TRENDS IN ARCTIC OIL AND GAS PRODUCTION AND ASSOCIATED EMISSIONS

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Synopsis[1]

This research brief continues the series of publications produced by the WWF Global Arctic Programme on the impacts of the Arctic's oil and gas sector on its nature and climate. Similarly to the previous research brief, published on December 1, 2023, this paper addresses scope 3 emissions from fossil fuel products extracted in the Arctic. This paper also looks at scope 3 emissions - indirect, downstream emissions from the global burning of fossil fuels produced in the Arctic. New in this brief is also a discussion around the direct emissions from fossil fuel extraction and production (scope 1 emissions), namely methane and black carbon from the routine flaring of natural gas.

New findings (2024)

In 2023, the overall production of fossil fuels in the Arctic dropped by 6 per cent versus the year before, largely due to a decrease in Russia's production volumes.

Despite this drop, Russia increased its routine gas flaring by roughly 10 per cent, resulting in an increase in its methane emissions that come from the oil and gas sector.

The projections for Norway's Arctic future production volumes increased, partly due to new oil and gas exploration planned for Norway's continental shelf. A second peak in Norway's Arctic production is now expected from 2035 to 2037.

Findings that are consistent with our previous research brief (2023)

Under the "business as usual" scenario, oil and gas production in the Arctic is still expected to continue to rise until at least the early 2040s.

In 2024, all Arctic nations continued to issue new exploration licences, including in the frontier and ecologically sensitive areas that were previously considered unfit or uneconomical for fossil fuel projects.

[1] The author thanks Tord Lauvland Bjørnevik (WWF Norway) and to Systemic Conservation Consultancy for their valuable contribution to this research brief.

1. Introduction

The context

Climate-induced changes in the Arctic region, defined as the area north of 65.5°N, are rapid and visible. The region has warmed at three to four times the global average rate, leading to unprecedented temperature increases, rapid loss of summer sea ice, and ocean acidification. When permafrost thaws, it stops serving as a natural carbon sink and instead becomes a source of carbon and methane emissions. In addition, the Arctic Ocean is acidifying rapidly in response to increasing global carbon emissions, and its sea ice extent is declining, spelling trouble for species that depend on ice and for Indigenous coastal communities, which are experiencing amplified coastal flooding. The accelerating warming is also melting the Greenland Ice Sheet and Arctic glaciers, raising sea levels worldwide.[2] Current trends indicate that several global tipping points, including melting of the Greenland Ice Sheet, and thawing permafrost, are fast approaching, with potentially catastrophic consequences for humanity and the planet.

The rapid changes affecting Arctic marine and terrestrial ecosystems are driven by the planetary climate crisis—itself caused by anthropogenic emissions that include, along with carbon dioxide, short-lived climate forcers (SLCFs), such as black carbon and methane. SLCFs have particularly powerful warming effects. The oil and gas sector is a significant source of these emissions in the Arctic due to gas flaring and leakages along their production chains.

The year 2023 was marked by two notable developments that have repercussions for the global and Arctic climate.

On the one hand, the world witnessed a record volume in fossil fuel use that resulted in the largest-ever volumes of energy-related carbon emissions from energy combustion, industrial processes and gas flaring.[3] Likewise, global oil production volumes grew by 1 per cent versus the previous year.[4] On the other hand, in 2023, national governments made a historic commitment to "transitioning away from fossil fuels" during the 28th meeting of the Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC) in Dubai.

Against this backdrop, humanity seems to be at a critical threshold: committing to the path of energy transition for all the right reasons, yet not taking the decisive steps needed to follow the path. Doing so would require, among other measures, adopting national plans to phase out the production of fossil fuels and make a rapid and equitable transition to renewable energy. The Intergovernmental Panel on Climate Change has concluded that if the world is to stay within a 1.5°C increase, global emissions must drop by at least 43 per cent by 2030 versus 2020 levels and reach net zero by 2050.[5]

To achieve this, governments would need to end all new developments of oil and gas fields immediately and stop issuing new exploration licences. This would ensure that no new hydrocarbons are extracted beyond the existing fields.

Instead, the world's total production is on a path to peak around 2030—and for the Arctic region, fossil fuel production is expected to continue rising until 2040 and beyond. The governments of Norway, Russia

[2] WWF, 2024.
[3] EIA, 2024 and UNEP, 2024.
[4] World Bank, 2024.
[5] Intergovernmental Panel on Climate Change (IPCC), 2023.

and the US—the countries that have producing fields above the Arctic Circle—have all continued to issue exploration licences for new oil and gas projects.

Methodology

This research brief offers an analysis that draws on two primary data sources and two spatial databases. To project fossil fuel volumes that will be produced in the Arctic up to 2050, we used the Rystad Energy asset-based database as our primary data source. These data are current to September 2024.[6]

In addition, we have obtained data about flaring sites and associated methane emission volumes from the World Bank's Global Gas Flaring Tracker and have juxtaposed these against the location of Arctic oil and gas production sites (from Rystad) and ArcNet-Geranium. The latter is a tool based on priority areas of conservation as identified in the Arctic conservation planning database developed by the WWF Global Arctic Programme.

