Calculation of a carbon budget for Norway and comparison with the embedded emissions in resource estimates for the Barents Sea South and the Barents Sea South-East

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1. Introduction

I have been given the following mandate:

In the context of the proceedings of Greenpeace Nordic and others v. Norway (app. no. 34068/21) before the European Court of Human Rights, the applicants (Greenpeace Nordic, Nature and Youth Norway and six individual applicants) are seeking an expert analysis of the carbon budget for Norway for holding the global temperature increase to 1.5 °C, as compared to the emissions embedded in the estimated resources for the Barents Sea South (BSS) and the Barents Sea South-East (BSSE), set out in the tables below. The resource estimates derive from St. Meld. 40 (1988-1989) p. 14 (BSS), St. Meld. 36 (2012-2013) p. 6 (BSSE). They have been converted to million ton CO2 (MtCO2) using the Norwegian Statistical Bureau's emission factors, available here: https://www.ssb.no/_attachment/404602/ utslippsider_2020.

Barents Sea South	*Resource estimate, bill. t. o.e.*	*Assuming 20% oil, MtCO2*	*Assuming 80% gas, MtCO2*	*Total MtCO2*
Minimum	*1.0*	*652*	*2228*	*2880*
Median	*1.8*	*1174*	*4010*	*5184*
Maximum	*2.2*	*1435*	*4910*	*6336*

Barents Sea South-East	*Resource estimate, mill Sm3. o.e.*	*17% oil, MtCO2*	*83% gas, MtCO2*	*Total MtCO2*
Minimum	*55*	*25*	*107*	*132*
Median	*300*	*137*	*585*	*722*
Maximum	*565*	*258*	*1369*	*1627*

An earlier production scenario for the Barents Sea South-East assumed a low and high production scenario at 45 and 165 mill. Sm3 o.e. The scenario assumed 17 % oil and 83 % gas. This corresponds to 106.9 and 388.0 MtCO2, respectively.

Barents Sea South-East	*Scenario, mill. Sm3 o.e.*	*17% oil, MtCO2*	*83% gas, MtCO2*	*Total MtCO2*
Low scenario	*45*	*39.6*	*67.3*	*106.9*
High scenario	*165*	*118.7*	*269.3*	*388.0*

The applicants ask the undersigned to answer the following questions, based on best available science:

1. *What was the remaining carbon budget for Norway as of 2016 to limit warming to 1.5 °C with a 50%, 67% and 83% likelihood?*
2. *Would the embedded emissions in the estimated resources in the Barents Sea South and the Barents Sea South-East overshoot this budget, and, if so, by what ratio?*
3. *Would the embedded emissions in the previous production scenario for the Barents Sea South-East overshoot this budget, and if so, by what ratio?*

2. Calculation of an equal per capita budget for Norway as of 2016.

The remaining carbon budget at the global level is determined by physical considerations and presented in successive reports of Intergovernmental Panel on Climate Change (IPCC) for various likelihoods of staying below a given global warming thresholds, including 1.5 °C. Calculating the carbon budget of a single country, including for courts, requires considering its fair share of the globally needed emissions mitigation efforts, in light of the Paris Agreement objectives as the latest IPCC report highlights: "Equity and fairness concerns are being raised in national and regional courts that are increasingly being asked to determine if the climate actions pledged by states are adequate in relation to their fair share, as it is only in relation to such a 'fair share' that the adequacy of a state's contribution can be assessed in the context of a global collective action problem."[1] Emissions budgets are used as indicators of fair and adequate distribution of mitigation efforts across countries. Using an equal per capita allocation of the global carbon budget does not account for prior responsibility of countries, or their capabilities, recognised in the Paris Agreement's article 2 as "Common But Differentiated Responsibilities and Respective Capabilities" (CBDR-RC). Accounting for Norway's responsibility and capability would result in a lower CO2 budget given Norway's above average historical emissions and financial capability. While the Paris Agreement does not specify a formula to account for countries' responsibility and capability, an overshoot of an equal per capita budget for Norway implies an even greater overshoot of a budget accounting for its responsibility and capability. As an example, the recent report from the European Scientific Advisory Board on Climate Change relies on methods to scale the equal per capita carbon budget based on countries' responsibilities and capabilities[2]. The results presented here can therefore be seen as more generous to Norway than the accounting of responsibility and capability. Then, while the equal per capita approach cannot capture what is a fair distribution of mitigation effort in light of the Paris Agreement's article 2, a breach of the equal per capita carbon budget can unambiguously be characterised as an even greater breach of a carbon budget that includes fairness considerations of responsibilities and capabilities.

