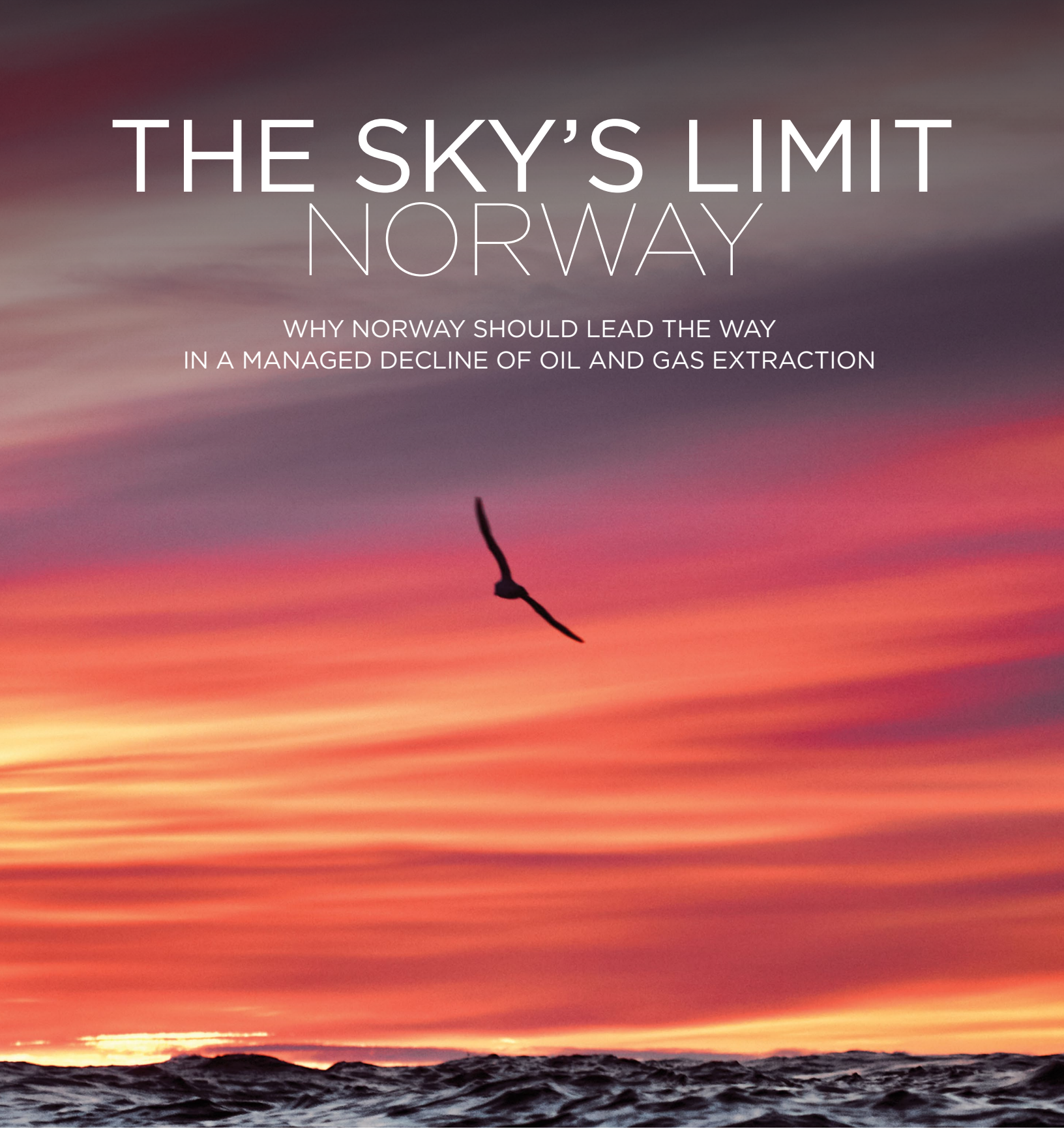

THE SKY'S LIMIT NORWAY

WHY NORWAY SHOULD LEAD THE WAY IN A MANAGED DECLINE OF OIL AND GAS EXTRACTION

OILCHANGE INTERNATIONAL

PUBLISHED IN COLLABORATION WITH

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This report was researched and written by Hannah McKinnon, Greg Muttitt, and Kelly Trout. All are with Oil Change International. It was edited by Emily Sproul.

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Oil Change International is a research, communications, and advocacy organization focused on exposing the true costs of fossil fuels and facilitating the coming transition towards clean energy.

Oil Change International
714 G Street SE
Washington, DC 20003 USA
www.priceofoil.org

Design: JML Design, LLC / www.jmldesign.com

Front cover photo: Seascapes of the Barents Sea.

Back cover photo: My Arctic Sunrise near Goliat oil Platform

August 2017

In September 2016, Oil Change International and partners published *The Sky's Limit, Why the Paris Climate Goals Require a Managed Decline of Fossil Fuel Production.* The report found that burning the oil, gas, and coal in already-producing fields and mines would be enough to take the world beyond 2 degrees Celsius of warming; therefore, to meet the Paris goals requires an end to new fossil fuel development.

This is one of a series of national briefings that consider the conclusions of that work and apply the same methodology at a country level, in this case Norway. For further detail on methodology and international implications, please see the original report. It can be found at:
http://priceofoil.org/2016/09/22/the-skys-limit-report/

1. SUMMARY

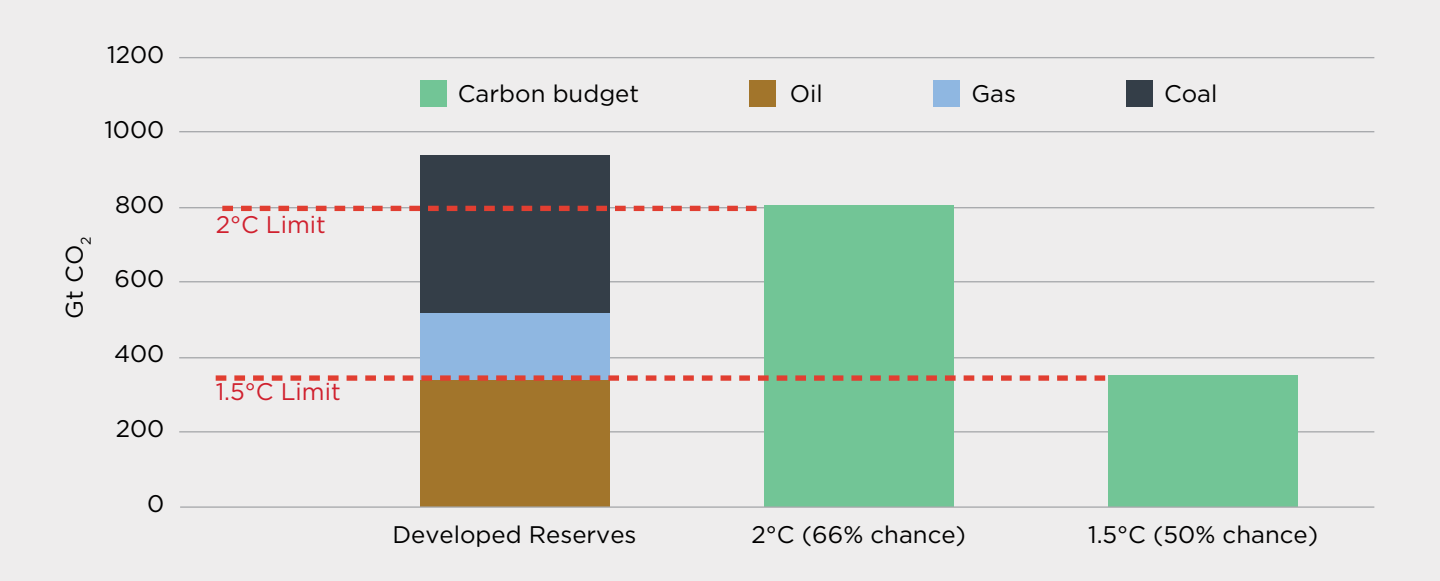
In December 2015, world governments agreed in Paris to limit global average temperature rise to well below 2 degrees Celsius, and to strive to limit it to 1.5 degrees Celsius. This report examines the implications of these climate boundaries for fossil fuel production in Norway.

In our September 2016 report, *The Sky's Limit, Why the Paris Climate Goals Require a Managed Decline of Fossil Fuel Production,* we analyzed what a Paris-aligned carbon budget would mean for fossil fuel production globally. Our key findings include[1]:

- The potential carbon emissions from the oil, gas, and coal in the world's currently operating fields and mines would take us beyond 2 degrees Celsius of warming.
- The reserves in currently operating oil and gas fields alone, even with no coal, would take the world beyond 1.5 degrees Celsius of warming.
- With the decline in fossil fuel production required over the coming decades to meet climate goals, clean energy can be scaled up at a corresponding pace, expanding the total number of energy jobs.

The potential carbon emissions from the oil, gas, and coal in the world's currently operating fields and mines would take us beyond 2 degrees Celsius of warming.

Figure ES 1: Emissions from Developed Fossil Fuel Reserves, Compared to Carbon Budgets



1. Greg Muttitt, *The Sky's Limit: Why the Paris Climate Goals Require A Managed Decline of Fossil Fuel Production,* Oil Change International, 22 September 2016, pg. 31, http://priceofoil.org/2016/09/22/the-skys-limit-report/

With developed reserves already exceeding carbon budgets, if Norway continues to permit exploration and development of new fields, it will both push the world into dangerous levels of climate change and risk billions of dollars of investment and thousands of jobs, forcing on itself (and others) a rapid transition at huge economic and social cost.

In the case of Norway, the country has been a vocal advocate for climate action in international forums and has made specific policy progress in areas such as electrification of transportation[2]. Yet there is significant cognitive dissonance as the country fails to address the impact of its oil and gas extraction, instead facilitating new production that is incompatible with global carbon budgets, and indeed undermines global efforts to reduce emissions. Just this year, the government offered a record number of 93 blocks for oil and gas exploration in the Barents Sea. This is uncharacteristically irrational behavior for Norway.

As a major exporter of oil and gas (Europe's largest), Norway's domestic climate efforts omit a key part of the picture[3]. Without commensurate action to limit the production and supply of oil and gas, Norway will fail to do its fair share in addressing the global climate crisis.

