). This is one of two central elements to our production gap quantification. We calculated the "2°C-consistent" pathway as the median of scenarios that have at least a 66% probability of limiting warming to below 2°C over the *entire* 21st century (meaning, no temperature overshoot), relative to the pre-industrial global average atmospheric temperature. We calculated the "1.5°C-consistent" pathway as the median of scenarios with at least a 50% likelihood of limiting warming to below 1.5°C by *end-of-century* (meaning, with a low amount of temporary overshoot allowed before 2100). We further constrained these two sets of scenarios by how much carbon they sequester from bioenergy with carbon capture and storage (BECCS) and by afforestation; specifically, we only included scenarios in which BECCS sequesters an average of less than 5 billion tonnes of carbon dioxide per year (GtCO₂/y) and in which afforestation sequesters an average of less than 3.6 GtCO₂/y, both as assessed between 2040 and 2060. This approach follows the

Climate Action Tracker’s interpretation of sustainable limits for these carbon dioxide removal (CDR) practices, given their “multiple feasibility and sustainability constraints,” as noted by the IPCC^{9,10}. (The IPCC’s *Mitigation of Climate Change: Working Group III Contribution to the Sixth Assessment Report*, which will be released later this year, will assess new mitigation scenarios in detail and will be accompanied by the scenario database that will allow us to update our analysis of coal, oil, and gas production under low-carbon pathways in the future.)

The second element to the production gap estimate is the pathway of global future coal, oil, and gas production implied by the plans and projections of national governments. For our 2021 Production Gap Report, we relied on the projections for fossil fuel production from 15 major producer countries, as outlined in their governments’ recent and publicly available national energy outlooks and plans, including projections from the UK’s Oil and Gas Authority (OGA)¹¹. Altogether, these 15 countries accounted for around 75% of global fossil fuel extraction, on an energy basis, in 2020. Their combined production levels are then scaled up to a global estimate, based on these countries’ projected future shares of global production. (Please refer to Chapter 2 and Online Appendix B of our 2021 Production Gap Report³ for full methodological details.)

The global coal, oil, and gas production gaps are shown in Figure 1. Also shown are the individual contributions of major producers to the global “countries’ plans and projections” pathways. As stated in our 2021 report, governments are collectively projecting an *increase* in global oil and gas production, and only a modest decrease in coal production, from 2020 onwards. By 2030, this would lead to 240% more coal, 57% more oil, and 71% more gas than levels consistent with the median 1.5°C-warming pathways. The production gaps grow much wider by 2040, with 450% more coal, 170% more oil, and 150% more gas than the median 1.5°C-warming pathways. Under the median 1.5°C-consistent pathways, global oil and gas production each decrease by around 30% between 2020 and 2030.

As stated above, there are many different constraints and assumptions underlying different mitigation scenarios, meaning that they can have very different conceptions of how the low-carbon transition might unfold. Although we use the median values across the selected scenarios to calculate the production gap, this is not the only way this estimate could be made. For example, it is possible that certain groups of scenarios — or even individual scenarios on their own — are more plausible than the median values. In the next section, we lay out and explore the policy implications of some of the major factors and assumptions influencing how quickly oil and gas production and use need to be phased down in order to meet the 1.5°C-warming limit under different mitigation scenarios.