The choice of 2016 as a starting point for the calculation of remaining budgets reflects the information available as of 2015 when the Paris Agreement was adopted. Calculating a more recent equal per capita budget is possible, and would be smaller, but it would not allow for accounting of national responsibility for emissions since the Paris Agreement was adopted. Updating national budget calculations annually based on a formula that does not fully account for historical responsibility, such as the equal per capita approach here, would reward inaction and high-emitting countries. Note that this report uses the latest carbon budget presented by the IPCC in its 6th Assessment Report, but carbon budgets were available in previous IPCC reports, including the 5th Assessment Report published in 2013.

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[1] Page 1468 of Patt, A., L. Rajamani, P. Bhandari, A. Ivanova Boncheva, A. Caparrós, K. Djemouai, I. Kubota, J. Peel, A.P. Sari, D.F. Sprinz, J. Wettestad, 2022: International cooperation. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera,
M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.016

[2] European Scientific Advisory Board on Climate Change, Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050. https://climate-advisory-board.europa.eu/reports-and-publications/scientific-advice-for-the-determination-of-an-eu-wide-2040/ [Accessed August 11 2024]

An equal per capita allocation of the remaining global carbon budget yields the following for Norway as of 2016 (see section 3. Methods):

- 289 MtCO2 for the 83% likelihood of limiting global warming to 1.5 °C,
- 359 MtCO2 for the 67% likelihood,
- 429 MtCO2 for the 50% likelihood.

These emissions budgets have been produced using the global carbon budget and population data, and do not rely on national emissions data. As such, these budgets can be used in various ways to inform or understand countries' responsibility over emissions. Different types of carbon accounting take various approaches to determining a country's responsibility for emissions while avoiding double-counting, including production-based accounting (that is territorial), extraction-based accounting and others[3]. All accounting methods reflect various aspects of countries' shared responsibilities over emissions sources. This report does not assume or recommend a specific carbon accounting approach for Norway. Instead, this report simply provides a comparison of how the embedded emissions in the resource estimates from the BSS and BSSE compare with the equal per capita carbon budget for Norway.

In order to provide a comparison with the data provided in the request, I show the ratio of emissions embedded in the resource estimates provided in the request over those of the emissions budget. A ratio below 1 implies no overshoot, and indicates the fraction of the budget that the projects are expected to represent. In the tables below, the data provided in the request is shown in black and the comparisons to the emissions budgets derived in this report are shown in red.

Barents Sea South	**Total MtCO2**	**Ratio to 50% budget**	**Ratio to 67% budget**	**Ratio to 83% budget**
Min	2880	6.71	8.02	9.97
Median	5184	12.08	14.44	17.94
Max	6336	14.77	17.65	21.92

Barents Sea South East	**Total MtCO2**	**Ratio to 50% budget**	**Ratio to 67% budget**	**Ratio to 83% budget**
Min	132	0.31	0.37	0.46
Median	722	1.68	2.01	2.50
Max	1627	3.79	4.53	5.63

Barents Sea South East	**Total MtCO2**	**Ratio to 50% budget**	**Ratio to 67% budget**	**Ratio to 83% budget**
Low scenario	106.9	0.25	0.30	0.37
High scenario	388.0	0.90	1.08	1.34

We can see that the embedded emissions in the resource estimates from the BSS and BSSE greatly overshoot Norway's equal per capita carbon budget. Comparing these embedded emissions to Norway's carbon budget, even the minimum emissions estimates from these projects would jointly overshoot Norway's carbon budget (as of 2016) by more than ten times (or 1000%).

[3] Steininger, K., Lininger, C., Meyer, L. *et al.* Multiple carbon accounting to support just and effective climate policies. *Nature Clim Change* **6**, 35–41 (2016). https://www.nature.com/articles/nclimate2867

According to data recently used in a Norwegian Official Report[4], the combustion emissions from Norwegian oil and gas from 2016 to 2022 were about 3218 MtCO2, which overshoots the equal per capita budget based on an 83% likelihood of limiting global warming to 1.5 °C with a ratio of more than 11.13, the budget based on a 67% likelihood with a ratio of 8.96, and the budget with a 50% likelihood with a ratio of 7.50.