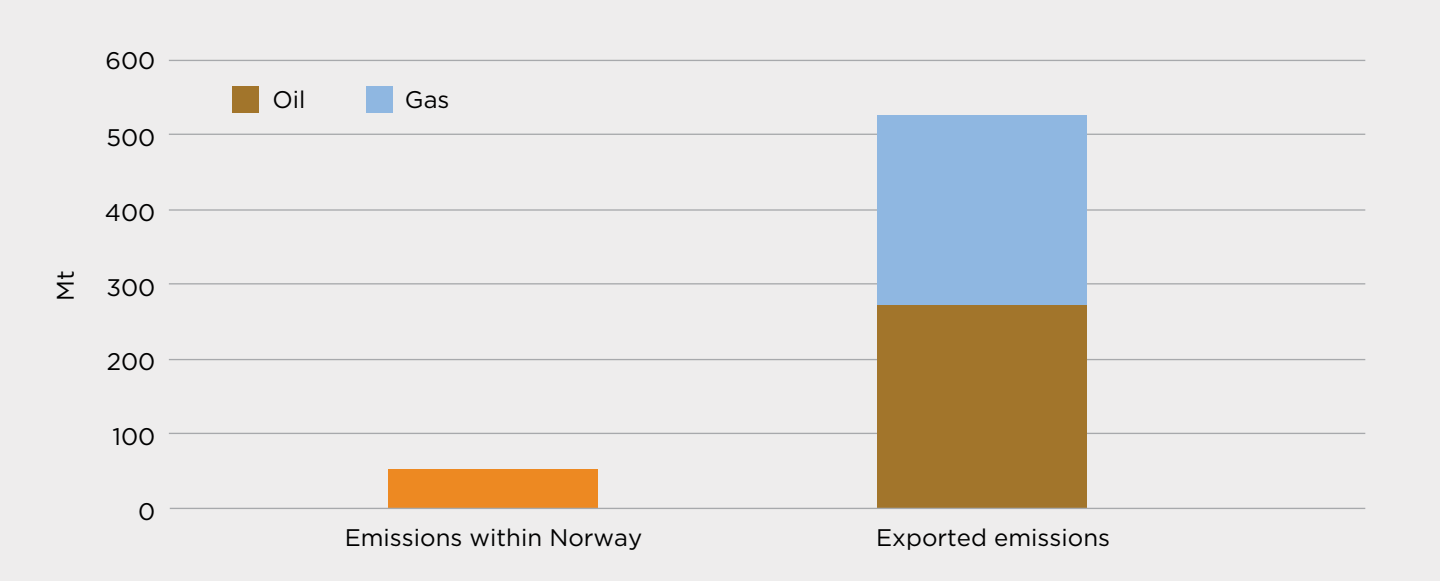
In specifically considering Norway's role within a climate safe global carbon budget, we find that:

- Through its oil and gas exports, Norway is exporting 10 times more emissions than the country produces at home (Figure ES 2).
- Norway is the world's seventh largest exporter of emissions (Figure ES 3).
- Norway's proposed and prospective new oil and gas fields would lead to 150% more emissions than what is in currently operating fields (Figure ES 4).
- Norway's emissions trajectory with proposed and prospective new oil and gas fields is not in line with the rate of global emissions reduction needed to achieve the Paris goals (Figure ES 5).

With developed reserves already exceeding carbon budgets, if Norway continues to permit exploration and development of new fields, it will both push the world into dangerous levels of climate change and risk billions of dollars of investment and thousands of jobs, forcing on itself (and others) a rapid transition at huge economic and social cost.

Since carbon budgets are finite, Norway is set to take an undue share of limited global carbon budgets, thereby depriving poor countries of an opportunity to develop. This choice weakens Norwegian leadership on climate and development.

Figure ES 2: Norway's emissions, domestic and exported, 2016



2. Climate Action Tracker, Norway country page, accessed July, 2017, http://climateactiontracker.org/countries/developed/norway.html
3. European Commission, Trade: Countries and Regions, accessed July, 2017, http://ec.europa.eu/trade/policy/countries-and-regions/countries/norway/

Figure ES 3: World's largest annual exporters of emissions

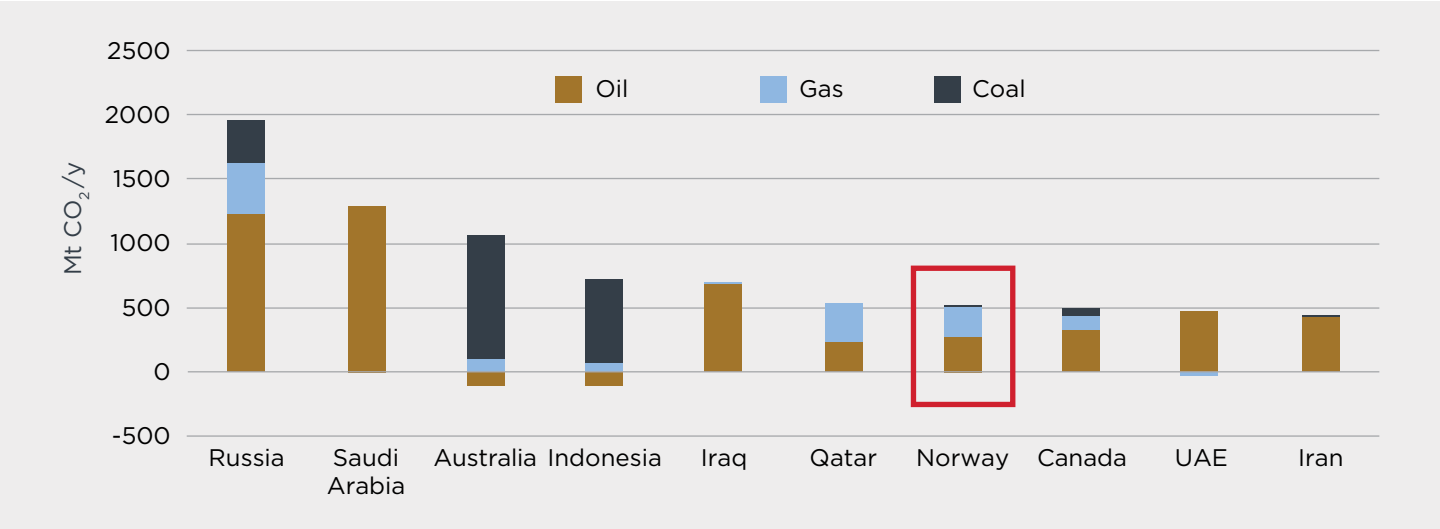
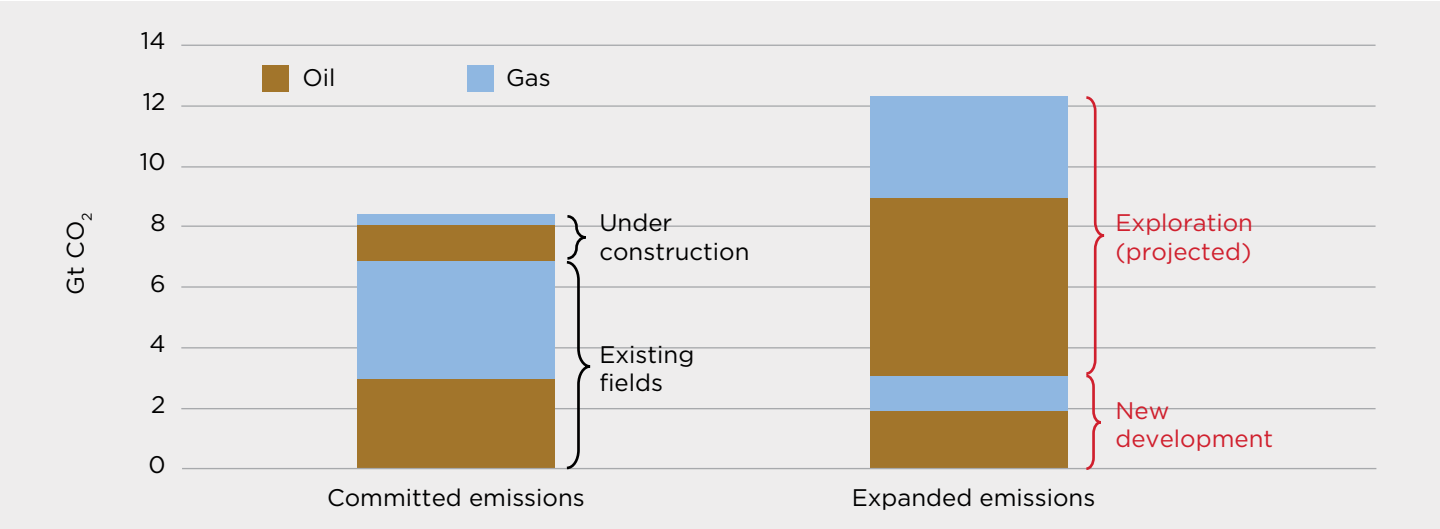


Figure ES 4: Committed and expansion emissions from Norway's oil and gas reserves.

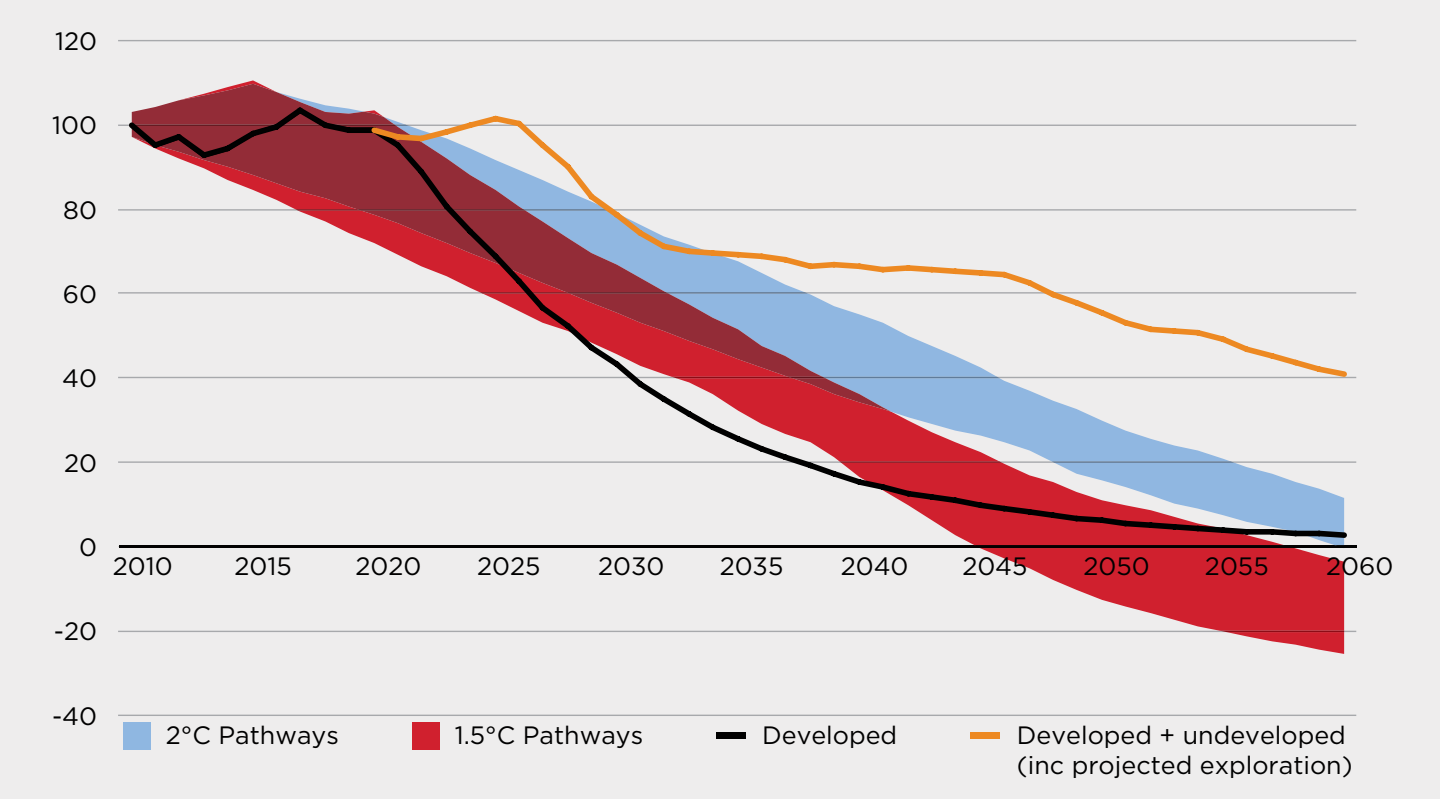


Alternatively, Norway has an historic opportunity to lead by becoming the first fossil fuel producing nation to announce its intention to manage the decline of its production within climate limits. As soon as possible, Norway should:

- Freeze further leases or permits for new oil and gas extraction projects or transportation infrastructure that would incentivize additional exploration.
- Publicly commit to managing the decline of the fossil fuel industry within the Paris goals of 1.5 degrees Celsius or well below 2 degrees Celsius.
- Redefine global climate leadership by setting a global precedent to manage the decline of existing production in line with climate safe limits while ensuring a just transition for affected workers and communities.

