



RESEARCH BRIEF

MISSING THE TARGET

FOSSIL FUEL PRODUCTION IN THE ARCTIC IS OUT OF STEP WITH THE 1.5 °C-ALIGNED EMISSION REDUCTION GOAL

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Missing the target: Fossil fuel production in the Arctic is out of step with the 1.5°C-aligned emission reduction goal

Fossil fuel production in the Arctic is expected to peak in 2040 and by 2050, the target year of reaching net zero emissions. It could be four to seven times higher than the production volumes consistent with limiting global warming to 1.5°C.

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Summary

- In the absence of stronger climate policies, oil and gas production in the Arctic region are expected to continue to rise until at least the late 2030s or early 2040s. By 2050, the gap between Arctic fossil fuel production and the Paris-aligned reduction pathways could reach 700 per cent.
- In 2022, 3,177 million barrels of fossil fuels (oil and the oil equivalent of natural gas) were produced in the Arctic—about 5.5 per cent of the world's total production that year.
- Russia is by far the biggest oil and gas producer in the Arctic, producing over 91 per cent of all Arctic-sourced oil and gas in 2022. Overall, 80 per cent of the gas and 60 per cent of the oil produced in Russia are extracted in the Arctic region.
- Even if Russia does not develop 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.

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What's at stake?

The Arctic's ecosystems are changing rapidly because of the climate crisis. Warming almost four times as fast as the global average, the region has lost more than 40 per cent of its sea ice since 1972.² On land, permafrost thaw has caused significant changes in biodiversity and the food web and spurred the release of greenhouse gases (GHG) into the atmosphere. The climate crisis is the main threat to the Arctic region's unique ecosystems, which support abundant wildlife, including emblematic species like the polar bear, walrus and Arctic whales (bowhead, beluga and narwhal). Many of these ecosystems remain intact for now, but face an uncertain future.

The accelerating warming is also melting the Greenland Ice Sheet and Arctic glaciers, raising sea levels worldwide.³ To prevent catastrophic consequences, global warming must not exceed 1.5°C by 2100. Even a 1.8°C increase could result in a 6- to 9-metre rise in sea levels. A 3°C increase could bring a devastating 15-metre rise by 2300.⁴

Fossil fuels are the greatest contributor to the climate crisis, and are currently responsible for 64 per cent of global anthropogenic GHG emissions.⁵ But despite being disproportionately negatively affected by increasing temperatures, the Arctic region bears its own share of responsibility for driving climate change. Oil and gas produced in onshore and offshore installations in the region account for 5 to 10 per cent of the world's production.

Most of these fossil fuels are transported from the Arctic to global markets by tankers or pipelines—and transporting fossil fuel generates its own negative impacts, including air pollution, underwater noise, ship strikes involving marine mammals, and the risk of accidents and oil spills in a part of the world where clean-up operations are costly and difficult.

The Intergovernmental Panel on Climate Change (IPCC) 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 and reach net zero by 2050.⁶ Moreover, emission reduction efforts must address energy production and consumption (supply and demand) simultaneously. Therefore, oil and gas companies should apply reduction pathways aligned with the 1.5°C target to the levels of fossil fuel they produce—on par with all other producing sectors and consuming markets of the global economy.

Both the IPCC and the International Energy Agency (IEA) have clearly stipulated that there is no room for the development of new oil and gas reserves beyond the fields that are already producing or in development. All fossil fuel reserves that are licensed but still awaiting a final investment decision—usually categorized as “new fields” or “under exploration”—are in excess of 1.5°C scenarios.

What does all of this mean for the fossil fuel industry in the Arctic?

² International Cryosphere Climate Initiative, 2022.

³ R. Milan et al., 2023.

⁴ Intergovernmental Panel on Climate Change (AR6 Synthesis Report), 2023.

⁵ O.B. von Kursk and G. Muttitt, 2022.

⁶ According to the IPCC, to stay on track for 1.5°C, GHG emissions need to peak before 2025, decrease by 43% by 2030, and reach net zero by 2050. A new milestone—a 60% decrease by 2035—was introduced by the IPCC AR6 Synthesis Report in March 2023.

Methodology

To answer this question, this paper identifies 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. It does not count emissions, including methane and other short-lived greenhouse gases, that are emitted during oil and gas extraction, processing or transportation.

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 a country's perspective.⁷ At the same time, these fossil fuel products will drive overall global emission levels. Given that most of the fossil fuels produced in the Arctic are consumed globally, we apply the global models of emission reduction to assess how Arctic fossil fuel production correlates with the Paris-aligned emission reduction trajectories.