2. An overview of oil and gas projects in the Arctic region and their impacts

The Arctic region contains about 13 per cent (90 billion barrels) of the world's undiscovered oil and 30 per cent of its undiscovered gas resources.[7] Not all of these are economically recoverable due to uncertainty about future oil prices and the high cost of developing Arctic hydrocarbons.[8]

In 2023, 2,978 million barrels of fossil fuels (oil and the oil equivalent of natural gas) were produced in the Arctic. This was 6 per cent less than the year before, mostly due to a decrease in Russia's fossil fuel production in the region. Nevertheless, Russia remained by far the largest producer of hydrocarbons in the Arctic that year, producing over 90 per cent of fossil fuels in the Arctic (both oil and gas, measured by oil equivalent). Russia was followed by the US (Alaska), with 174 million barrels, and Norway's Arctic, with 97.4 million barrels. Russia has continued to dominate the production of fossil fuels in the Arctic by a magnitude of 28 to one compared to Norway and 15 to one compared to Alaska.

Russia's Arctic production takes place in the basins of two large northern rivers: the Pechora and Ob, which flow into the Barents and Kara seas. It is also developing a new oil project, known as Vostok Oil, in the basin of the Yenisey River. As shown on the map, the producing fields are surrounded by enabling fossil fuel infrastructure, including pipelines, ports, and oil and/or liquid natural gas (LNG) terminals.

In Alaska, oil production takes place in the coastal areas of the North Slope adjacent to the Beaufort Sea. The Trans-Alaska pipeline, built in 1977, transports oil to markets from the Prudhoe Bay oil field. Alaska's oil production numbers will go up over the next few years due to the development of the ConocoPhillips mega-project—known as the Willow Project—on the Alaskan North Slope.

In Norway, Arctic oil and gas production comes from offshore fields located on the Norwegian continental shelf: two fields in the Barents Sea and one in the Norwegian Sea. The latter is connected by a pipeline to the larger network that delivers gas to European consumers and LNG facilities. A new large oil field that has been under development by Equinor (known as the Johan Castberg oil field) is scheduled to begin

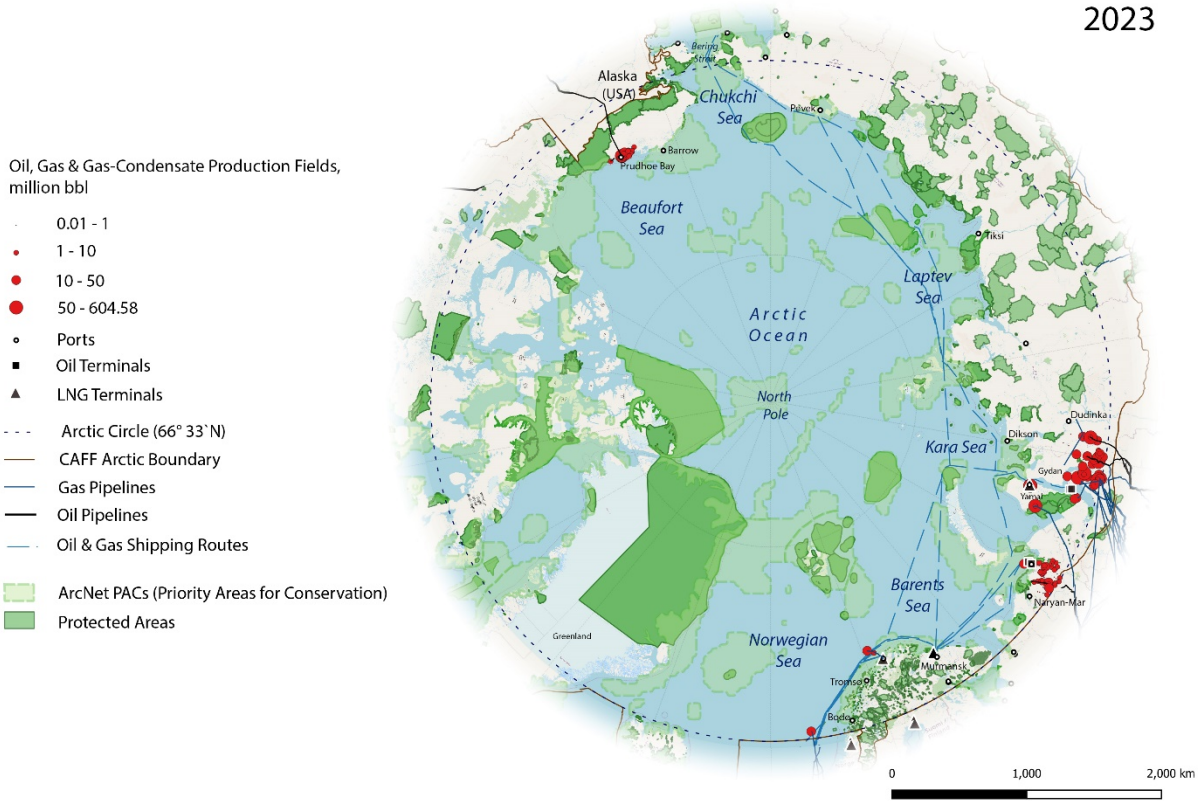
[6] These production models reflect Rystad's assumption that the benchmark Brent oil price will decline to around US$70 by 2026 and stay there until 2050, which is a higher estimate compared to that used in last year's projections.
[7] United States Geological Survey, 2008.
[8] According to the US government's Energy Information Administration (2012), the main reasons for these high development and operating costs are frigid temperatures, remote locations, poor soil conditions, lack of transportation infrastructure, and higher wages.