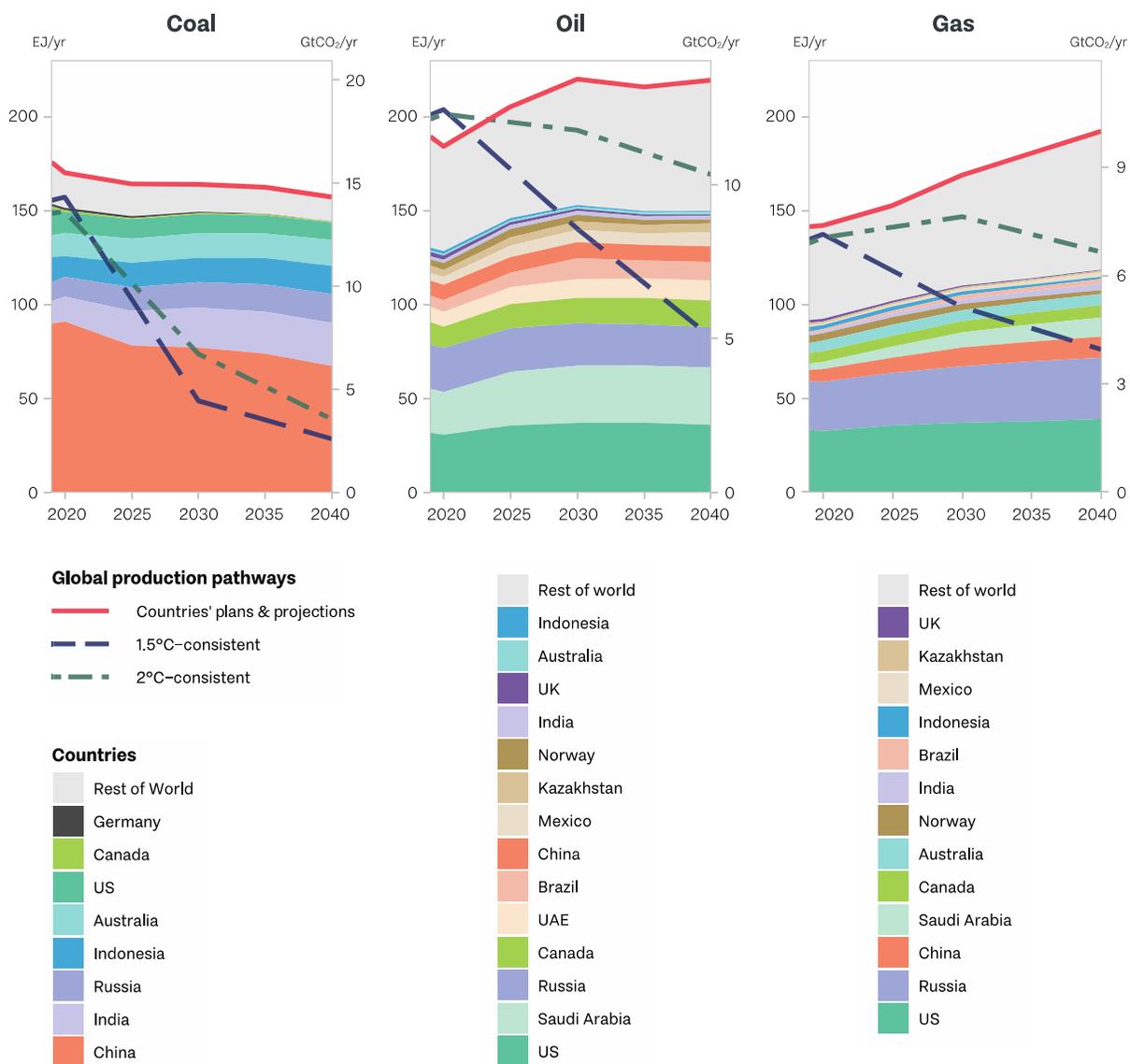


Figure 1. This figure is taken from Figure 2.3 of the 2021 Production Gap Report, showing individual countries' contributions to global production estimated under the "countries' plans and projections" pathways. For each fuel, countries are plotted in order of decreasing cumulative 2019–2040 production, from bottom to top. Global production under the median 1.5°C- and 2°C-consistent pathways are overlaid. Annual coal, oil, and gas production are shown in energy units (exajoules, or EJ) on the primary axes, and in units of extraction-based CO₂ emissions on the secondary axes. (To allow for these two units to be shown on the same plot, globally averaged, extraction-based emission factors for each fuel are applied to all countries here.)