Two possible pathways

Based on a review of relevant policy and scientific literature, this paper finds that two 1.5°C-aligned pathways are widely cited as feasible.⁸

The first is the IEA's net-zero scenario. In this scenario, oil and gas production must decline by 3 per cent per year from now to 2030 and accelerate to a 6 per cent decline per year from 2030 to 2050. The caveat in this scenario is that it relies on carbon capture and storage technologies. Serious concerns have been raised about the feasibility of these technologies to play a substantial role in reducing carbon emissions. Despite almost five decades of being deployed globally, their use remains limited due to a combination of high costs, low technological readiness, and investment risk.⁹

The second pathway selected for this analysis is the IPCC's low-demand scenario. Unlike the IEA scenario, this one does not require the use of carbon capture and storage technologies.¹⁰ Instead, it relies on reducing demand for fossil fuels. It also mandates faster and deeper emission reductions: 6 per cent per year until 2030, accelerating to a 7 per cent annual decline by 2050. Both pathways show a dramatic drop in fossil fuel production by 2050 (78 per cent and 85 per cent, respectively).

Overall, production levels from conventional oil and gas fields generally decline by about 4 per cent per year as reservoir pressure decreases. Therefore, if no new fields are developed, the production of oil and gas will decrease naturally. 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.

⁷ The mismatch between the growing export volumes of fossil fuels and the goal of decreasing national emissions is well noted by B. McKibben in his 2023 article, [Uncounted Emissions: The Hidden Cost of Fossil Fuel Exports](#). The author argues that because oil and gas exports are not counted when countries tally their greenhouse gas emissions under the Paris Agreement, nations can report progress on their emission reduction goals while continuing to ship fossil fuels overseas.

⁸ O.B. von Kursk and G. Muttitt, 2022; Trout et al., 2022; Loualalen and Trout, 2023; Achakulwisut et al., 2023; and others.

⁹ IPCC, 2022; A. Carter et al., 2023.

¹⁰ In fact, the IPCC LD (low demand) scenario deploys no-fossil carbon capture and storage or bioenergy with carbon capture and storage for normative reasons, informed by concerns about innovation failure, investment risks, and public opposition. See P. Achakulwisut et al., 2023.

To calculate the embodied CO₂ emissions that would result from burning oil and gas produced in the Arctic from 2022 to 2050, our analysis utilizes the Rystad Energy asset-based database as the primary source of data on projected oil and gas production. These data and production models are current to October 2023, reflecting Rystad's assumption that the benchmark Brent oil price will decline to around USD \$35/barrel by 2030 before rebounding to USD \$60/barrel over the long term.

Four licensed categories of fossil fuel reserves—reflecting a standard oil and gas extraction project lifecycle—are captured in the analysis:

- 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

The latter two categories represent licensed fields that are not yet committed to commercial extraction. Because production in these fields is not imminent, it can still be stopped.

Research overview

According to the 2023 *Production Gap Report*,¹¹ there is a significant gap between global fossil fuel production levels, global projected CO₂ emissions from fossil fuels, and the Paris Agreement's goal “to hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C.”¹² According to the report, currently producing fossil fuel fields, when assessed globally, already hold enough fossil fuels to respect the 1.5°C pathway. Yet governments, in aggregate, still plan to produce more than double the amount of fossil fuels by 2030 than would be consistent with limiting warming to 1.5°C.

The report's findings are also replicated in this paper, which uses global fossil fuel reserves data from Rystad (Figure 1). Notably, the production gap for the Arctic as a whole looks wider than the global gap (Figure 2). In 2030, fossil fuel companies operating globally are expected to produce almost double the volume of fossil fuels that would be consistent with limiting global warming to 1.5°C.¹³ However, the peak of fossil fuel production in the Arctic region is not expected to occur until 10 years after the global production peak, anticipated in 2030. By 2050, the gap between Arctic fossil fuel production and the 1.5°C-aligned reduction pathway has the potential to reach 700 per cent.¹⁴ This massive production overshoot will be mostly due to Russia developing new fields in the Arctic.

In Russia, meeting the emission reduction goal will require more than just stopping licences and permits for new fossil fuel developments. It will mean taking steps to close down some portion of currently producing fields prematurely (Figure 2). Future decisions related to new fields in the Arctic will also affect the global climate, given the high potential for fossil fuel discoveries in the Arctic and the important role played by all three Arctic hydrocarbon producers (Russia, the US and Norway) in global production.