production near the end of 2024. It is located in the Barents Sea, 100 kilometres northwest of the Snøhvit Field. Johan Castberg's estimated potential is 450 to 650 million barrels, with a production lifecycle of 30 years. (Its production data were not yet captured in 2023 volumes.)

The impacts of fossil fuel production can be broken down into two main categories: direct impacts on climate and nature (attributed to emissions from oil and fuel production process, air, water and soil pollution, and underwater noise from offshore drilling and production); and indirect impacts from the transportation and burning of these fossil fuels and thus producing GHG emissions elsewhere, usually far away from their Arctic production sites. The latter are known as scope 3 emissions.

Among the most significant indirect impacts is the transportation of hydrocarbons to consumer markets. Most of the hydrocarbons produced in the Arctic are exported overseas via pipelines, oil tankers, and LNG carriers. Transporting fossil fuel by tankers and LNG carriers increases air and water pollution, underwater noise, and the likelihood of ship strikes involving marine mammals. Meanwhile, fossil fuel pipelines fragment species' habitats and pose the risk of leakages.[9]

Map 1: Arctic oil and gas projects and associated infrastructure



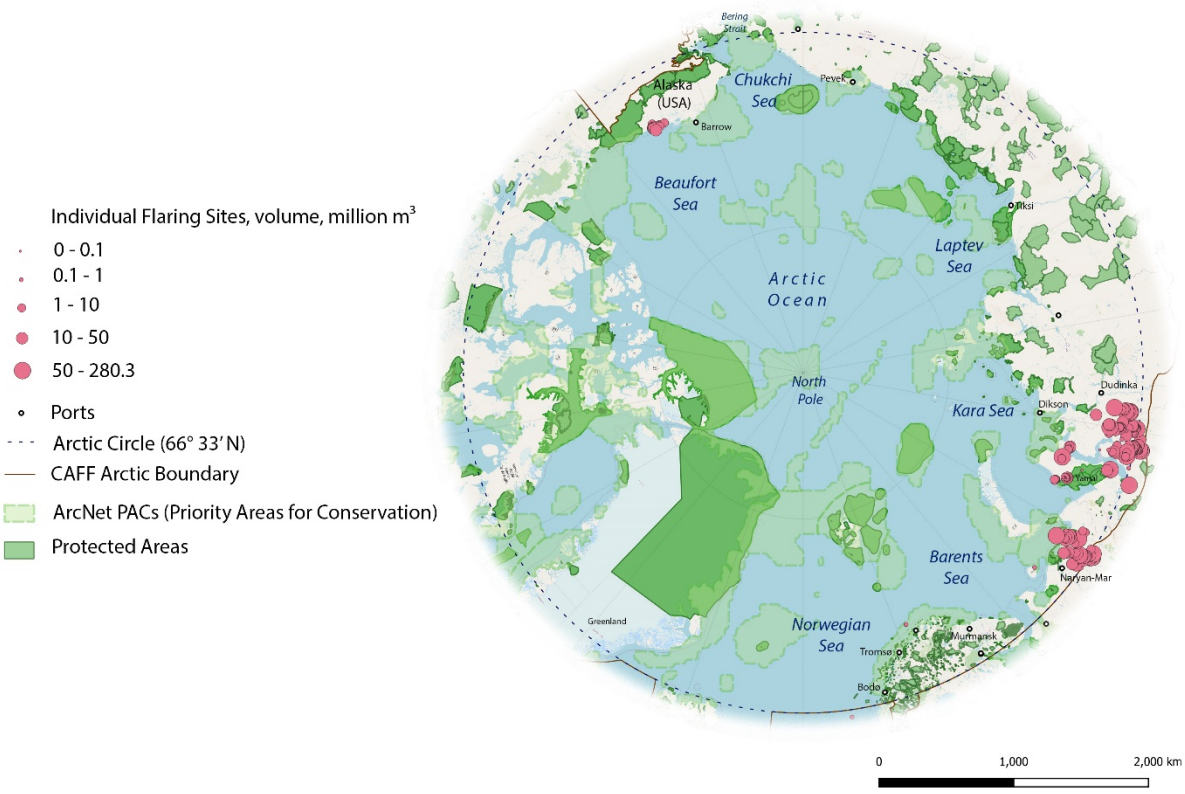
Sources: Oil and gas fields: Rystad, 2024; shipping routes: ASTD, 2023; oil and gas pipelines: Global Energy Monitor, Global Oil Infrastructure Tracker, May 2023 release.