2. Global oil and gas pathways consistent with limiting warming to 1.5°C: assumptions and policy implications

Figure 2 shows the global pathways of coal, oil, and gas production (and use) and four related variables as modelled under different subsets of or individual IPCC SR1.5 scenarios with varying temperature outcomes consistent with limiting long-term warming to 1.5°C and different CDR constraints as described in Table 1.

Table 1. Classification and selection of IPCC SR1.5 mitigation scenarios shown in Figure 2. The “pathway class” and “pathway selection criteria and description” definitions are drawn from Table 2.1 of the IPCC SR1.5 Chapter 2. The same additional CDR constraints are applied to each pathway class and the median is calculated from the remaining 19 scenarios to derive the “PGR 1.5°C-consistent pathway”.

IPCC SR1.5 pathway class	IPCC SR1.5 pathway selection criteria and description	Number of scenarios	Additional CDR limits imposed	Number of scenarios
Below-1.5°C	Pathways limiting peak warming to below 1.5°C during the entire 21 st century with 50-66% likelihood	9 (“Below 1.5°C” in Figure 2)	Pathways in which the average 2040-2060 BECCS values (variable name: Carbon Sequestration CCS Biomass) are lower than 5.0 GtCO ₂ /y and average 2040-2060 afforestation values (variable name: Emissions CO2 AFOLU) are lower than 3.6 GtCO ₂ /y. (Pathways with missing values for these variables are excluded.)	4
1.5°C-low overshoot	Pathways limiting median warming to below 1.5°C in 2100 and with a 50-67% probability of temporarily overshooting that level earlier, generally implying less than 0.1°C higher peak warming than “Below-1.5°C” pathways	44 (“1.5°C low-OS” in Figure 2)		15

In addition to the subsets of mitigation scenarios outlined in Table 1, we also show the results under one of the “illustrative pathways” of the IPCC SR1.5, the “P1”. This is a sustainability-oriented scenario with “lower energy demand up to 2050 while living standards rise, especially in the global South”, and with afforestation/reforestation (AR) as the only CDR option⁹. This is because a 2021 expert survey conducted by Grant et al.¹² found that IPCC SR1.5 scenarios appear to have substantially overestimated the potential for CDR via BECCS in general. Thus, although we had already imposed some limits on mid-century CDR reliance in our selection of pathways for the Production Gap Report as discussed in the previous section and laid out in Table 1, the P1 represents a scenario with zero reliance on BECCS (and on carbon capture and storage (CCS) coupled to fossil fuel use), while its reliance on cumulative negative emissions via land use practices is roughly consistent with the feasible AR potential based on expert consensus¹. Furthermore, we also show the energy supply from coal, oil, and gas, and other modelled variables, from the “Net Zero by 2050 pathway for the energy sector” from the International Energy Agency (IEA NZE)¹³.

Table 2 details the decreases in global oil and gas production in 2030 and in 2040 relative to 2020 as modelled by the different sets of or individual mitigation scenarios shown in Figure 2.

What we intend to illustrate with this exercise is that the decline pathways for global oil and gas production as modelled by different mitigation scenarios are contingent upon several major assumptions and outcomes, including but not limited to the following:

- 1) The level of risk society is willing to accept in terms of the probability of limiting long-term warming to 1.5°C, and whether we are likely to temporarily exceed this limit at some point this century.
- 2) The rate at which global coal production and use is phased down.
- 3) The level of reliance on future CDR deployment, primarily through BECCS and AR.
- 4) The level of future carbon capture and storage (CCS) that can be coupled to coal and gas burning and other industrial processes that emit CO₂.
- 5) The rate at which global methane emissions can be reduced.