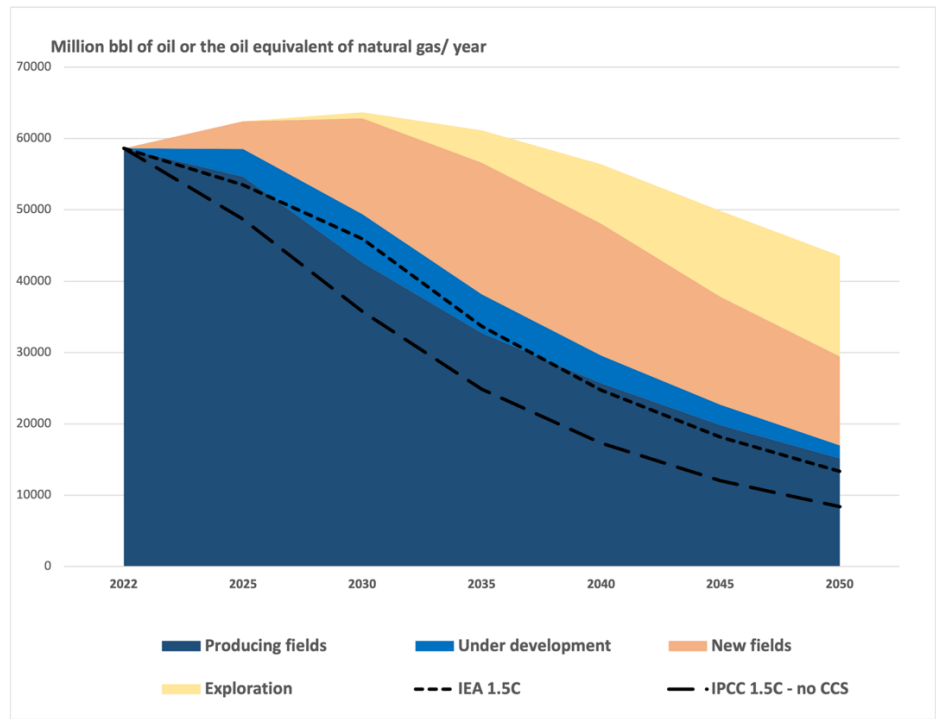
¹¹ SEI, Climate Analytics, E3G, IISD, and UNEP, 2023.

¹² Paris Agreement (2015), Article 2.1.

¹³ The 2030 projected production is compared with the IPCC 1.5°C trajectory, which does not factor in carbon capture and storage.

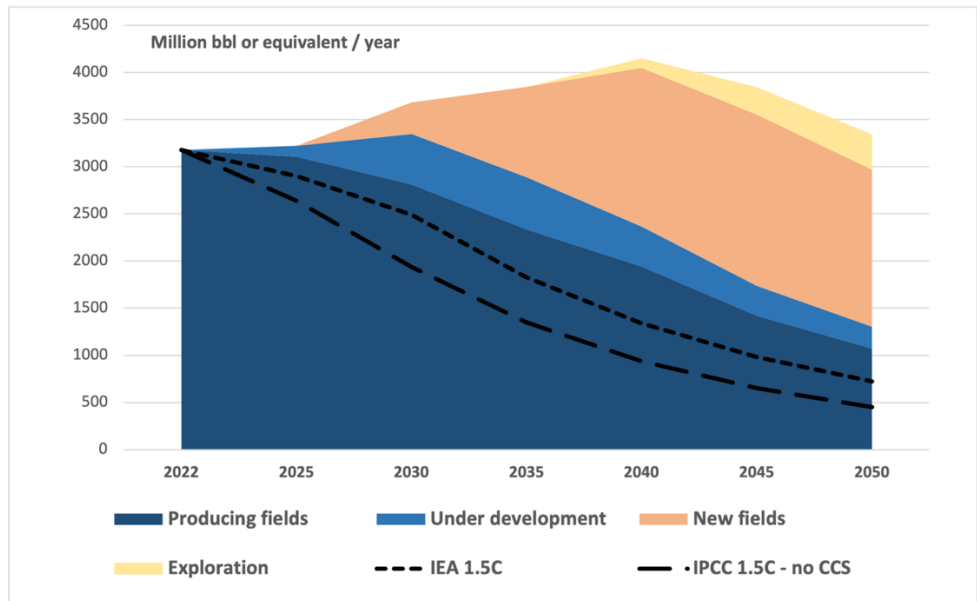
¹⁴ If new fields and reserves currently under exploration are all developed.