[9] Tracy, E., 2021.

3. Methane and black carbon emissions from extraction (scope 1)[10]

The oil and gas sector is a significant emitter of SLCFs, such as methane and black carbon. These are characterized by short atmospheric lifetimes (relative to carbon dioxide) that can last from a few hours to two decades. In the Arctic, flaring of excess natural gas is a source of these SLCFs; methane is also emitted through purposeful venting and unintentional leaks along the production chain (known as fugitive emissions). Aside from wasting fuels that could have been used, SLCF emissions contribute significantly to climate change. In 2023, the global fossil fuel extraction sector accounted for 10 per cent of total greenhouse gas (GHG) emissions.[11] As a greenhouse gas, methane is considered a "super-pollutant" because it is more than 80 times more potent in trapping heat than carbon dioxide during its first 20 years in the atmosphere.[12] As a result, it is responsible for almost one-third of global warming. Meanwhile, black carbon emissions, more commonly known as "soot," are particularly detrimental to Arctic environments: when soot settles on a surface, it increases the rate of ice and snow melting. It can also cause health problems.

Map 2: Routine flaring sites in the Arctic



[10] Scope 1 emissions refer to direct emissions from the sources that are owned or controlled by the fossil fuel producer (company).
[11] United Nations Environment Programme, 2024.
[12] White House, 2022.

Sources: Flaring sites: Global Gas Flaring Tracker, World Bank, 2024.