Nevertheless, there are some common and important conclusions that can be drawn across these different subsets of or individual scenarios consistent with limiting long-term warming to 1.5°C:

1. Ultimately, the exact decline rates in coal, oil, and gas production and use may vary among different low-carbon pathways. But they all share one common outcome for limiting long-term warming to 1.5°C: a rapid and sustained wind down of global oil and gas production and use, with production peaking no later than 2020 for coal and oil, and no later than 2025 for gas.

¹ The median estimate of cumulative 2020-2100 AR potential from the expert survey conducted by Grant et al. is around 224 GtCO₂. We estimate the cumulative 2020-2100 negative emissions via agriculture, forestry, and land use under the “P1” pathway to be 169 GtCO₂ based on the provided model output of “Emissions|CO2|AFOLU” at decadal intervals.

2. Uncertainty in the future potential of CDR technologies should encourage greater climate action in the 2020s¹². The less carbon dioxide removal (as well as carbon capture and storageⁱⁱ) that can be deployed at scale in future years, the faster and greater that oil and gas supply and demand must decline.
3. Aggressive and immediate reductions in global methane emissions from all sources (including from the oil and gas sector) are essential and apparent in all scenarios. However, this is *not* a substitute for the need to wind down oil and gas production itself in line with the Paris Agreement’s goals. Both need to occur concurrently.

What this all means, in practice, for the application of a potential "production gap" criterion, as in question #20, is that there is no single "production gap"; instead, the "production gap" the UK chooses to use in a climate compatibility checkpoint will depend upon its views (whether implicitly or explicitly held) on the topics above. In the next section, we lay out some concrete examples for what this means in terms of operationalizing a "production gap" test for evaluating future oil and gas licensing.

ⁱⁱ On average, while the IPCC SR1.5 "Below 1.5°C" and "1.5°C-low overshoot" pathways rely on similar amounts of CDR via BECCS and AFOLU, the latter class relies on much more carbon capture and storage (CCS) coupled to fossil fuel use (see Figures 2d-f).