Figure 1: Global oil and gas production and selected 1.5°C pathways



Source: Rystad Energy (November 2023)

Figure 2: Oil and Gas production in the Arctic region, 2022 to 2050

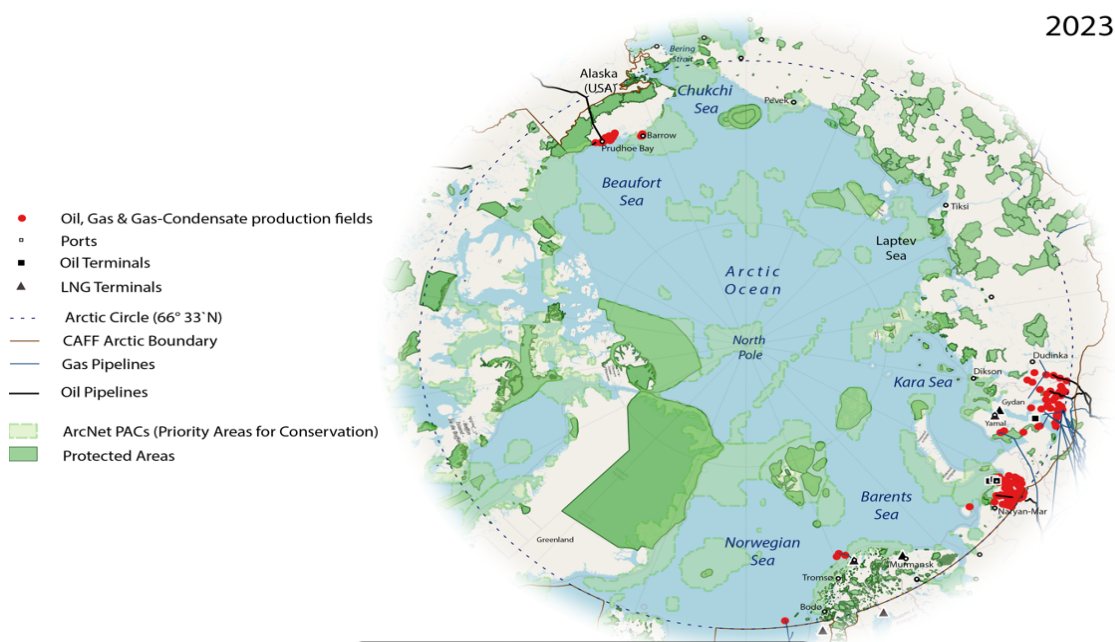


Source: Rystad Energy (November 2023)

According to the US Geological Survey, the Arctic region contains about 13 per cent of the world's undiscovered oil and 30 per cent of its undiscovered gas resources.¹⁵ Not all of these are economically recoverable, given the significant level of uncertainty about future oil prices and the high cost of developing Arctic hydrocarbons, which can be double that of developing these outside of the Arctic.¹⁶

In 2022, 3,177 million barrels of fossil fuels (oil and the oil equivalent of natural gas) were produced in the Arctic—about 5.5 per cent of the world's total production that year. Russia was by far the largest producer of hydrocarbons in the Arctic, with 2,902 million barrels¹⁷ of fossil fuels (both oil and gas measured by oil equivalent) that year. Russia was followed by the US (Alaska), with 176 million barrels, and Norway's Arctic, with 98 million barrels. In other words, Russia dominates the production of fossil fuels in the Arctic by a magnitude of 26 to 1 compared to Norway and 14 to 1 compared to Alaska.

Figure 3: Oil and gas production in the Arctic, 2023



Sources: Rystad Energy (October 2023); WWF Global Arctic Programme ArcNet.

The majority of currently producing fields in the Arctic (shown in red in Figure 3) can be found in two Russian provinces: the Nenets and Yamalo-Nenets, adjacent to the Barents Sea and Kara Sea, respectively. Only one producing field in the Russian Arctic is offshore: Prirazlomnoye, operated by Gazprom, located in the continental shelf of the southeastern corner of the Barents Sea. The rest of Russia's production takes place in the basins of two large northern Siberian rivers, the Pechora and the Yenisey. As shown on the map, the producing fields are surrounded by enabling fossil fuel infrastructure:

¹⁵ US Geological Survey, 2008.

¹⁶ According to the US government's Energy Information Administration (2012), the main reasons for these high development and operating costs include frigid temperatures, remoteness, poor soil conditions, lack of transportation infrastructure, and higher wages.

¹⁷ A barrel is a unit of measurement for crude oil and other petroleum products. It typically contains 42 US gallons or approximately 159 litres.

pipelines, ports and oil/liquid natural gas (LNG) terminals. Overall, 80 per cent of the gas and 60 per cent of the oil produced in Russia is extracted in the Arctic region.