It is important to note that while the budget was allocated here as of 2016, as a reference point regarding the obligations of Norway under the Paris Agreement, it has shrunk since then given emissions since 2016. The latest update of the IPCC global carbon budget from a recent study[5] (2023), shows that the 1.5 °C budget is now 247 GtCO2 for a 50% likelihood, 60 GtCO2 for 66% and -166GtCO2 for 83%. The budget is already exceeded to secure an 83% chance of staying below 1.5 °C. It should also be noted that Norway's emissions have accumulated since 2016. According to the European Environment Agency, the cumulative net emissions for Norway (not including international aviation and transport) from 2016 until 2022 is: 202.864 MtCO2.

Overall, these findings are consistent with findings at the global level highlighting that the oil and gas already being exploited are sufficient for the needs of a transition to limit global warming to 1.5 °C. The exploitation of additional fields would cause additional harm from global warming, and is found to be inconsistent with limiting global warming to 1.5 °C. Looking at current production plans, the UNEP Production Gap Report 2023 states: "governments are planning on producing around 110% more fossil fuels in 2030 than would be consistent with limiting warming to 1.5°C, and 69% more than would be consistent with limiting warming to 2°C".[6] The Summary for policymakers from the last IPCC report[7] (approved by the Norwegian government and all other country Parties): "Estimates of future CO2 emissions from existing fossil fuel infrastructures without additional abatement already exceed the remaining carbon budget for limiting warming to 1.5 °C (50%) (high confidence)."[8]

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[4] NOU 2023: 25, The transition to low emissions — Climate policy choices towards 2050, Official report by a committee appointed by Royal Decree on 13 August 2021, Submitted to the Ministry of Climate and Environment on 27 October 2023, p. 225, figure 12.1 with further references to the Norwegian Petroleum Directorate and Andrew, R. (2021). Norway's emissions exports, available at: https://folk.universitetetioslo.no/roberan/t/export_emissions.shtml

[5] Lamboll, R.D., Nicholls, Z.R.J., Smith, C.J. *et al.* Assessing the size and uncertainty of remaining carbon budgets. *Nat. Clim. Chang.* **13**, 1360–1367 (2023). https://www.nature.com/articles/s41558-023-01848-5

[6] UNEP, 2023 (8 November), Production Gap Report 2023, 'What's new in this year's report?': https://www.unep.org/resources/production-gap-report-2023 [Accessed August 11 2024]

[7] Page 20 of IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

[8] In chapter 6 of its WGIII report, the IPCC explains: "The physical infrastructure includes all the infrastructure and equipment used to extract, transform, transport, transmit, and convert energy to provide energy services." in Clarke, L., Y.-M. Wei, A. De La Vega Navarro, A. Garg, A.N. Hahmann, S. Khennas, I.M.L. Azevedo, A. Löschel, A.K. Singh, L. Steg, G. Strbac, K. Wada, 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change[P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.008.

3. Methods

As a starting point, I use the global carbon (CO2) budget for 1.5 °C from the IPCC Working Group I Summary for Policy Makers[9]. The global carbon budget remaining depends on the likelihood with which the warming threshold is expected to be respected. From the 1st of January 2020, the remaining global carbon budget is 300 GtCO2 for 83% chance of staying below 1.5°C, 400 GtCO2 for 67% chance of staying below 1.5 °C (defined as likely in the IPCC reports), and 500 GtCO2 for 50% chance of staying below 1.5 °C.

We then convert this to a budget from the 1st Jan 2016, following the Paris Agreement, by adding global CO2 emissions between 2016 and 2020 i.e. 160 GtCO2. This gives a global carbon budget of 460 GtCO2 for a 83% likelihood of staying below 1.5, 560 GtCO2 for a 67% likelihood, and 660 GtCO2 for a 50% likelihood, from 1st Jan 2016.