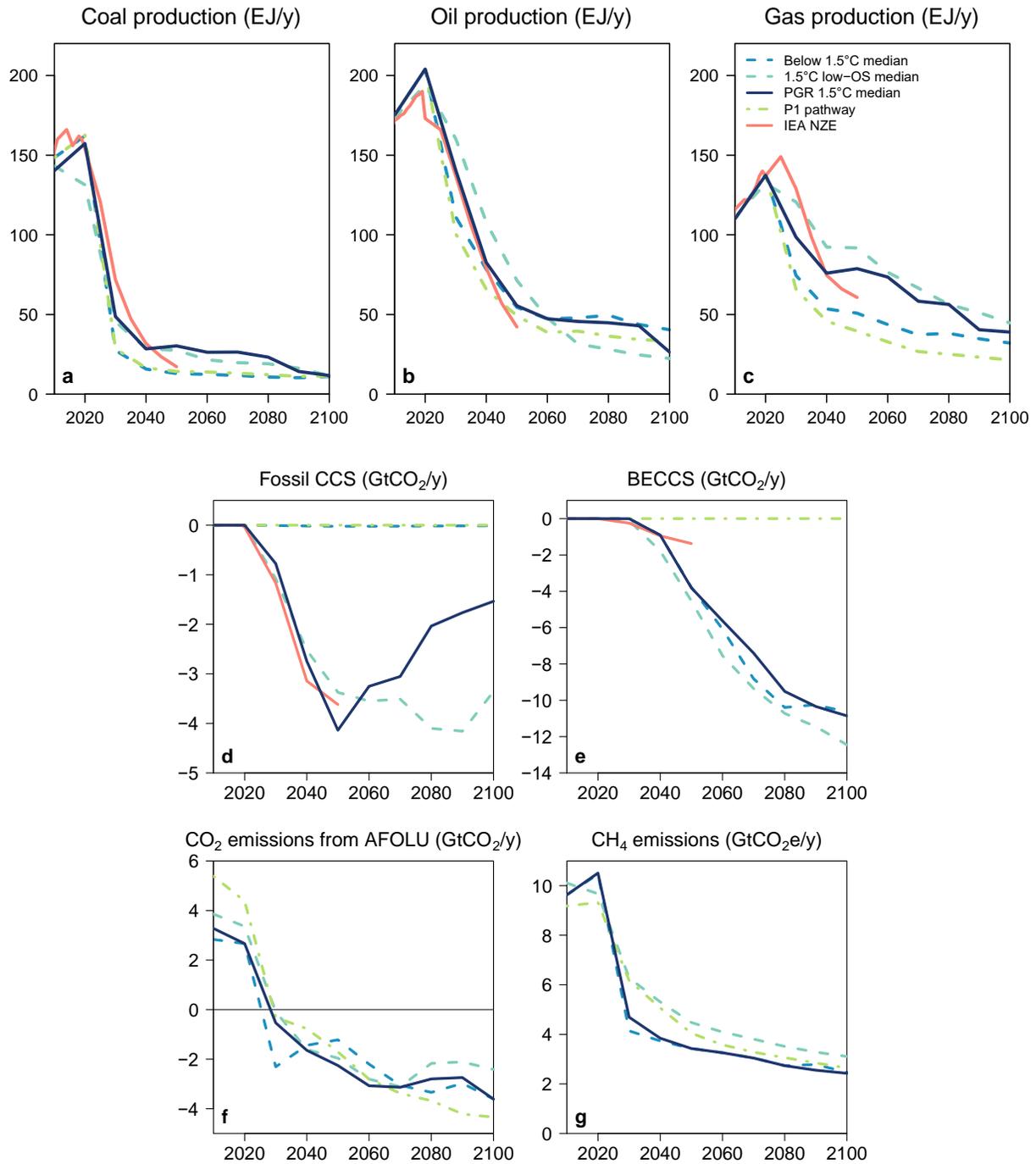


Figure 2. Subplots (a)-(c) show the global 2010-2100 pathways of coal, oil, and gas production (in units of exajoules or EJ per year) consistent with limiting warming to 1.5°C. Subplots (d)-(g) show key model variables underlying different 1.5°C-warming pathways for the same time period: (d) the amount of CO₂ emissions from fossil fuel burning that can be captured and stored, fossil CCS (GtCO₂/y); (e) the amount of CO₂ emissions that can be captured and stored through bioenergy from biomass, BECCS (GtCO₂/y); (f) CO₂ emissions from agriculture, forestry, and other land use, AFOLU (GtCO₂/y); and (g) methane emissions from all sources (GtCO₂-equivalent/y). Negative emission values represent carbon storage or sequestration. The 1.5°C-warming pathways shown are as follows (see Table 1 for details): (1) The median of pathways classified as “Below 1.5°C” in the IPCC SR1.5; (2) The median of pathways classified as “1.5°C-low overshoot”; (3) The median “1.5°C-consistent pathway” shown in

Figure 1 here and previously shown in our Production Gap Report series, which represent pathways that fall under (1) and (2) with CDR limits imposed (see Table 1); (4) the “P1” illustrative pathway of the IPCC SR1.5, which is one of many scenarios in the “1.5°C-low overshoot” pathway class; and (5) the “Net Zero by 2050 pathway for the energy sector” from the International Energy Agency, “IEA NZE”. For (1)-(4), model outputs are available and plotted at decadal intervals between 2010-2100. For the IEA NZE, data are available annually between 2010-2020, and every five years between 2020-2050; the IEA NZE did not model or output AFOLU and total methane emissions, so these pathways are omitted from panels f-g.

Table 2. Percentage decreases in global oil and gas production under different 1.5°C-warming pathways.