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 fossil fuel production peaked in the late 1980s and has been declining steadily since then. With the advent of discoveries in US southern regions (including Texas) that were more commercially viable, Alaskan oil production declined to 4 per cent of domestic production by 2020 from 20 per cent in 1981. Nevertheless, the government has continued to hold lease sales for areas located in the Arctic and has approved a mega-infrastructure project estimated at USD\$40 billion. Known as the Alaska LNG project, it involves the construction of a 1,300 km gas pipeline across Alaska from the North Slope to Cook Inlet to deliver gas produced in Alaska to overseas markets.¹⁸

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 pipeline to the larger network that delivers gas to European consumers and LNG facilities. Although Norway is a relative newcomer to Arctic fossil fuel production, its government and oil and gas companies view the Barents Sea as an area with significant potential for development.¹⁹

All three Arctic fossil fuel-producing nations (Russia, the US and Norway) are pushing for new oil and gas operations in the region that will expand the global production of fossil fuels in the next few years (Box 1). The governments of these countries continue to issue new exploratory licences and drilling permits, invest in enabling infrastructure (such as pipelines), and give tax breaks to the fossil fuel industry, even though IPCC and UN leaders have clearly stated that limiting warming to 1.5°C requires no new oil and gas projects.²⁰

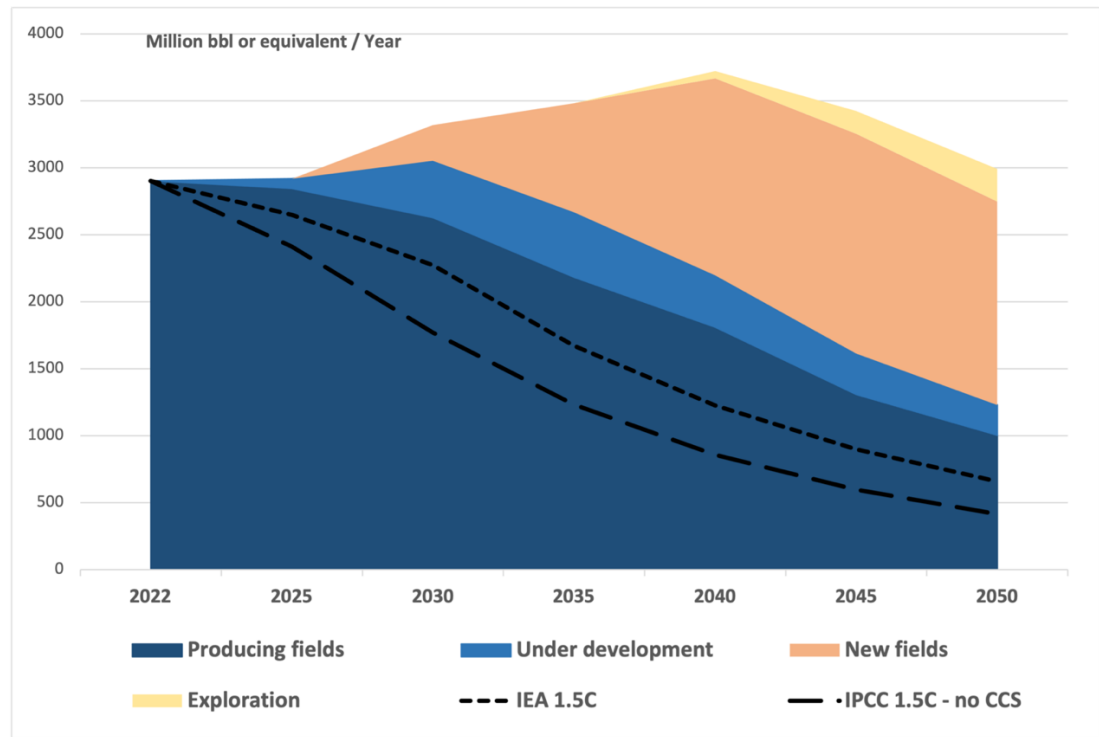
In the absence of stronger climate policies, oil and gas production in the Arctic are expected to exceed current levels until at least the late 2030s or early 2040s. Emission growth will be driven primarily by continued exploration and development in new fields in Russia.

¹⁸ Alaska Public Media, 2023.

¹⁹ WWF Norway, 2021.