Norway has long known that wisdom, knowledge, and foresight are important in dealing with the oil industry. After oil was first discovered offshore in 1969, the Norwegian government made a concerted effort to build a thriving industry that served the country and its people. It created Statoil as a national oil company, encouraged the development of a Norwegian supply chain, and invested in innovation through research and development. At the same time, it slowed oil development while ensuring that the

Figure ES 5: Rates of change (base year 2010 = 100) of global emissions in a range of 1.5 or 2 degree Celsius scenarios, and of emissions from Norwegian developed and undeveloped oil and gas fields.



After all, one of the most powerful climate policy levers is also the simplest: stop digging for more fossil fuels.

government had sufficient expertise and capacity to oversee the industry, and created a fund to invest the revenues for future generations.

While most oil-producing countries were intoxicated by the short-term benefits of oil revenues, and cut taxes or dramatically increased government expenditure,[4] Norway instead focused on the country's long-term prosperity [5]. As a result, Norway has built an industry and an economy, including the world's largest sovereign wealth fund of USD 960 billion[6], that became the envy of the oil world.

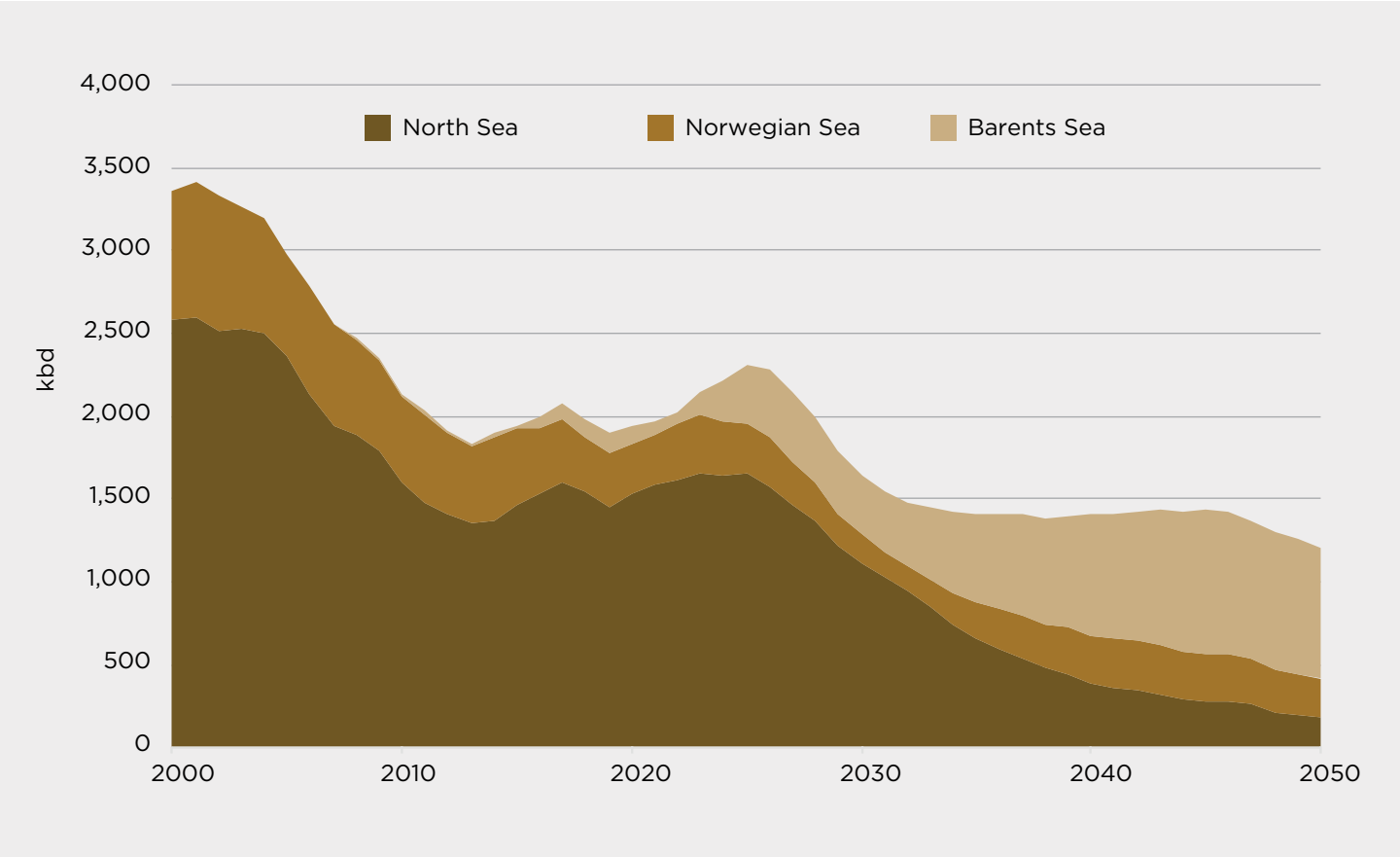
Today, similar vision, clarity, and foresight are needed in the industry's retirement. The world needs Norway to lead by example in managing the decline of the oil and gas industry within climate limits. After all, one of the most powerful climate policy levers is also the simplest: stop digging for more fossil fuels.

4. Including the United Kingdom on the other side of the North Sea
5. See eg Terry Lynn Karl, "The Paradox of Plenty - Oil Booms and Petro States", University of California Press, 1997, pp.213-221
6. Gwladys Fouche, Factbox: Norway's $960 billion soveriegn wealth fund, Reuters, 2 June 2017, http://www.reuters.com/article/us-norway-swf-ceo-factbox-idUSKBN18T283

2. NORWEGIAN OIL AND GAS PRODUCTION: EXPORTING EMISSIONS

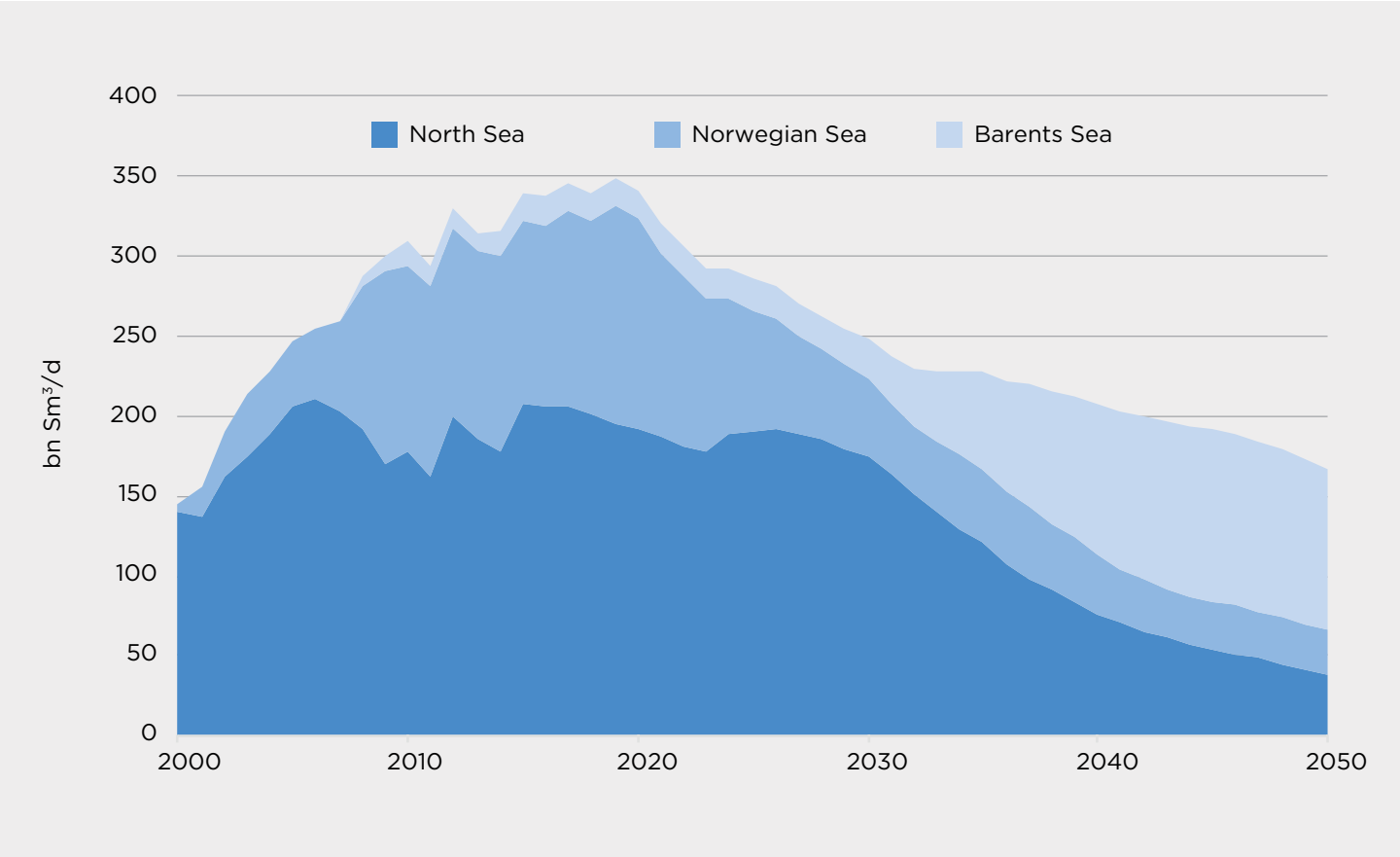
Norway is Europe's largest producer and exporter of oil and gas. Although oil production is in very slow overall decline, this decline is being partially offset by exploration and development of undeveloped reserves. Gas production continues to grow, and is expected to peak in the early 2020s. Within current projections, Norwegian oil production would still exceed 1.2 million barrels per day (mbpd) by 2050, and gas would be about 6,000 cubic feet per day (mcf/d)] by 2050 (Figures 1 and 2).