Timeframe	Fossil fuel	“Below 1.5°C” (median)	“1.5°C-low overshoot” (median)	Production Gap Report “1.5°C-consistent pathway” (median)	“P1” (individual 1.5°C-low overshoot scenario)	IEA NZE
2020-2030	Oil	-45%	-17%	-31%	-46%	-21%
	Gas	-46%	-9%	-28%	-37%	-6%
2020-2040	Oil	-62%	-44%	-59%	-73%	-54%
	Gas	-61%	-30%	-45%	-63%	-46%

3. How to design a “production gap” test to evaluate the climate compatibility of the UK’s future oil and gas licensing

The information laid out above, or similar information from the soon-to-be-released *Sixth Assessment Report* by the IPCC, could be used to design a series of benchmarks or reference pathways for the UK to assess whether its future national oil and gas production are consistent with the goal of limiting long-term warming to 1.5°C.

For example, taking a precautionary approach may suggest opting for the most stringent temperature outcome, therefore leading one to favour scenarios that fall in the “Below 1.5°C” pathway class (i.e., limiting peak warming to below 1.5°C during the entire 21st century with 50-66% likelihood). Under this pathway, global oil and gas production decline by around 45-46% between 2020 and 2030 on average. If the UK government were to use these global averages as their benchmarks, then the latest national production projections by the OGA (September 2021 release)¹⁴ would appear to already be aligned (i.e., a 49% and a 59% decrease in oil and gas production, respectively, between 2020 and 2030). Consequently, any new license that would lead to an increase in national oil or gas production such that 2030 production levels relative to 2020 will decrease by less than 46% would be considered “incompatible”, unless existing fields could also be retired early in order to meet the established benchmarks. (The information laid out here necessitates that the UK comprehensively evaluates all of its future national production from all sources, license types, and stages of development in order to evaluate the “production gap” compatibility.)

Alternatively, the UK’s oil and gas production targets as described in the “Vision 2035” scenario of the OGA’s 2019 Corporate Plan, which was “co-created with industry”, would not be aligned, as these show smaller decreases of 22% and 28%, respectively, between 2020 and 2030¹⁵. Consequently, there also needs to be consistency and transparency around exactly which UK production outlooks and plans are used to inform such a “production gap” checkpoint assessment.

As another illustrative example, the UK government could decide to take an even more conservative approach on the future feasibility of CDR¹². While the majority of the “Below 1.5°C” scenarios of the IPCC SR1.5 rely on very small amounts of future CCS coupled to fossil fuel use (hence their median appears close to zero in Figure 2d), they do generally rely on substantial amounts of CDR via BECCS and afforestation (Figures 2e-f). The less carbon dioxide removal that can be deployed at scale in future years, the faster and greater that oil and gas supply and demand must decline even more than the illustrative numbers above. Additionally, as we previously discuss, except for one 1.5°C-warming scenario that relies on significant amounts of CDR via direct air capture, all other scenarios show steep, near-term reductions in global methane emissions from all sources (including from the oil and gas sector) alongside declines in coal, oil, and gas supply and demand.

4. The importance and implications of considering equity and the principle of Common but Differentiated Responsibilities and Respective Capabilities

At the same time, and regardless of which precise mitigation scenarios are used to evaluate the Production Gap in the discussion above, there are growing calls from government officials and civil society for an equitable and just transition away from fossil fuel extraction^{16,17}. A number of scholars have begun exploring approaches and principles for sharing a limited budget of fossil fuel extraction, many of whom have emphasised the importance of considering equity principles^{2,18-24}. For example, Caney (2016)¹⁹ proposed three criteria for defining an equitable allocation: a country's level of development, its historical responsibility in terms of past extraction and benefits accrued, and the availability of other resources for development. Muttitt and Kartha (2020)²³ proposed five principles, which include suggestions that countries that are least dependent on extraction and have the greatest capacity to transition should decrease production faster than others. Our previous analysis²⁵ has also shown that, based on current economic trends and without new policy interventions, the trajectories of oil and gas production over the next two decades in countries with the highest income level would exceed global pathways consistent with limiting warming to 1.5°C. The same is true for countries with the lowest level of fossil fuel revenue dependence. If not actively and internationally managed, a global wind-down of production in line with international climate goals could therefore be highly inequitable among countries.