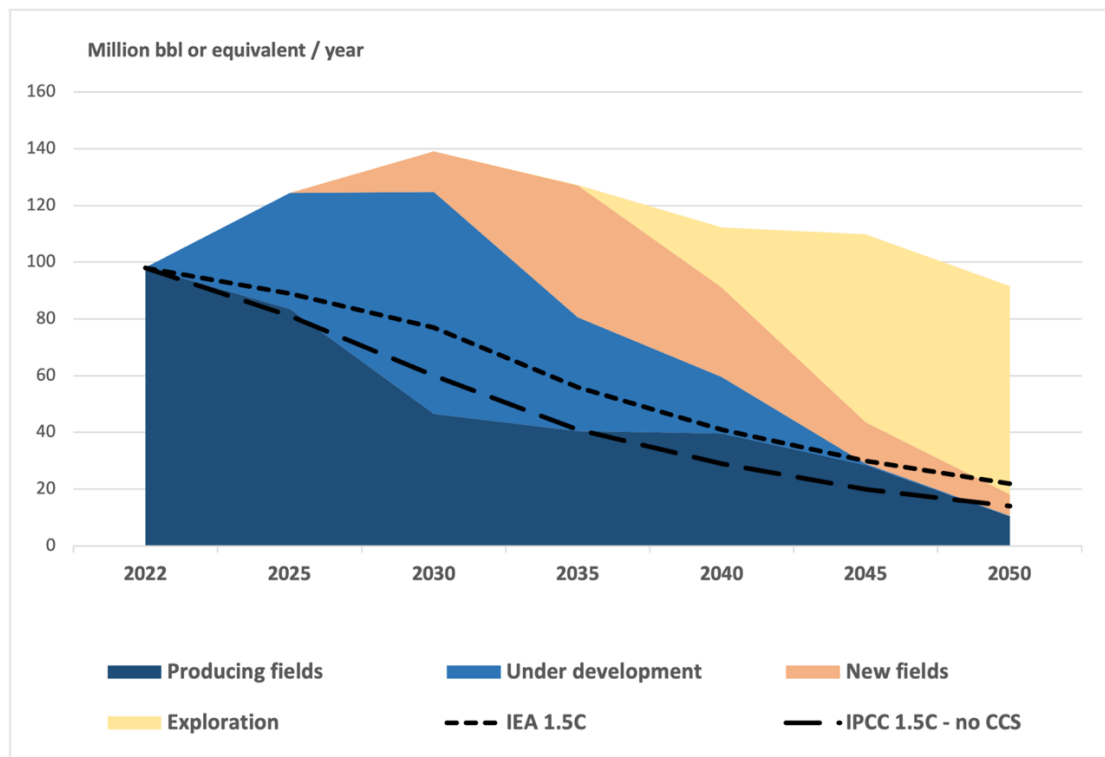
²⁰ "The world must phase out fossil fuels in a just and equitable way—moving to leave oil, coal and gas in the ground where they belong—and massively boosting renewable investment in a just transition. Fossil fuel industry transition plans must be transformation plans that chart a company's move to clean energy— and away from a product incompatible with human survival... End licensing or funding of new oil and gas. Stop the expansion of existing oil and gas reserves—and support the just transition of the impacted developing countries." UN Secretary-General, Antoni Guterres. United Nations, June 15, 2023.

Figure 4: Oil and gas production in the Arctic, Russia, 2022 to 2050



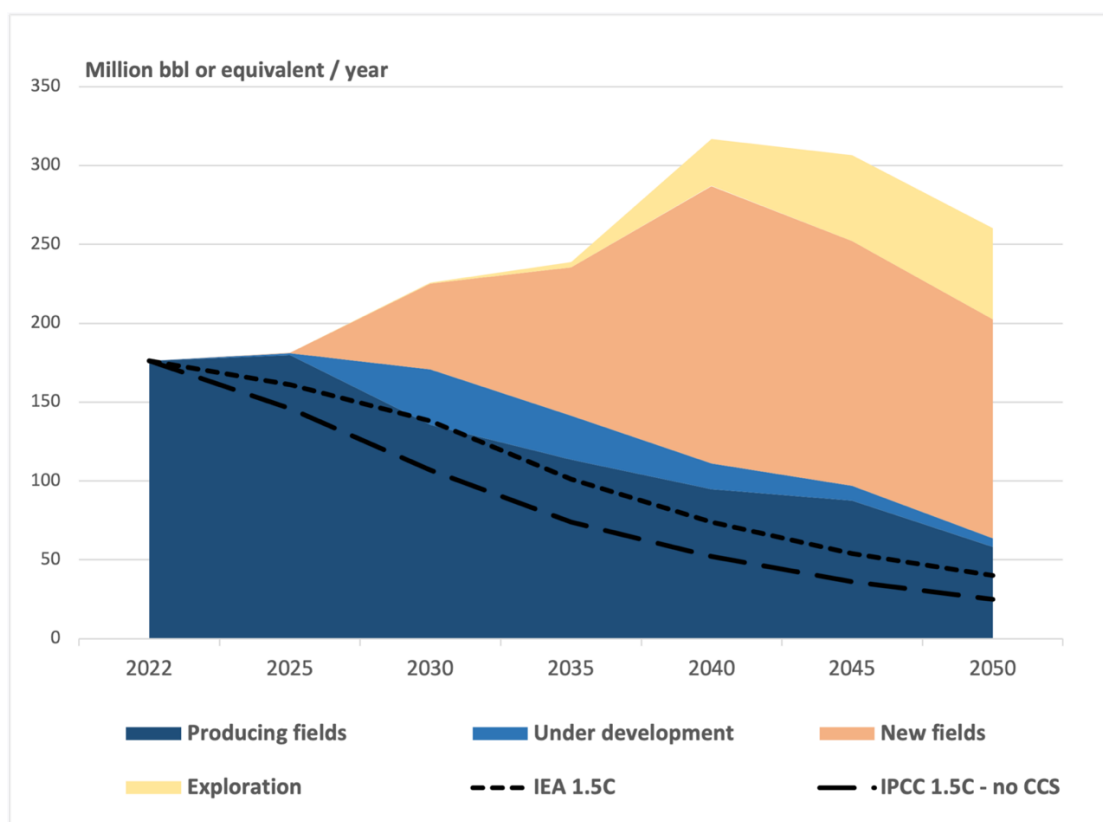
Source: Rystad Energy (November 2023)