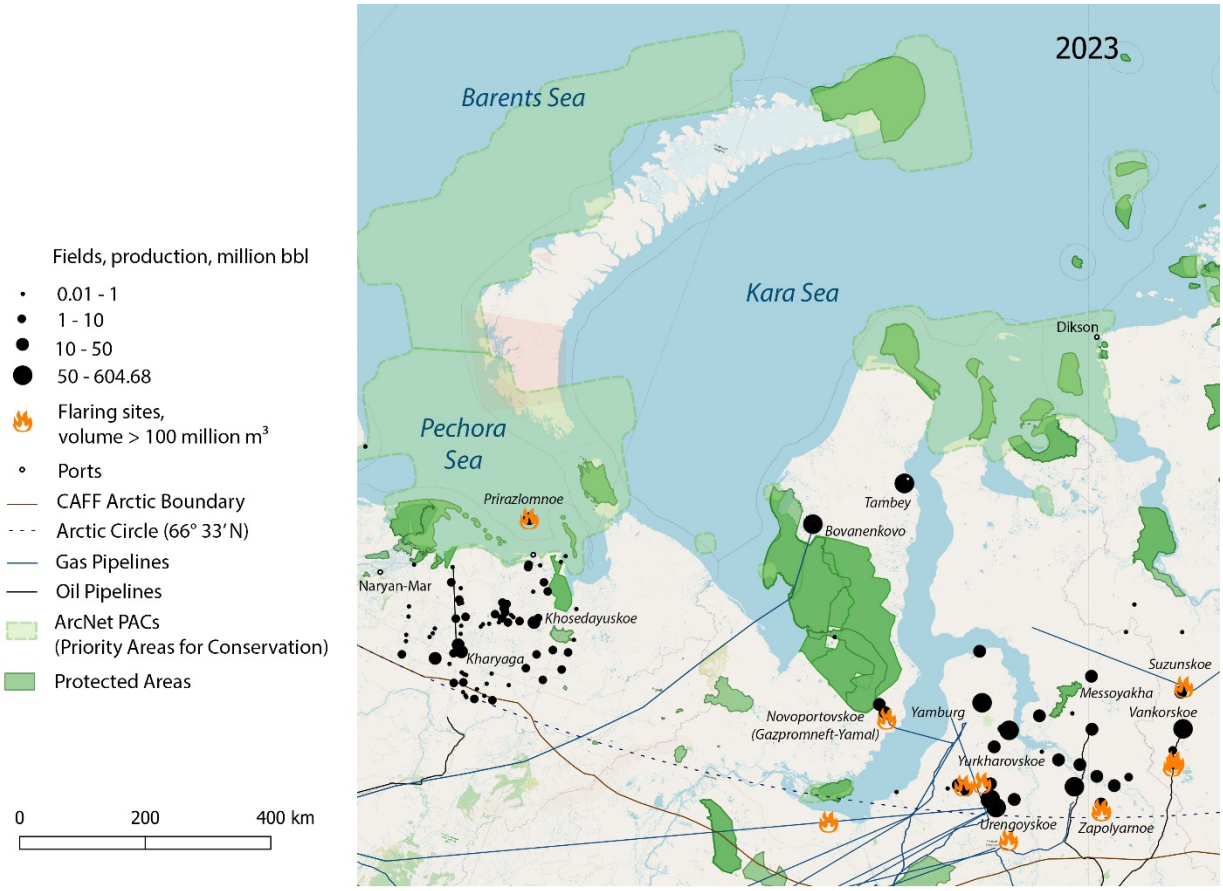
Flaring

During oil production, the associated natural gas is often flared (burned) for a number of economic, regulatory or technical reasons. According to World Bank estimates, 148 billion cubic metres of gas was flared globally in 2023 (a 7 per cent increase over the previous year), equivalent to 381 million tonnes of carbon dioxide emissions. Arctic states contributed 39 billion cubic metres, and about 10 per cent of these (i.e., 4 billion cubic metres) were flared above the Arctic Circle, nearly all in the Russian Arctic.

According to satellite images of routine gas flaring in the Arctic, the majority occur in Russia's Yamalo-Nenets and Nenets regions.

Map 3 depicts flaring sites that exceed 100 million cubic metres per year. A flaring site near Gazpromneft Yamal oil field appears to be the biggest source of flaring in the Arctic, with 264 million cubic metres annually. There is one significant offshore flaring, also in Russia, in Prirazlomnoye, Russia's only offshore gas platform in Arctic waters. It is operated by Gazprom and located in the continental shelf of the southeastern corner of the Barents Sea.

Map 3: Arctic routine flaring sites exceeding 100 million cubic metres per year



Sources: Flaring sites: World Bank, 2024, Global Gas Flaring Tracker; oil and gas fields: Rystad, 2024; oil and gas fields pipelines: Global Energy Monitor, Global Oil Infrastructure Tracker, May 2023 release.

Flaring volume data are also used as an indicator of the levels of and trends in black carbon emissions from the sector, even if these emissions are also influenced by combustion technologies and the properties of the gas flared. The global warming impacts of black carbon are sensitive to the location of the emission sources.

4. Indirect emissions from global burning fossil fuels produced in the Arctic (scope 3 emissions)[13]

While being disproportionately affected by increasing temperatures caused by anthropogenic GHG emissions, the Arctic region is also a source of these emissions. Oil and gas produced in Arctic onshore and offshore installations account for 5 to 10 per cent of the world's production. Because the majority of hydrocarbons produced in the Arctic are exported to overseas markets, their embodied emissions are also exported. Consequently, these emissions will not be captured in the producing country's national accounting emission systems. In other words, these emissions are unaccounted for from any country's perspective—yet they drive overall global emission levels.

It has been emphasized that emission reduction efforts must address energy production and consumption (supply and demand) simultaneously. Last year, WWF identified a gap between the levels of carbon emissions from burning fossil fuels produced in the Arctic region and the modelled pathways of emission reductions that are consistent with the need to limit global warming to 1.5°C.[14] According to the Rystad Energy asset-based database, oil and gas production in the Arctic region was expected to continue to rise until at least the late 2030s or early 2040s. Based on last year's projections, by 2050, the gap between Arctic fossil fuel production and the Paris-aligned reduction pathways could reach 700 per cent.