Figure 1: Norwegian past and projected future oil production[7]



7. Rystad UCube, 27 June 2017. Includes condensate and NGL.

Figure 2: Norwegian past and projected future gas production[8]



Norway is the world's seventh largest exporter of emissions. For a small country, this is very significant in relation to climate change.

The climate impact of Norwegian oil and gas is significant. In 2016, emissions within Norway were about 50 million metric tons (Mt) (a quarter of which are from fossil fuel production [9]). In contrast, the combustion emissions of exported oil and gas amounted to over 500Mt - an order of magnitude larger (Figure 3).

As the world moves beyond gas, oil, and coal, this will become an increasingly moral issue: comparable to production and export of asbestos when its domestic use has been phased-out. For example, the Canadian government continued to lobby for asbestos production and exports despite global opposition, conclusive evidence of the product's dangers, and having banned its use within Canada[10].

In fact, Norway is the world's seventh largest exporter of emissions, as shown in Figure 4. For a small country, Norway is globally very significant in relation to climate change.

As we discuss further in section 4, this is a case of cognitive dissonance: the Norwegian government understands the need to reduce emissions, both in Norway and globally, yet plans to continue significant production and export of oil and gas. If global emissions are to decrease, that necessarily implies less fossil fuels.

8. Rystad UCube, 27 June 2017. Includes flared gas volumes
9. As a contribution to the Paris Agreement, Norway has committed to reducing domestic emissions by at least 40% below 1990 by 2030 and achieving carbon neutrality by 2050. See: *Submission by Norway to the ADP Norway's Intended Nationally Determined Contribution,* March 2015, http://www4.unfccc.int/submissions/INDC/Published%20Documents/Norway/1/Norway%20INDC%2026MAR2015.pdf. The oil and gas sector itself is a significant source of Norwegian emissions, accounting for nearly a quarter (23.9%) of the country's total GHGs. The sector has had a growing contribution to national emissions, accounting for 11% of the national total in 1990. See: Norwegian Environment Agency, *Greenhouse Gas Emissions 1990- 2015, National Inventory Report,* pg. 39 http://www.miljodirektoratet.no/Documents/publikasjoner/M724/M724.pdf. Between 1990 and 2015, the total annual greenhouse gas emissions increased by roughly 2.2 million tonnes, or 4.2%. Norwegian Environment Agency, *Greenhouse Gas Emissions 1990- 2015, National Inventory Report,* pg. 33, http://www.miljodirektoratet.no/Documents/publikasjoner/M724/M724.pdf.
10. Julia Ireton, *Full asbestos ban, changed codes and regulations expected by 2018*, CBC, December 15 2016, http://www.cbc.ca/news/canada/ottawa/asbestos-ban-announcement-1.3895843

Figure 3: Norway's emissions, domestic and exported, 2016[11]

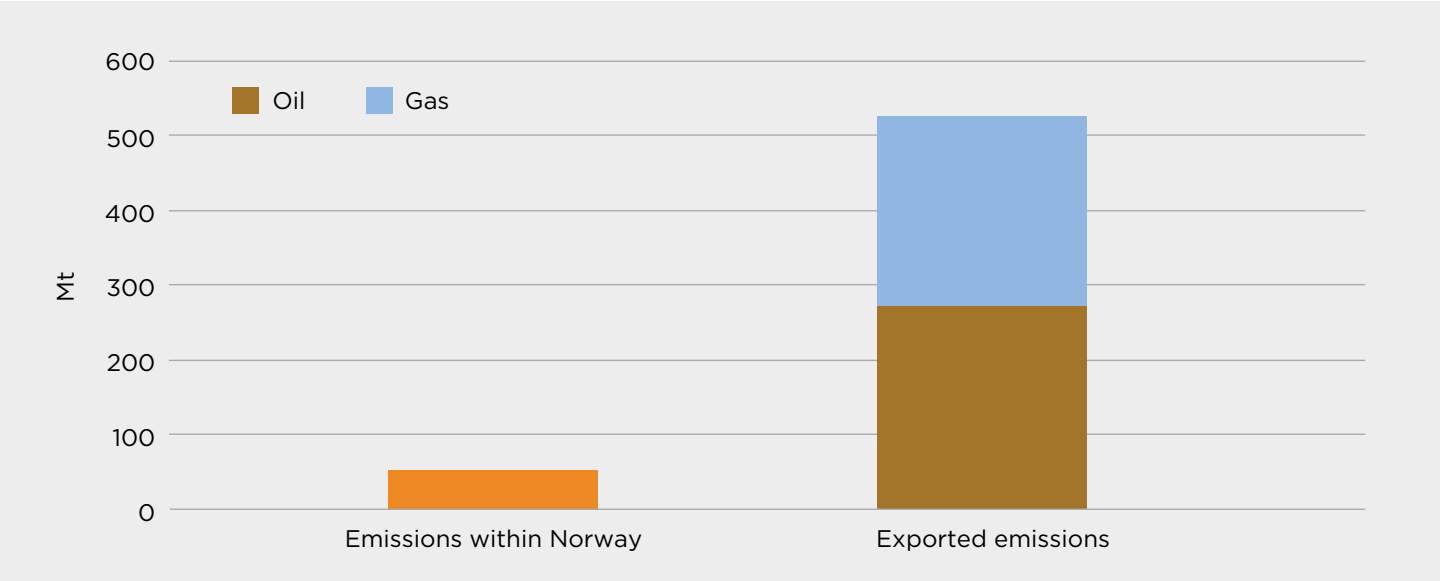
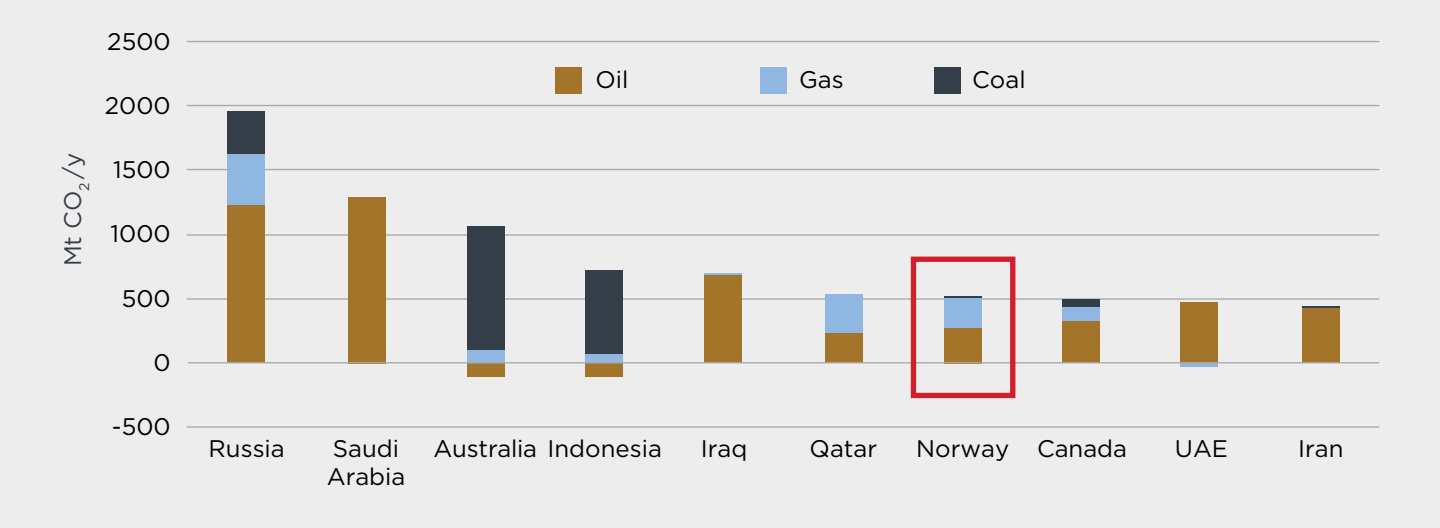


Figure 4: World's largest annual exporters of emissions[12]



In fact, the government seems utterly blind to the contradictions. "The melting ice of the Arctic is a barometer for the global warming that may cause unimaginable damage to our planet," said Minister of Foreign Affairs Børge Brende in 2016. But as the ice retreats, he went on, opportunities open up for oil and gas extraction - opportunities where Norway can lead the charge. Apparently unaware of the irony, he promised to continue "working for deeper international cooperation in the High North, by making our own policies a model of sustainable business and development, and by making our region a source of inspiration in the fight against climate change."[13]

11. Domestic emissions from Statistics Norway, Emissions of greenhouse gases - Preliminary figures, May 2017, https://www.ssb.no/en/klimagassn
Oil and gas production from Rystad UCube, 27 June 2017. Oil includes condensate and NGL. Gas includes flared gas as well as sold.
Oil and gas consumption from BP Statistical Review of World Energy 2017, http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html
Oil emissions factor of 426 kg/bbl average of downstream (combustion) emissions of three Norwegian crudes, from Carnegie Endowment for International Peace Oil Climate Index, http://oci.carnegieendowment.org
Gas emissions factor 2.1 kg/Sm3, from IPCC Guidelines for National Greenhouse Gas Inventories, 2006, http://www.ipcc-nggip.iges.or.jp/public/2006gl/
12. Oil and gas data for 2016, from BP Statistical Review 2017, op. cit.
Coal data for 2015 (the most recent available), from German Federal Institute for Geosciences & Natural Resources (BGR), "Energy Study 2016", https://www.bgr.bund.de/EN/Themen/Energie/Produkte/energy_study_2016_summary_en.html
Emissions factors based on carbon content from IPCC Guidelines, op. cit.: oil 0.42 tCO_2/bbl, gas 59,726 tCO_2/bcf, anthracite/bituminous coal 2.53 tCO_2/t, sub-bituminous coal 1.81 tCO_2/t, lignite 1.20 tCO_2/t.
Assume each country's hard coal divided between anthracite/bituminous and sub-bituminous in same proportions as 2011 production (most recent breakdown available), according to World Energy Council, "World Energy Resources 2013", https://www.worldenergy.org/wp-content/uploads/2013/09/Complete_WER_2013_Survey.pdf
13. Børge Brende, "The Arctic: Important for Norway, Important for the world", speech, 16 April, 2015; reproduced in Harvard International Review, 16 July 2015, https://www.regjeringen.no/en/aktuelt/arctic_harvard/id2406903/