Figure 5: Oil and gas production in the Arctic, Norway, 2022 to 2050



Source: Rystad Energy (November 2023)

Figure 6: Oil and gas production in the Arctic, the US (Alaska), 2022 to 2050



Source: Rystad Energy (November 2023)

In the Russian Arctic, production levels are expected to rise until 2040. This will be due to increasing volumes in currently producing and developed fields until 2030, and to the development of new fields after that.

The upshot is that the gap between the 1.5°C-aligned pathway and the level of production is too wide. Here, to achieve a Paris-aligned trajectory, it will not be enough just to keep oil and gas from new fields in the ground. More drastic measures are needed to reduce the embodied emissions from fossil fuels produced in the Russian Arctic and make them consistent with a 1.5°C pathway. Even if Russia does not develop new reserves, by 2050 the expected future volumes from currently producing and developed reserves will exceed the Paris-aligned targets by 200 to 300 per cent.

For Norway, the great unknown is what the government may decide to do about fields that are currently under exploration (i.e., in the stage prior to commercial discovery). If these are never developed, and the oil and gas stays in the ground, then Norway's production level is projected to come close to the net-zero target by 2050, even though there will be increases in production through the late 2020s and early 2030s. However, the current Norwegian government may push for more exploratory activities in the High North. The Norwegian Petroleum Directorate believes that the future of Norwegian petroleum activity is in the Barents Sea, which it claims holds "more than half of the oil and gas that has not yet been discovered."²¹

²¹ Norwegian Petroleum Directorate, 2019.

Another scenario is that Norway will increase production until 2030 and then exceed the 1.5°C-aligned pathway into the 2040s. A delay in phasing out the extraction of oil and gas in already-developed fields would cause cumulative carbon emissions to surpass the remaining carbon budget consistent with the 1.5°C goal even if the level of production were to then decrease substantially from 2040 to 2050.

For Alaska, the excess production vis-à-vis the Paris-aligned trajectory will be observed mainly in reserves that are currently in the new field category (i.e., those that are past the stage of commercial discovery, but have not yet received a final investment decision and/or government approval). These potential sources of additional emissions can be still prevented.

Box 1: Large Arctic fossil fuel projects scheduled for production in the near future

If measured in terms of oil and gas resources, **Russia's Vostok Oil** is the biggest fossil fuel project in the Arctic. Controlled by Russia's state-owned energy giant, Rosneft, the project includes 13 fields located in the remote and vulnerable tundra of the Taymyr Peninsula. According to Rystad estimates, Vostok Oil is poised to become Russia's biggest-ever fossil fuel project, producing more than 8 billion barrels of oil and its equivalent between now and 2060.²²

Rosneft intends to increase oil production to reach 100 million tonnes by 2030, most of which will be shipped on tankers using the Northern Sea Route eastward along Russia's Arctic coast, through the Bering Strait toward Asian markets. The traffic generated by these tankers in ecologically sensitive marine areas will impose additional negative impacts on Arctic marine ecosystems and species by increasing pollution, underwater noise, ice-breaking, habitat destruction, strikes with marine mammals, oil-spill risks, and other disturbances.