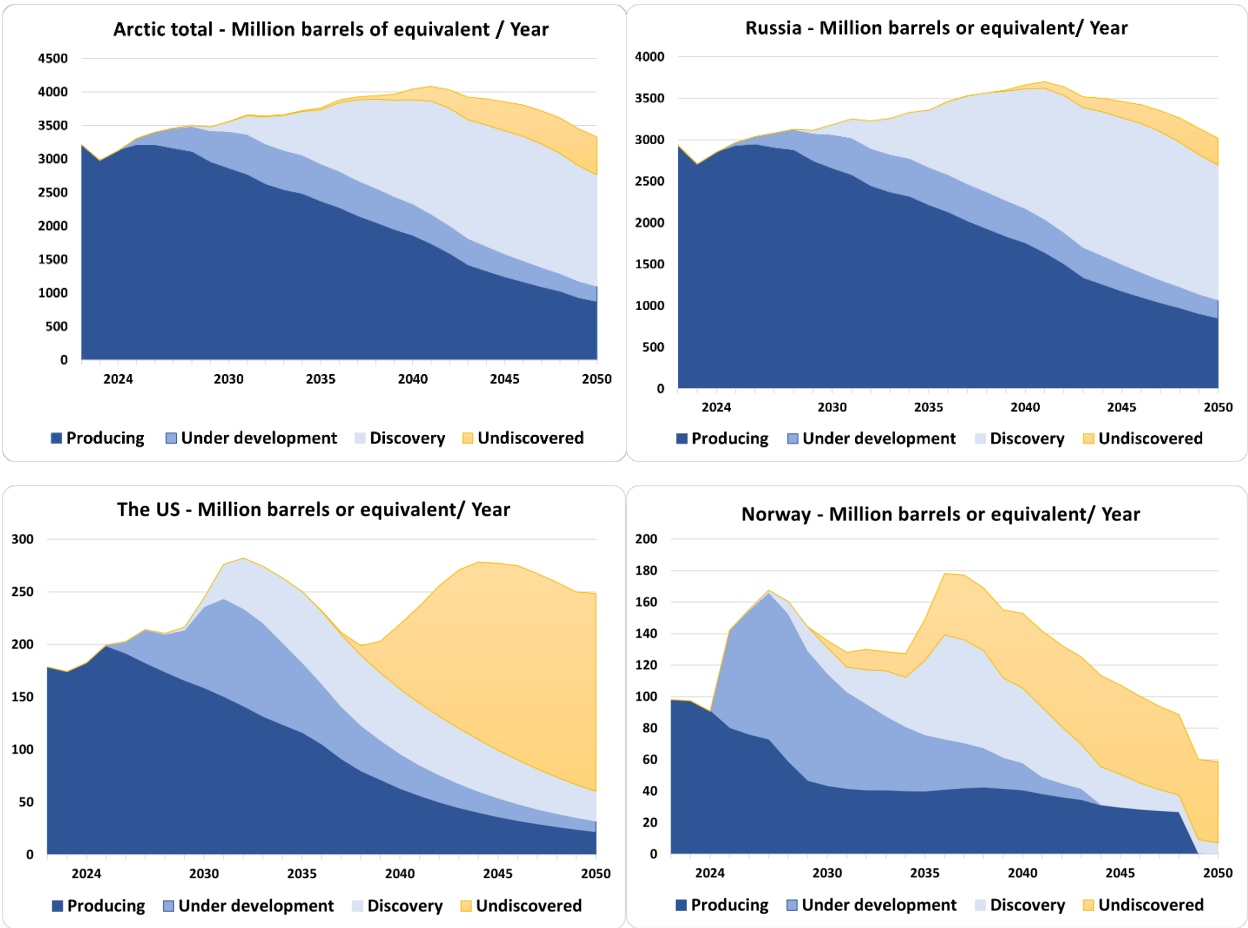
This year, we projected future production using the same models as the last year that are consistent with the Rystad framework.

The graphs showing the production projections (Picture 1) capture four licensed categories of fossil fuel reserves, reflecting a standard oil and gas extraction project lifecycle. The categories are:

- Currently producing reserves;
- Reserves under development after receiving final investment decisions;
- New reserves that have confirmed recoverable resources (commercial discovery) about which no investment decisions have been made yet;
- Reserves under exploration.

[13] Scope 3 emissions refer to indirect emissions that occur across the value chain and are outside the direct control of a producing company.
[14] WWF Global Arctic Programme, 2023.

Picture 1: Projections of Arctic fossil fuel production, 2024 to 2050



Source: Rystad Cube database, 2024.

Production levels from conventional oil and gas fields naturally decline by about 4 per cent per year as reservoir pressure decreases. Therefore, if no new fields are developed, production will decrease naturally and eventually come to a complete halt when the reserve is depleted. This is confirmed in the findings: the trajectory of currently producing fields declines steadily over time, replicating the shape of the 1.5°C–aligned trajectories.

In the case of Norway's production, the reserves of the currently producing fields in the Norwegian shelf—that is, the Goliat, Snøhvit and Aasta Hansteen fields—have expiry dates before 2050. In the case of Russia and the US, currently producing fields in the Arctic have longer lifespans and will run well beyond 2050, albeit at much lower levels than today.

In 2023, 2,978 million barrels (bbl) [15] of fossil fuels (oil and the oil equivalent of natural gas) were produced in the Arctic. Russia was by far the biggest producer in the region, responsible for more than 91 per cent (2,707 million bbl) of all Arctic-sourced oil and gas in 2022. Even if Russia were to develop no new reserves, by 2050 the expected volumes from currently producing and developed reserves will exceed the Paris-aligned targets by 200 to 300 per cent. To meet the Paris goals, Russia would need to prematurely shut down half of its currently producing oil and gas fields in the region.

[15] In the context of oil production, bbl stands for barrels. One bbl is equivalent to about 159 litres.

For Norway, this year's projections differ from last year's. In 2023, it was expected that Norway's production would peak by 2030 and then steadily decline. However, this year's projections show a different pattern: production now appears slated to peak prior to 2030, then drop by 2034 (the last year of operation for the Aasta Hansteen field), after which fossil fuel volumes coming from the Arctic area of the Norwegian continental shelf are expected to pick up again, with a second (and higher) peak expected from 2035 to 2037.

This double peak is partly because Norway's Ministry of Energy issued many exploration awards this year for areas in the country's Arctic waters, aiming to award new production licences at the beginning of 2025.[16] The ministry attributed the expansion of the licensing round in the North and the Barents seas to "gaining new geological knowledge" about the Norwegian continental shelf. Another factor influencing the increase in production projections is a higher estimate (versus last year) of future oil prices. These boosted the government's (and fossil fuel companies') optimism about the projects' long-term economic viability.