Photo: Climate March in Oslo. © Monica Løvdahl / Greenpeace

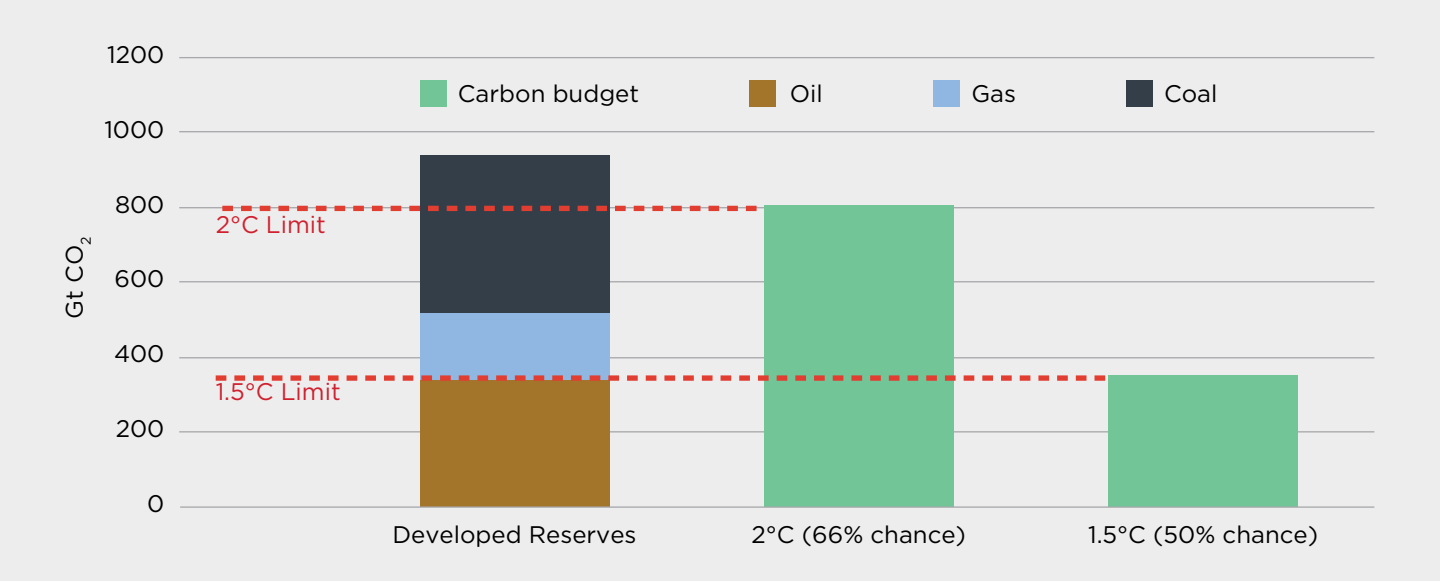
3. THE GLOBAL CARBON BUDGET: NO ROOM FOR NEW PRODUCTION

The Paris Agreement, now officially in force and ratified by Norway, sets a global temperature goal of staying well below 2 degrees Celsius above pre-industrial levels while striving to limit the increase to 1.5 degrees Celsius. These goals were chosen to create a reasonable chance of avoiding the most dangerous impacts of climate change[14].

Basic climate science shows us that the total cumulative carbon dioxide (CO_2) emissions over time determines how much global warming will occur. There is a set level of total cumulative emissions that can occur for a given temperature limit. This is our carbon budget[15].

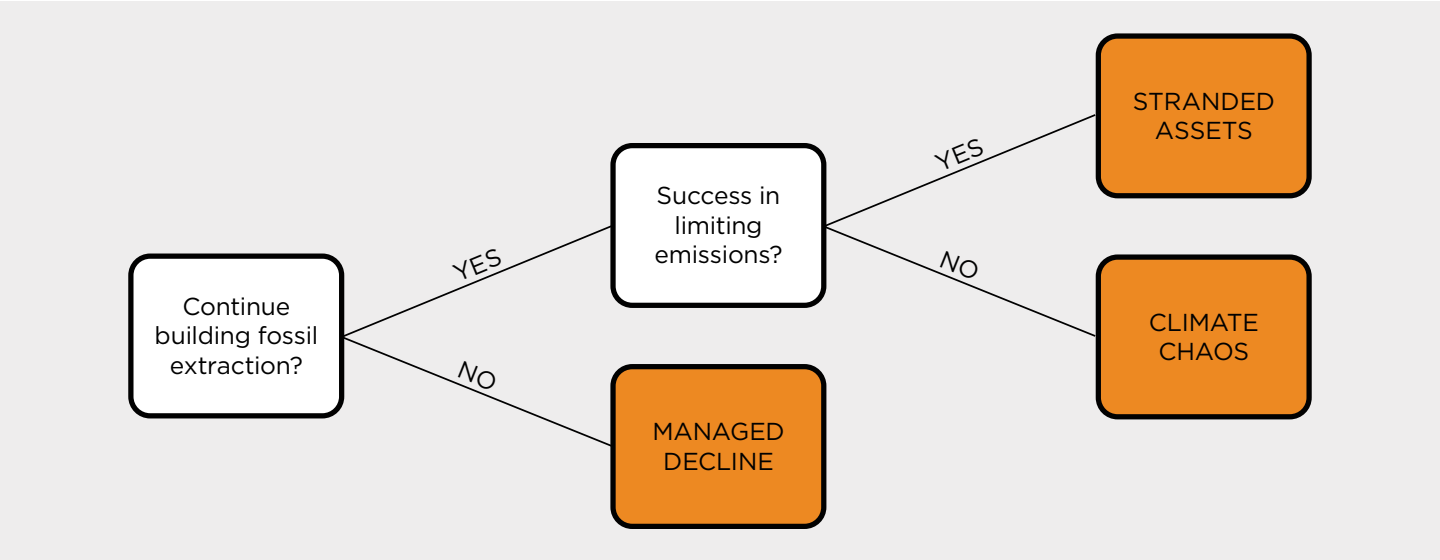
In our *Sky's Limit* report, we used the carbon budgets, calculated by the Intergovernmental Panel on Climate Change, that would give a likely (66%) chance of limiting temperature increases below 2 degrees Celsius, and a medium (50%) chance of limiting temperature increases to below 1.5 degrees Celsius - equivalent to the range of the Paris goals. We compared these budgets to the cumulative CO_2 that will be released over time from all existing and under-construction coal, gas, and oil projects currently operating around the world[16].

Figure 5: Emissions from Developed Fossil Fuel Reserves, Compared to Carbon Budgets



14. UNFCCC, Adoption of the Paris Agreement, pg. 2 https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf
15. The carbon budgets approach does not apply to short-lived greenhouse gases such as methane, whose effects are factored into the calculation of carbon budgets in the form of assumptions about their future emissions.
16. For detailed methodology see Muttitt, Sky's Limit, *op. cit.,* Section 2

Figure 6: Logic Tree of Fossil Fuel Supply vs. Emissions Restrictions



By stopping new fossil fuel developments and beginning a carefully managed decline of the fossil fuel industry towards an economy powered by clean energy, we have the brightest future.

The results show that existing oil and gas fields alone are enough to take the world beyond the 1.5 degree goal. The oil, gas, and coal in already-producing fields and mines are more than we can afford to burn while keeping likely warming below 2 degrees Celsius. Logically, these findings tell us there are three possible futures.:

1. **Managed decline:** We succeed in restricting new fossil fuel supply projects and carefully managing the decline of the fossil industry over time, while planning for a just transition for workers and communities. This path gives us a likely chance of achieving the goals of the Paris Agreement and avoiding the worst impacts of climate change.

2. **Unmanaged decline:** We allow further fossil fuel development to continue, but eventually manage to limit emissions to within carbon budgets. Meeting the Paris Goals would become much harder and would lead to a sudden and dramatic shutdown of fossil fuel production, stranding assets, damaging economies, and harming workers and communities reliant on the energy sector.

3. **Climate catastrophe:** We fail to restrict emissions. New long-lived fossil fuel infrastructure locks us into a high carbon future that puts the Paris targets out of reach. Climate change reaches dangerous levels, causing compounding, irreparable harm for people and ecosystems around the world.

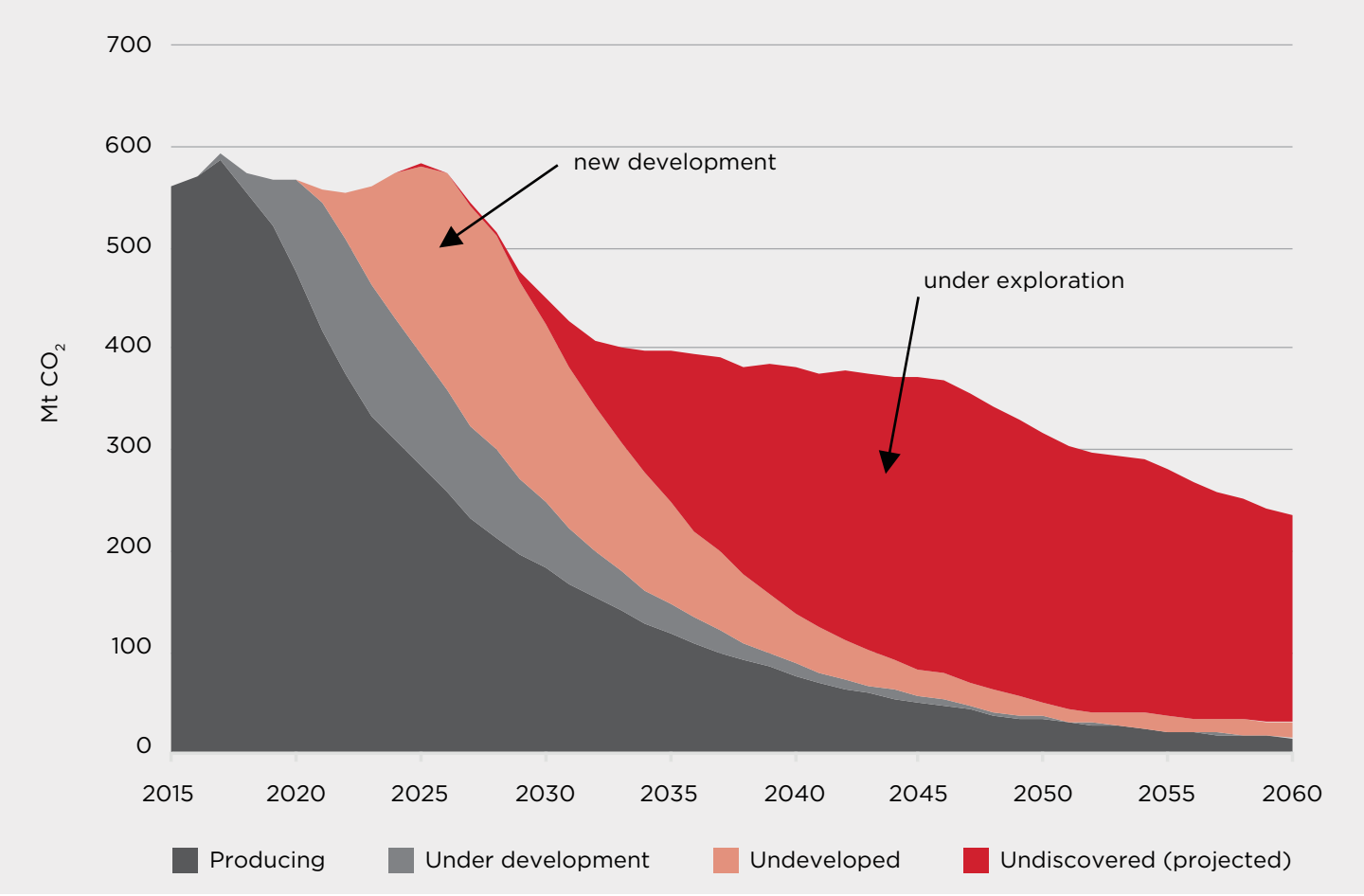
Clearly, the first option is the safest and most efficient path. By stopping new fossil fuel developments and beginning a carefully managed decline of the fossil fuel industry towards an economy powered by clean energy, we have the brightest future.