The UK is a “high-income”²⁶ country with a relatively low dependence on oil and gas revenues^{2,23}, and is historically the 15th and 9th largest oil and gas producer, respectivelyⁱⁱⁱ. Given that the UK considers itself a “climate leader”²⁷ and has, along with other Parties, committed to “the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances” under the Paris Agreement, it may be incumbent upon a country like the UK to commit to a wind down of national oil and gas production that is even faster than the global average decline rates consistent with limiting warming to 1.5°C. Translating equity principles into a specific, faster decline rate is a challenging endeavour. Until this can be accomplished, low-dependence, high-capacity countries like the UK could opt for the most precautionary of the 1.5°C-consistent scenarios with respect to oil and gas production.

5. Evidence that reducing UK production may affect other producers and reduce global consumption

The BEIS consultation document describes a potential “con” of considering the global production gap as being “not evident that [reducing oil and gas production] would have any impact on other producers. It would certainly increase UK imports over time, particularly of gas. This could increase overall global emissions (depending on the source)”.

We understand the concern here to be that, were the implementation of the climate compatibility checkpoint to reduce UK oil and gas production to levels lower than they otherwise would be (without the checkpoint), that it is not evident to BEIS that this outcome would reduce *overall* (i.e. global) production and consumption of these fuels.

Here, we would like to offer some evidence that, indeed, reducing the UK's oil and gas production *would* lead to net decreases in global emissions of these fuels. Namely, there is considerable empirical research on the relationship between fossil fuel supply, prices, and consumption to establish that, indeed, a reduction in supply will increase prices and, in turn, reduce consumption²⁸⁻³⁰. In simple terms this means that, for each unit of oil or gas production not produced by the UK (relative to the scenario without the checkpoint), other producers would *not* substitute for all of the avoided production, and global oil or gas production levels *would* decrease. The exact amount of the decrease is, of course, subject to uncertainty^{31,32}, but the direction of the effect on consumption is unambiguous.

Along these lines, one way to think about potential reductions in oil and gas production within the UK could be to counteract emissions leakage due to implementation of climate policy within the UK. Namely, as the UK ramps down its oil and gas consumption, some of that oil and gas will, nonetheless, be consumed elsewhere, somewhat counteracting the global emissions benefit of the action taken within the UK. Efforts to ramp down production at similar ambition to consumption could help counter-act this emissions leakage^{31,33,34}.

ⁱⁱⁱ Based on our own analysis, using data from Rystad Energy, for production between 1900 and 2018.

Furthermore, the need to take into account the global market effects of fossil fuel supply decisions is increasingly being recognized by the courts³⁵. For example, the largest oil and gas leasing sale in United States government history was recently overturned for failing to account for these effects³⁶, a decision that drew on an earlier, appeals-court decision³⁷. Similarly, the District Court of the Hague ruled that Royal Dutch Shell must cut its CO₂ emissions by 45% by 2030, compared to 2019 levels³⁸. This includes the emissions associated with burning oil and gas (“scope 3” emissions), and therefore, in effect, is a ruling that Shell must reduce its fossil fuel production. In making the decision, the judge criticized Shell’s experts for “not [taking] account of the causal relationship between production limitation and emission reduction”, directly quoting the Production Gap Report in response. (One of us, Peter Erickson, submitted an expert letter to the court on this topic³⁹.)

Lastly, we do not dispute that reducing UK oil and gas production would increase UK reliance on imports, on a proportional basis. For example, as shown in Figure 2 of the consultation document, net imports (the difference between demand and production) would become an increasing fraction of demand. However, even in that outcome, *absolute* imports of both oil and gas would still decline markedly. Regardless, we see little scientific basis for using import balance as a criterion in assessing any production gap criterion.

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