5. Discussion

The current trajectory of the fossil fuel industry's plans for production in the Arctic is inconsistent with the 2050 net-zero commitments made by the producers' respective governments under the Paris Agreement. Despite the 6 per cent drop in production volumes last year (because of Russia's decrease in production), the long-term trend is upward until the late 2030s to early 2040s, depending on the country. Despite the historic commitment last year at COP28 to transition away from fossil fuels, all Arctic governments have continued to issue new licences and awards for exploring new areas. This includes areas within sensitive Arctic ecosystems, onshore and offshore, including those that were previously deemed unfit or uneconomical for such projects. In addition, enduring optimism around future oil prices is influencing investors' decisions and driving projections up.

It takes an average of 20 years from the moment an exploration licence is granted to the start of production.[17] Consequently, the exploration activities that are being approved now will begin producing in the late 2030s and early 2040s, by which time—according to current plans—the world is expected to be in the full swing of the clean energy era. According to the International Energy Agency's *World Energy Outlook 2024,* clean energy is currently developing at an "unprecedented rate," with investments in clean energy projects approaching US$2 trillion per year. The trade in clean technologies is on track to reach US$575 billion by 2035, which is 50 per cent more than the current value of global trade in natural gas.[18]

If this trend continues, the reductions in the global demand for hydrocarbons will be imminent. The as-yet-unbuilt infrastructure to serve these future fossil fuel projects will become unprofitable, increasing the risk of stranded assets. In addition, the investment decisions made during the next decade with respect to new Arctic oil and gas fields (that are currently being explored for their commercial viability) risk locking in carbon emissions for decades.

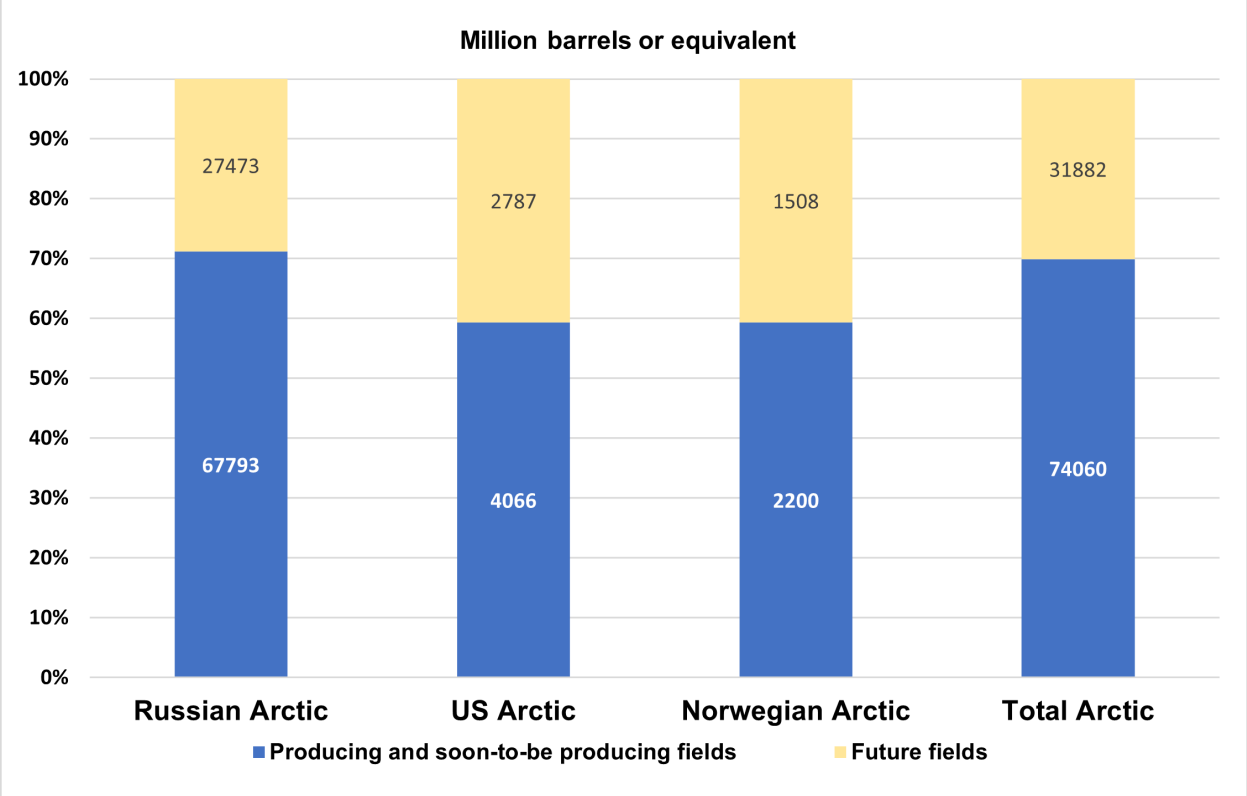
These investment decisions have not been made yet, even though several governments have issued approvals permitting companies to explore more Arctic areas for commercially viable reserves. For

[16] These are called "awards in predefined areas" (also known as APAs), an annual licensing round for the best-known exploration areas that have not been licensed yet. See this media release from the Norwegian government (September 6, 2024): https://www.regjeringen.no/en/aktuelt/21-companies-are-applying-for-new-exploration-areas/id3052458/.