4. THE PRODUCER'S PREDICAMENT: WHY SUPPLY MATTERS

COGNITIVE DISSONANCE

Figure 7 below shows the emissions associated with Norway's forecasted production through to 2060, with emissions exceeding 300Mt CO_2 in 2050, and continuing well into the second half of the century. Juxtaposed with the following Figure 8, the inconsistencies with the Paris climate goals are obvious.

Figure 7: Projected emissions from Norwegian oil and gas through 2060[17]



17. Rystad UCube, 27 June 2017. See note to Figure 3.

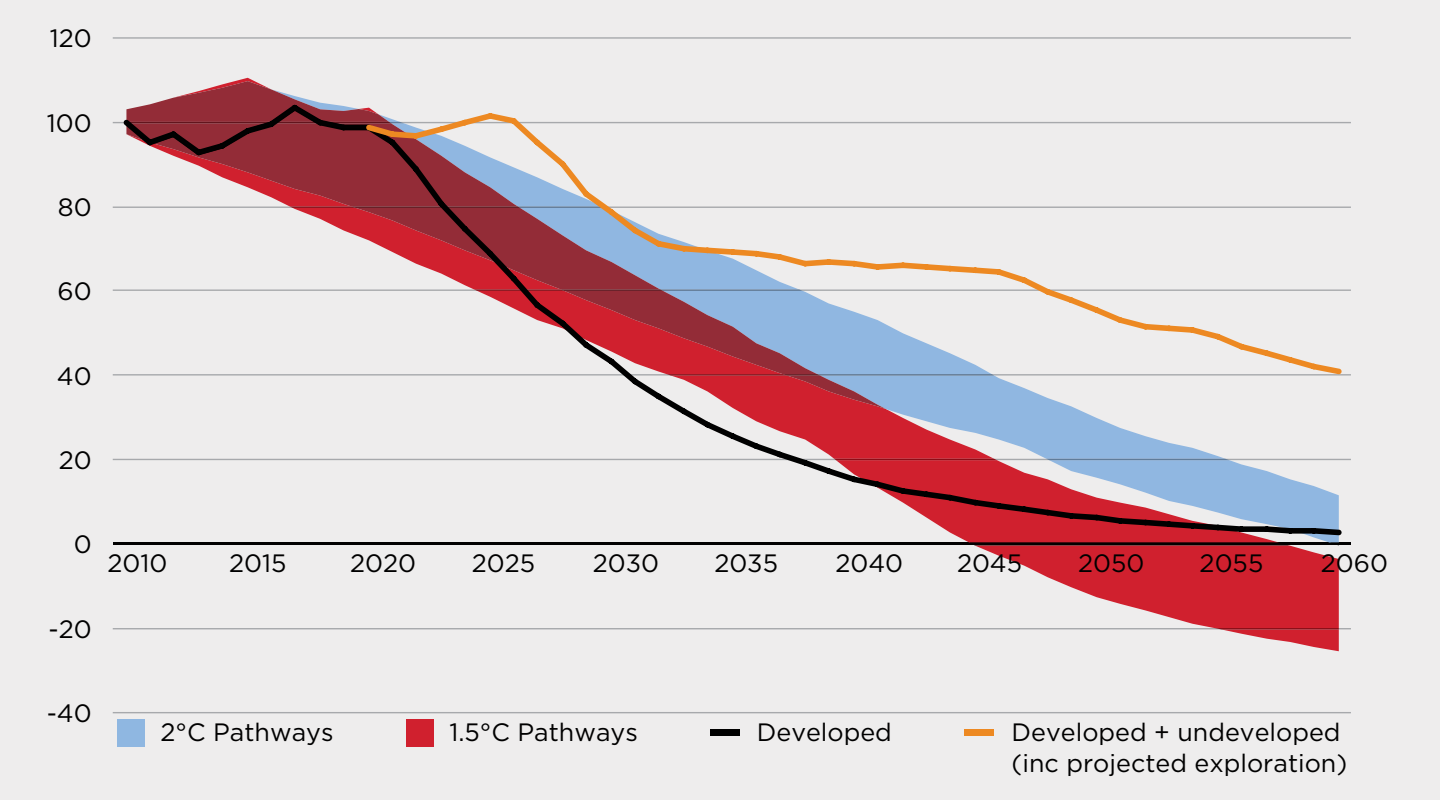
A study by Joeri Rogelj and colleagues, published in *Nature Climate Change,* used the integrated assessment models (IAMs) MESSAGE and REMIND and found that to keep warming below 2 degrees Celsius, global emissions need to be reduced by half from current levels by the late 2030s, and reach zero some time around 2065. To aim for 1.5 degrees Celsius, emissions need to be halved by the early 2030s - in fifteen years' time - and reach zero by 2050 (Figure 8)[18]. And these estimates rely on unproven negative emissions technology working out - if it doesn't, those cuts need to be achieved earlier.

Figure 8 compares these rates of emissions declining globally in safer climate scenarios with projected emissions in Norway under two scenarios: no new development, and exploitation of undeveloped and undiscovered reserves. If Norway is to be somewhat aligned with the necessary global trajectory for either 1.5 or 2 degrees Celsius, it must not develop new reserves, and must manage the decline of existing production.

Norway has no good answer as to how to square these two very different rates of change. When pressed, the government says that the world needs more oil, often citing the International Energy Agency (see box), and argues that it's best that it is Norwegian oil. For example, climate and energy minister Vidar Helgesen has said "We are living in a time of tremendous energy transformation. We want to play a part whether it is in electrification, bio-energy, hydropower, or any other green energy. But Norway has the cleanest hydrocarbons anywhere in the world. And as long as the world needs oil and gas, we will provide it."[20]

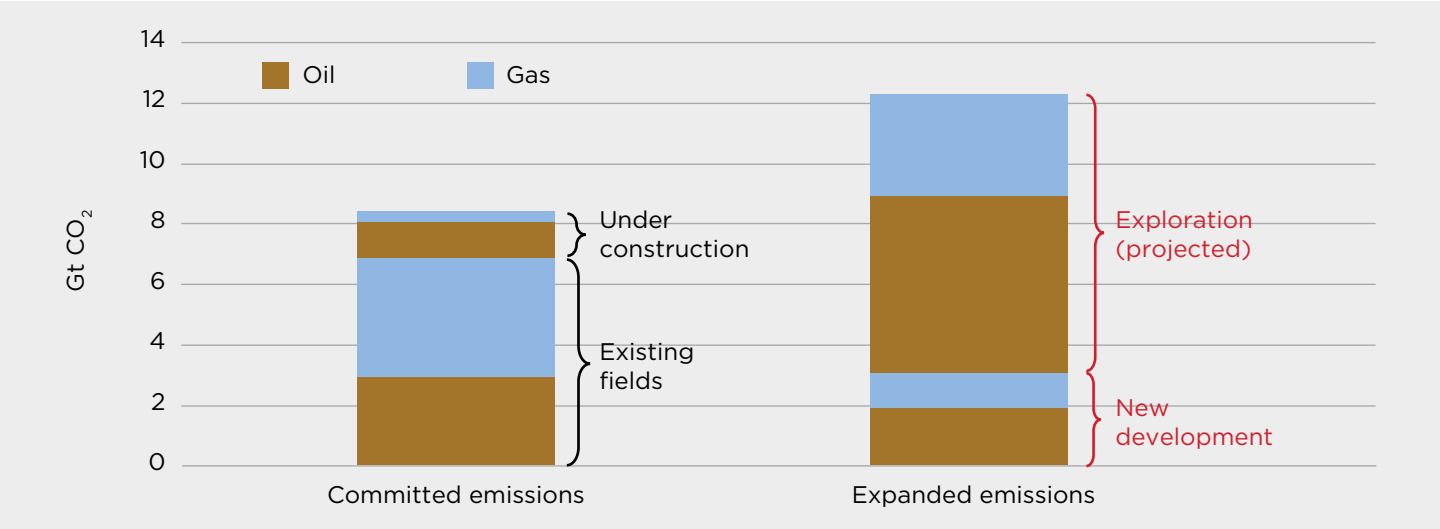
For Norway to produce a larger share, other countries' production would have to be restrained - but the government has never explained how this is supposed to happen. If by market forces, as the government seems to believe, it needs to explain how it expects

Figure 8: Rates of change (base year 2010 = 100) of global emissions in a range of 1.5 or 2 degree Celsius scenarios, and of emissions from Norwegian developed and undeveloped oil and gas fields.[9]



18. Joeri Rogelj et at, *Energy system transformations for limiting end-of-century warming to below 1.5°C,* Nature Climate Change, Vol.5, June 2015, p.520; communication with author
19. *Ibid*
20. Mark Lewis, "Paradox nation: Norway, a climate leader making money on oil", AP, 1 August 2016, https://apnews.com/0bd16375f6f64b5692762d9bade062fd/paradox-nation-norway-climate-leader-making-money-oil

Figure 9: Committed and expansion emissions from Norway's oil and gas reserves.[21]



markets to favor its expensive oil over cheaper extraction elsewhere. This is the cognitive dissonance at the heart of Norwegian climate policy.

We saw in section 3 that the oil, gas and coal in the world's existing fields would take warming beyond 2 degrees Celsius, and oil and gas alone would take it beyond 1.5 degrees. Through its current petroleum policy, Norway is one of the countries adding to this imbalance, driving the world toward climate catastrophe.

As Figure 9 shows, Norway's proposed expansion and projected exploration results would generate 150% more emissions than what is in its currently operating fields.

The global climate crisis cannot be dealt with effectively by using only demand side policies, because expanding production undermines efforts to reduce emissions. Supply and demand interact in global markets and should be addressed in parallel[22].

This is the crux of the predicament for Norway. By failing to extend its climate leadership to limiting and managing the decline of its own oil and gas sector, Norway is instead facilitating new production that is incompatible with global carbon budgets.

By failing to extend its climate leadership to limiting and managing the decline of its own oil and gas sector, Norway is instead facilitating new production that is incompatible with global carbon budgets.

Norway falls within a small category of regions that are wealthy fossil fuel producers, who simultaneously advocate for ambitious climate action within international forums, and take steps to reduce the use of fossil fuels domestically. By failing to limit fossil fuel production on the supply side, such regions are undermining their own commitments and reinforcing incentives for the petroleum industry to continue expansion globally. Others in a similar position include Canada, whose tar sands production and expansion is at cross-purposes with climate goals, and the state of California in the United States, whose fracking undermines other state-level climate action.

LOSING MONEY, LOSING THE CLIMATE

In a climate-safe world, the global demand for oil will decline dramatically. Any assumption that investments in long-term oil projects (like those proposed in Norway) will continue to be profitable assumes the opposite: that demand will not decline and climate action will fail.

If fossil fuel demand reduction is tackled without addressing fossil fuel supply, as the Norwegian government advocates, declining oil demand will lead to lower prices, making

21. Rystad UCube, 27 June 2017. See note to Figure 3.
22. See Muttitt, Sky's Limit, *op. cit.*, section 4 for an in depth discussion on the topic.

projects that relied on a sustained higher price a bad investment[23]. They then become stranded assets; that is, assets that fail to deliver economic returns.