The global carbon budget to be shared across countries should also exclude the emissions scope that does not fall within countries' borders and national emissions reporting, namely emissions from international aviation and shipping. The average of the very low (SSP1-1.9) and low (SSP1-2.6) emissions scenarios[10] from the latest Coupled Model Intercomparison Project[11], which were also widely used in the Physical Science (WG1) Contribution to the latest IPCC report (see, for example, Table SPM.1 of WG1's Summary for Policy Makers[12]), indicates that international aviation and shipping will contribute to 46 GtCO2. Given the strong mitigation assumed in these scenarios, this estimate may be lower than the space expected to be taken by international aviation and shipping and may be considered conservative. The remaining global carbon budgets as of 2016, excluding international aviation and shipping are:

- 414 GtCO2 for the 83% likelihood of limiting global warming to 1.5 °C,
- 514 GtCO2 for the 67% likelihood,
- 614 GtCO2 for the 50% likelihood

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[9] Table SPM.2 page 29 of IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3−32, doi:10.1017/9781009157896.001

[10] Riahi, K., Van Vuuren, D.P., Kriegler, E., Edmonds, J., O'neill, B.C., Fujimori, S., Bauer, N., Calvin, K., Dellink, R., Fricko, O. and Lutz, W., 2017. The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. Global environmental change, 42, pp.153-168.
Van Vuuren, D.P., Stehfest, E., Gernaat, D.E., Doelman, J.C., Van den Berg, M., Harmsen, M., de Boer, H.S., Bouwman, L.F., Daioglou, V., Edelenbosch, O.Y. and Girod, B., 2017. Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm. Global Environmental Change, 42, pp.237-250.
O'Neill, B.C., Kriegler, E., Ebi, K.L., Kemp-Benedict, E., Riahi, K., Rothman, D.S., Van Ruijven, B.J., Van Vuuren, D.P., Birkmann, J., Kok, K. and Levy, M., 2017. The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. Global environmental change, 42, pp.169-180.

[11] Tebaldi, C., Debeire, K., Eyring, V., Fischer, E., Fyfe, J., Friedlingstein, P., Knutti, R., Lowe, J., O'Neill, B., Sanderson, B. and Van Vuuren, D., 2021. Climate model projections from the scenario model intercomparison project (ScenarioMIP) of CMIP6. Earth System Dynamics, 12(1), pp.253-293. O'Neill, B.C., Tebaldi, C., Van Vuuren, D.P., Eyring, V., Friedlingstein, P., Hurtt, G., Knutti, R., Kriegler, E., Lamarque, J.F., Lowe, J. and Meehl, G.A., 2016. The scenario model intercomparison project (ScenarioMIP) for CMIP6. Geoscientific Model Development, 9(9), pp.3461-3482.

[12] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K.Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3−32, doi:10.1017/9781009157896.001.

In 2016, Norway's population was 5.235 millions, that is about 0.07% of a global population of 7491 millions. An equal per capita allocation of the remaining global carbon budget yields the following for Norway as of 2016:

- 289 MtCO2 for the 83% likelihood of limiting global warming to 1.5 °C,
- 359 MtCO2 for the 67% likelihood,
- 429 MtCO2 for the 50% likelihood.

4. Datasets used

Regarding the population data, I use 2016 carbon emissions and population data for all calculations of countries' fair shares. The population data is from the World Population Prospect from the United Nations[13].

I use historical carbon emissions data from the peer-reviewed composite aggregation of emissions data PRIMAP-hist v2.4.2 and specifically its dataset prioritising country reported data (named HISTCR)[14]. The data used reflects the latest available data for national emissions reporting and remaining carbon budgets as per the IPCC.

Regarding the national emissions data for Norway, I use the official data reported by Norway and compiled by the European Environment Agency[15] that Norway is a member of. The cumulative net emissions for Norway (not including international aviation and transport) from 2016 until 2022 is: 202.864 MtCO2.

Dr. Yann Robiou du Pont

[13] United Nations, Department of Economic and Social Affairs, Population Division (2022). World Population Prospects 2024, Online Edition. https://population.un.org/wpp/ and https://data.worldbank.org/indicator/SP.POP.TOTL [Accessed August 11 2024]
[14] Gütschow, J.; Pflüger, M. (2023): The PRIMAP-hist national historical emissions time series v2.4.2 (1750-2021). zenodo. doi:10.5281/zenodo.7727475
[15] EEA greenhouse gases — data viewer, online at https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer [Accessed August 11 2024]