[17] IEA, 2022.
[18] IEA. 2024.

Norway and the US (Alaska), almost 40 per cent of the total projected fossil fuel volumes produced between now and 2050 will come from fields that are currently in the “discovery” and “undiscovered” categories. For Russia, this share is 30 per cent (Picture 2). Because production in these fields is not imminent, these future projects—and the associated GHG emissions—can still be averted.

Picture 2: Comparing production volumes: producing or near-production fields versus future fields



Source: Rystad Cube database, 2024.

The fossil fuel sector’s optimism about continued growth in Arctic fossil fuel production is also reflected in the fact that no company operating in the region has established targets to reduce scope 3 emissions (although some have adopted targets and plans to reduce scope 1 emissions, including methane emissions).[19]

The fact that it remains optional for fossil fuel producers to report on scope 3 emissions when these account for 80 to 95 per cent of total emissions from oil and gas companies is a major obstacle when it comes to holding the sector accountable for its impact on the global climate.

The methane emissions associated with fossil fuel production, particularly with gas flaring and leakages, reached a record high in 2023, both around the world and in the Arctic. Russia broke its own record because of a significant (10 per cent) increase in routine flaring. It is likely to be a factor of several things, one of which is the deterioration and shortage of infrastructure needed to process and use the associated gas from oil-producing fields.

[19] Reporting on scope 1 emissions is becoming standard in the oil and gas industry.

Compared with Russia and other fossil fuel–producing nations, Norwegian fossil gas is relatively clean in terms of upstream CO_2 emissions. Similarly, the flared methane emissions from Alaska's Arctic operations in coastal areas of the North Slope, while notable, are dwarfed by the flaring volumes observed in Arctic Russia. Currently, Russia's methane emissions from routine gas flaring are far too high to meet international climate targets. To limit global warming to 1.5°C worldwide, methane emissions from the fossil fuel sector must decline by 75 per cent by 2030.

Norway and the US have rules or regulations in place that limit their methane emissions from oil and gas operations. For example, Norway has banned routine flaring and venting, imposed a tax on CO_2 emissions, and applies a specific tax rate for natural gas (in effect, a "methane tax"). The US introduced a methane emissions reduction plan in 2021, and its Environmental Protection Agency sets out standards for reducing methane from oil and natural gas facilities. In comparison, Russia is lagging in terms of adopting effective measures to regulate its methane emissions from the oil and gas sector. Given its outsized volume of fossil fuel production, it is now the world's largest emitter of methane from its oil and gas operations.[20]

Norway and the US are also among the Arctic nations that committed to the Global Methane Pledge, launched during COP26 to reduce methane by 30 per cent by 2030 versus 2020 levels. Russia—the biggest methane emitter in the Arctic oil and gas sector—has yet to make this commitment.

6. Conclusion

All Arctic fossil fuel–producing countries—Norway, the US and Russia—committed to the Paris Agreement, adopting national net-zero strategies to significantly reduce GHG emissions in the coming decades.[21] Under these commitments, these governments are required to prepare and submit to the UNFCCC a core element of their national climate plans: Nationally Determined Contributions (NDCs). The next submissions are due in February 2025 and should indicate more ambitious 2030 and 2035 targets as milestones for reaching net zero. It is imperative that these NDCs include a credible path towards phasing out fossil fuel production.

With these commitments in mind, we suggest the following recommendations:

- The NDCs of Arctic fossil fuel–producing nations should clearly indicate milestones related to winding down the production volumes of hydrocarbons, in line with these nations' net-zero strategies and the Paris Agreement reduction pathways. Otherwise, these governments' claims that their NDCs are aligned with the 1.5˚C pathways will remain hollow.
- Fossil fuel companies operating in the Arctic and elsewhere should start reporting their scope 3 emissions in order to fully account for their emission footprints.
- Russia should reduce and eventually eliminate its routine gas flaring because it is a significant source of methane, a potent greenhouse gas. This will help reduce GHG emissions from fossil fuel production and save a valuable economic resource that can be put to better use.
- Finally, and most importantly, there should be no new fossil fuel projects planned in the Arctic region from now on.

These measures will help the world return to a path that is more consistent with 1.5°C–aligned scenarios and safeguard pristine Arctic ecosystems that are vulnerable to the impacts of extraction.

[20] The World Bank, 2024.

[21] The US has strategies that aim for net zero by 2050. Norway has adopted "a low-emissions society" strategy that aims to reduce its GHG emissions by 90 to 95 per cent by 2050. Russia adopted a net-zero strategy that is to be achieved by 2060.

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