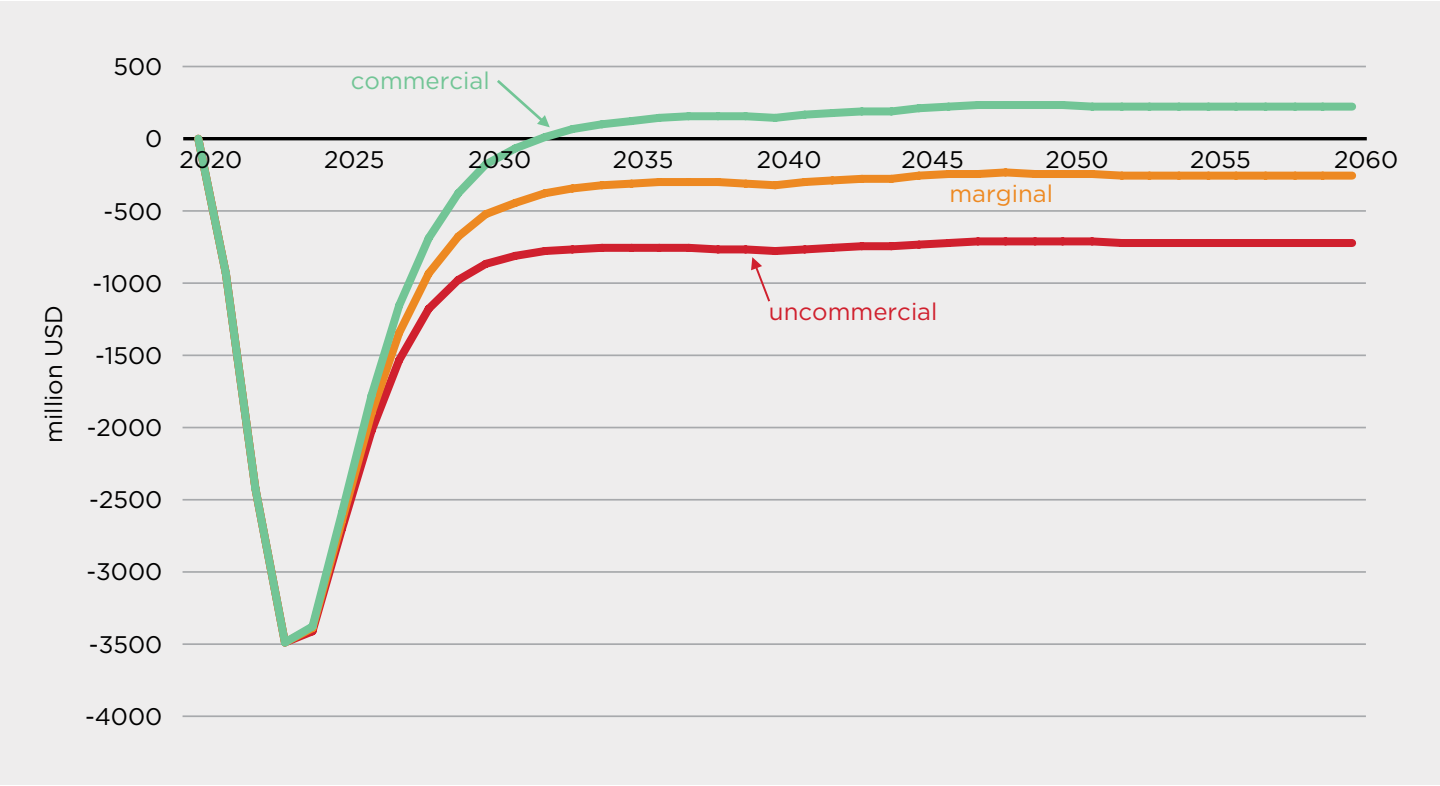
Because oil and gas production is capital-intensive, investments today may crash into climate policy tomorrow. To illustrate the problem, we look more closely at one proposed project: the Wisting Field, which is one of Norway's largest ever oil finds in the Barents Sea.[24] Discovered in 2013, the field is currently undergoing appraisal, with a final investment decision expected in 2019 or 2020, on whether to invest about USD 13 billion. Future prices dictate the project's economics:

- At constant real oil price of USD 60 per barrel, it will break even in 2032, and deliver a comfortable internal rate of return of 11.3%.
- At USD 50, the project is at best marginal, delivering an IRR of 8.6%.[25]
- At USD 40, Wisting is uncommercial, delivering just 5.3% - well below the cost of capital.

If oil companies decide in 2019-20 to proceed with the project, they are making a bet that oil prices will stay well above USD 50 for at least the next 15 years.

Abrupt climate action at a later date is much more difficult than not developing new resources to begin with. Figure 10 shows the expected cashflow profile of the Wisting project. Once the project has been developed, the economic incentives push for continued production even if it means a long-term loss on the capital invested, since closing down would lead to an even greater loss. As long as the curve is rising - which happens as long as oil price is above the marginal operating cost of about USD 9 per barrel - continued production reduces the ultimate loss, or maximizes any gain. This is the problem of lock-

Figure 10: Projected cumulative discounted cashflow for the Wisting field in three price scenarios (10% discount rate, in nominal terms)[26]



23. Alternatively, if more of global climate action is on the supply side, there are no plausible justifications for Norway continuing to build new infrastructure, within the global carbon budget.
24. Wisting is operated by OMV, but Statoil has the largest share in the consortium.
25. The IRR, like the chart below, is expressed in nominal terms.
26. Oil Change International model, using production and expenditure projections from Rystad UCube, 7 July 2017. Assume inflation 2.5%, emissions 9 kg per bbl, carbon tax NOK 445/t, exchange rate NOK 1 = USD 0.12 Oil Change International model, using production and expenditure projections from Rystad UCube, 7 July 2017. Assume inflation 2.5%, emissions 9 kg per bbl, carbon tax NOK 445/t, exchange rate NOK 1 = USD 0.12

in. This carbon will be burned unless governments take the much more difficult action to force early closure.

In other words, developing new oil fields sets up a lose-lose scenario. Companies lose money, workers lose jobs, and emissions exceed climate limits.

Research by Adrian Down and Peter Erickson of Stockholm Environment Institute suggests this problem applies to most of the new activity proposed in Norway. They arranged Norwegian oil resources on a cost curve, and compared these with the breakeven price implied by restricting global production so as to keep warming well below 2 degrees. They found that while many of Norway's already-producing sub-basins had breakeven price below that threshold, all but one of those yet to be developed had a higher price.[27] If developed, these new resources would either lose money, or would prevent the world achieving the Paris goals, or both.

NORWAY—NOT THE GREENEST

Governments in Norway have often made the self-serving argument that even if there is a constraint to how much oil can be extracted worldwide, it is best that more of it is extracted in Norway, which has stronger climate policies.

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For example, former Oil & Energy Minister Tord Lien said, "Norway already has the world's strictest rules, including its own CO_2 tax, which is ten times higher than the quota price. I want to reduce emissions both in Norway and internationally, but reducing the Norwegian oil and gas production will have minimal impact on climate in the world. If Norway produces less, other, less environmentally friendly countries will produce more."[28]

There are two elements to this argument: first, that reducing Norwegian production will not affect global emissions because other countries will replace the production; and second, that production in Norway has lower emissions. The first is at best misleading, and the second misses the point.

The claim that others will replace any reduced Norwegian production refers to a problem known as leakage: reduced supply in one place pushes up the oil price, making more expensive production viable somewhere else. This does happen to some extent, but only partially. In fact, the same is true when tackling emissions at source, also only partially: reducing oil demand (for example, by making vehicles more efficient) decreases the price, encouraging consumers elsewhere in the world to increase their consumption.[29] The key question is on which side climate action leaks more? The answer depends on the price elasticities of supply and demand: if demand is more elastic than supply, leakage will be greater for demand policies, and vice-versa.[30]

Taran Fæhn and colleagues at Statistics Norway examined this question for Norwegian policy specifically. Taking into account leakage on both sides, they found that emissions could be reduced on the supply side at less than half the cost of doing so on the demand side. They recommended that in order to achieve maximum climate benefit at lowest cost to the Norwegian economy, the majority of climate mitigation should take place on the supply side [31].

27. The SEI study looked at the economics of Norway's new oil fields using a 10% nominal discount rate and Rystad Energy's "risked" estimates of future production volumes, therefore evaluating these fields in a manner consistent with other prospective oil investments around the world. It is possible, and even likely, that the support provided for oil extraction by the Norwegian government may reduce the risk of new investments in the country to such an extent that they may nonetheless remain profitable. If so, this raises questions about the role of Norway's petroleum taxation and support regime in making the country's oil "consistent" (or not) with a low-carbon pathway.
Adrian Down and Peter Erickson, "Norwegian oil production and keeping global warming 'well below 2°C'", SEI Discussion Brief, March 2017, https://www.sei-international.org/mediamanager/documents/Publications/SEI-DB-2017-Norway-oil-production-well-under-2C.pdf
28. Cato Husabø Fossen & Petter Emil Wikøren, "Oljeministeren sjokkert over Ap: – Støre truer tusenvis av norske jobber", VG Nyheter, 14 August 2014, http://www.vg.no/nyheter/innenriks/olje-og-energi/stoere-truer-tusenvis-av-norske-jobber/a/23273327/
29. See The Sky's Limit pages 33-34
30. Michael Lazarus, Peter Erickson and Kevin Tempest, "Supply-side climate policy: the road less taken", SEI Working Paper, October 2015, pp.13-15, http://sei-us.org/Publications_PDF/SEI-WP-2015-13-Supply-side-climate-policy.pdf
31. Taren Faehn et al., Climate policies in a fossil fuel producing country Demand versus supply side policies, 13 June 2013, Discussion Papers, Statistics Norway Research department No. 747, pg. 4, https://www.ssb.no/en/forskning/discussion-papers/_attachment/123895?_ts=13f51e5e7c8

Part of the reason for this result is that Lien's claim of Norwegian oil production having lower emissions misses the point. According to Wood Mackenzie, emissions from Norwegian oil production are 9.7 kg per barrel of oil equivalent (kg/boe), compared to a global average of 18 kg/boe.[32] The difference of 8.3 kg is just 2 percent of the roughly 430 kg that are emitted from burning each barrel. Even if the leakage rate were very high at 80 percent, the effect of additional production is still an order of magnitude greater than a gain due to lower operational emissions.

FORECASTING FAILURE: THE SHORTFALLS OF THE IEA 450S[33]

When seeking justification for continued fossil fuel development, the Norwegian government has cited the International Energy Agency's (IEA) 450 Scenario (450S). For example, an article quoting former Oil Minister Tord Lien referencing the 450S states: "I mean that today's report shows that it is possible to develop a sustainable energy system and that even in such a scenario you describe, there is considerable room for Norwegian oil and gas." Lien points out that in the 450 scenario, about 60 percent of the energy needed will come from fossil energy sources.[34]"

However, this scenario gives only a 50% probability of keeping temperature increases below 2 degrees Celsius[35]. As such it does not match current internationally agreed global climate goals, as contained in the Paris Agreement of staying well below 2 degrees Celsius and striving for 1.5 degrees Celsius. First published in 2009, the 450S reflects the previous aim of limiting warming to 2 degrees Celsius[36]. Since then, new findings on climate change impacts have indicated that 2 degrees Celsius can no longer be considered an adequate target, but rather the absolute maximum that can be tolerated[37].