Norway's Johan Castberg project, located offshore in the Barents Sea, comprises three oil fields with a volume of recoverable oil estimated at 400 to 650 billion barrels and an operational lifespan estimated at 30 years. It is operated by Equinor, a state-owned energy company. The most recent estimate of the project's cost, including infrastructure facilities, is USD\$7.4 billion. Production is slated to begin in the fourth quarter of 2024.²³ According to Rystad, offshore shelf investments have increased by 17 per cent worldwide in 2023 over the previous year, driven primarily by Norway, Qatar and Saudi Arabia.²⁴

The Willow Project, operated by ConocoPhillips on the Alaskan North Slope, is the world's biggest fossil fuel project in 2023 if measured in terms of greenfield capital expenditure (USD\$7.8 billion).²⁵ With a projected production volume of 600 million barrels, the Willow megaproject will move the energy-producing sector further away from the 1.5°C-aligned pathway. It will also lock in large investments in fossil fuel facilities and infrastructure—money that could have been directed by investors to clean energy projects. The risk of stranded assets also looms large if demands for hydrocarbons start to decrease and prices fall—a scenario that the IEA expects to unfold in the 2030s.

²² Rystad Energy, 2023.

²³ Offshore Technology, 2023.

²⁴ Rystad Energy, 2023.

²⁵ Ibid.

Discussion and recommendations

Governments play an active role in facilitating oil and gas expansion: they issue licences to explore sites, and when resources are discovered, they grant permits, approve and fund infrastructure, and introduce tax regimes that are favourable to fossil fuel companies. These measures create the conditions needed to attract investments in oil and gas projects and build the required infrastructure.

Our findings show that governments continue to award new leases for fields that are expected to begin production as late as the mid- and late 2040s, by which time the world's emissions should start to approximate the net-zero carbon emission target if our planet is to escape the most drastic climate change scenarios.

To meet the Paris target, at a bare minimum, Arctic governments must stop licensing and issuing permits for new fossil fuel development.

This must be accompanied by efforts to create regulatory and fiscal frameworks that will prompt investors to redirect finance away from fossil fuels and toward renewables. This means the end of massive direct and indirect fossil fuel subsidies and infrastructure.

It also means that in Russia, about half of the oil fields currently in production must be phased out and decommissioned prematurely, even if no new fields are developed.

For Norway and Alaska, at a minimum, Arctic resources that are currently in the exploration and appraisal stages must stay in the ground. For Alaska, the largest source of future emissions in excess of a 1.5°C-aligned trajectory will come from developing new fields—that is, fossil fuel reserves that are past commercial discovery, but still awaiting final investment decisions. For Norway, the greatest potential source of excess emissions is future production from as-yet undiscovered sites that have received exploration licences, but have not been proven by drilling.

Given that these reserves have already received exploratory licences from governments, it will be necessary to convince investors not to finance these potential projects. In turn, financial institutions need governments to create the enabling conditions to redirect finance from fossil fuel projects to the clean energy transition.

There is a real risk that some projects that have received (or will receive) investments to build necessary facilities and infrastructure will become uneconomical before they even begin generating profits, resulting in stranded assets. **In the Arctic, the risk of stranded asset traps is higher than elsewhere.** When the market is volatile, and hikes in market demand are replaced by sudden cooling-off periods, investments can become uneconomic long before the anticipated returns kick in. In the Arctic context, this risk is exacerbated by the longer times required to bring a fossil fuel reserve from the discovery stage to production as well as the high cost of development due to harsh environmental conditions, remote location and lack of infrastructure.²⁶ In fact, the future risk of stranded assets is a strong incentive for investors to redirect financial flows from fossil fuels to renewable and clean energy projects.

²⁶ According to WWF's study, *The Economics of Oil Development in the Arctic National Wildlife Refuge*, it takes an average of 20 years or more from the time of awarding a license to the start of production. See WWF, 2021.

In parallel with the phase-out of oil and gas production, a Paris-aligned transition requires an increase in the use of energy from renewable sources, such as wind and solar. To enable the 1.5°C-aligned pathways, investments in renewable energy must be 3 to 4.5 times higher than current levels, depending on the type of energy. Stopping investments in new fossil fuel fields and preventing further exploration of hydrocarbon fields will free up capital to drive the production of solar and power energy.

The continued policy of licensing oil and gas development poses multiple risks: to the Earth's climate, to the sensitive ecosystems (such as those in the Arctic) where these frontier projects are proposed, and to investors, who will face stranded assets and financial losses when the world moves away from fossil fuels.

Instead of being treated as the last frontier for fossil fuel expansion, the Arctic region should become a leader in deploying clean energy, leaving its pristine ecosystems intact and mineral riches unexplored—in the ground, where they belong.

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