Like any projection, the 450S tells us only about one possible future in which its assumptions turn out to be correct. It is not **the** 2 degrees Celsius future. Three important assumptions in the 450S may lead to understating the decline of oil and gas production:

- It makes generous assumptions about technological success in Carbon Capture and Storage (CCS)[38]. This may be a dangerous assumption: progress to date on the technology has been described by the *Financial Times* as "woeful", and today several governments and companies are pulling back from CCS projects[39].
- It assumes an overshoot of the climate target,[40] where negative emissions are expected to later bring down atmospheric concentrations – another unproven technology. The IEA also does not disclose the rate at which emissions are expected to fall after the outlook period to 2040: it may be that deeper cuts are assumed, which understate the required cuts during the period being examined.
- It assumes the majority of emissions reduction will occur in developing countries[41] – an unlikely outcome, given both climate politics and basic fairness. Since poorer countries rely disproportionately on coal for their energy, compared to oil and gas,[42] a consequence of this assumption is that it may understate the degree of reductions in oil and gas.

Combined with the low probability of success, the result is that the 450S projects oil production would have to fall by just 17 percent between 2013 and 2040 (and coal by only 38 percent); while gas production could actually increase by 16 percent[43].

Meeting the Paris goals will require much deeper reductions than the 450 Scenario suggests.

32. Wisting is operated by OMV, but Statoil has the largest share in the consortium.Wood Mackenzie, "Oil and gas in Norway: A pioneering carbon approach", 6 March 2017, https://www.woodmac.com/analysis/norway-carbon-approach The IRR, like the chart below, is expressed in nominal terms.
33. Greg Muttitt, Forecasting Failure: *Why investors should treat oil company energy forecasts with caution*, Oil Change International, March 2017, http://priceofoil.org/content/uploads/2017/03/forecasting-failure.pdf
34. Martin Larsen Hearth, Sysla,Fremdeles plass til norsk olje og gass, October 11 2015, https://sysla.no/gronn/fremdeles-plass-til-norsk-olje-og-gass/ Lien's predecessor made the same argument. Drawing on the 450 Scenario, he argued: "Significant changes are required if we are to limit global warming to no more than two degrees by 2050. However, even in that scenario, energy consumption will have increased by more than 20% in 2035" - Ola Borten Moe, "Norway's Energy Challenges", in Roy H. Gabrielsen and John Grue (Eds.), "Norwegian Energy Policy in Context of the Global Energy Situation", Det Norske Videnskaps-Akademi / Norges Tekniske Vitenskapsakademi, May 2012, p.21, http://www.ntva.no/wp-content/uploads/2014/01/norwenergypolicyglobalcontext.pdf, IEA: Norge bør produsere mer olje og gass, May 30, 2017, https://www.nrk.no/norge/iea_-norge-bor-produsere-mer-olje-og-gass-1.13537716
35. The IEA's annual World Energy Outlook contains three scenarios, intended to illustrate three levels of climate action: no further action (Current Policies Scenario), emissions pledges met (New Policies Scenario) and long-term goal met (450 Scenario). The problem is that the 450 Scenario uses the wrong long-term goal.
36. The 2°C goal was proposed by the UNFCCC in Copenhagen in 2009 and formally adopted the following year at Cancún.
37. eg "The 'guardrail' concept, in which up to 2°C of warming is considered safe, is inadequate and would therefore be better seen as an upper limit, a defense line that needs to be stringently defended, while less warming would be preferable" - UNFCCC Subsidiary Body for Scientific and Technological Advice, Forty-second session, Bonn, 1–11 June 2015, Report on the structured expert dialogue on the 2013–2015 review, p.18, http://unfccc.int/resource/docs/2015/ sb/eng/inf01.pdf For analysis of the difference in impacts between 1.5°C and 2°C, see Carl-Friedrich Schleussner et al, "Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2°C," Earth System Dynamics #7, 2016, pp.327-351, http://www.earth-syst-dynam.net/7/327/2016/esd-7-327- 2016.pdf
38. The CCS assumption was reduced in the 2016 World Energy Outlook, but still assumes about 3 Gt of CO_2 per year are captured by 2040. IEA, World Energy Outlook 2016, Fig.8.6, p.327
39. For example, in 2015 the United Kingdom cancelled its competition for commercial-scale CCS projects and the United States terminated funding for the FutureGen CCS retrofitting demonstration project. Earlier in 2015, four leading European utilities pulled out of the European Union's Zero Emission Platform. For a discussion, see Muttitt, Sky's Limit, op. cit, p.48
40. IEA, World Energy Model Documentation, 2016 Version, p.5, http:// www.worldenergyoutlook.org/media/weowebsite/2016/WEM_ Documentation_WEO2016.pdf
41. IEA, *World Energy Outlook 2014,* Fig.2.21, p.91
42. Coal accounts for 19% of primary energy in industrialized countries in OECD countries, but 37% of primary energy in non-OECD countries. IEA, World Energy Outlook 2015 data tables
43. IEA, *World Energy Outlook 2015,* p.583

5. EQUITY: WHY NORWAY SHOULD LEAD

The world already has access to more fossil fuels than it can afford to burn. By continuing to explore for and develop new reserves, Norway is forcing a more difficult transition on other countries (as well as itself). Given finite global carbon budgets, each barrel of oil extracted in Norway is a barrel that cannot be extracted elsewhere. The likely result is depriving poor countries of development opportunities: essentially of revenue that could be used to build hospitals or schools.

Moving beyond oil will be a challenge for Norway, where it currently accounts for 12 percent of the country's GDP and 13 percent of government revenue[44]. But, as we discuss further in section 6, Norway has also built a relatively diverse economy that would be resilient in a well managed decline of oil and gas production. By comparison, in Angola for example, oil accounts for 40 percent of GDP and 70 percent of government revenue[45]. Not only is Norway less dependent than many other major producers, but it also has significantly more resources (income and wealth) to facilitate the transition. When Oil Minister Terje Søviknes says "It won't be possible to replace the [Norwegian] revenue stream from oil and gas for several more generations,"[46] that is a claim either that the rest of the world must suffer climate change, or that poorer countries should bear more of the burden of transition than wealthy Norway.

While all countries will need to undergo a managed decline of their fossil fuel sectors, the poorest nations will need significant support, including their fair share of the global carbon budget to aid in the transition.

Norway has managed its fossil fuel wealth arguably better than any other nation in the world, generating over USD 960 billion for its sovereign wealth fund[47]. This wealth, secured through foresight and good management, makes Norway well-positioned to lead in phasing out extraction.

The equitable distribution of a global carbon budget will not be clear cut or simple. But, by the various likely measures, there are no circumstances in which Norwegian production continues unfettered. In addition to its wealth and relative ease of transition, Norway is also home to some of the most expensive oil currently proposed for development with breakeven prices generally around USD 40 to USD 50. Furthermore, much of this proposed development pushes further into the fragile and remote Arctic - among the most environmentally damaging development and where a spill would be catastrophic.

The world already has access to more fossil fuels than it can afford to burn. By continuing to explore for and develop new reserves, Norway is forcing a more difficult transition on other countries (as well as itself).

Norway is often considered a nation of upstanding morality and ethical values. Alfred Nobel believed the Norwegians to be uniquely qualified to judge the Nobel Peace Prize, presumably on this basis. These values can be seen emerging in the ethical considerations made vis-à-vis the investments of the nation's sovereign wealth fund. And they are the same values that should underpin a principled and just transition away from fossil fuels.

44. Ministry of Petroleum and Energy / Norwegian Petroleum Directorate, "The government's revenues", http://www.norskpetroleum.no/en/economy/governments-revenues/
45. CIA World Factbook - Angola, https://www.cia.gov/library/publications/the-world-factbook/geos/ao.html
46. NewsinEnglish.no, "Leaders clash at NHO conference", January 5, 2017, http://www.newsinenglish.no/2017/01/05/leaders-clash-at-nho-conference/
47. Gwladys Fouche, Reuters, *Factbox: Norway's $960 billion sovereign wealth fund,* June 2 2017, http://www.reuters.com/article/us-norway-swf-ceo-factbox-idUSKBN18T283

Photo: Climate March in Oslo. © Monica Løvdahl / Greenpeace

6. MANAGED DECLINE AND A JUST TRANSITION: A RATIONAL WAY FORWARD

MANAGING THE DECLINE

A consistent thread of Norway's climate policy, through different governments over the years, is the notion that climate change should be addressed only at the point of emissions, while the supply of fossil fuels should be left to the market. That view is now no longer supportable. Our analysis indicates a hard limit on the amount of fossil fuels that can be extracted worldwide, pointing to an intervention that can only be implemented by governments. We conclude that as soon as possible, Norway should:

- Freeze further leases or permits for new oil and gas extraction projects as well as transportation infrastructure that would incentivize additional exploration.
- Set a global precedent and publicly commit to managing the decline of the fossil fuel industry within the Paris goals of 1.5 degrees Celsius or well below 2 degrees Celsius.

While this would mark a significant change in the direction of climate policy, it is also the least disruptive and least painful option. In the absence of a dramatic turnaround for CCS, further building of fossil fuel extraction infrastructure will lead us only to two possible futures, both of which entail vast economic and social costs. What we propose in this report is the easiest global approach to restraint: when in a hole, stop digging.

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Existing fields contain a large amount of oil and gas, which will be extracted over time. Rates of extraction will decline without development of new resources and infrastructure, but the decline is far from precipitous. For example, Statoil's Johan Sverdrup oilfield in the North Sea, due to start production in 2019, is designed to produce for 50 years.[48] Remember that emissions must decline rapidly, to net zero around 2065 for a likely chance of staying below 2 degrees Celsius, or by 2050 for a medium chance of staying below 1.5 degrees Celsius.

We saw in the previous section that Norway has a responsibility to lead. That does not mean it is easy for Norway. Oil still accounts for 12 percent of Norway's GDP, and 13 percent of government revenues,[49] and there is a need to replace these through further economic diversification. To date, Norway has been more successful than most other oil exporters in diversifying its economy, essentially by creating a strong domestic supply chain for its oil industry, and then enabling those suppliers to diversify into providing for other sectors, while giving strong government support for innovation. With almost all of its power generation hydro-electric, Norway also has a comparative advantage in low-carbon manufacturing in electricity-intensive industries.[50]

48. Statoil, "Proceeding with Phase 2 of the Johan Sverdrup development," March 21, 2017, https://www.statoil.com/en/news/proceeding-with-Johan-Sverdrup-development.html
49. Ministry of Petroleum and Energy / Norwegian Petroleum Directorate, "The government's revenues", http://www.norskpetroleum.no/en/economy/governments-revenues/
50. Olav Wicken, "Industrial diversification processes and strategies in an oil economy", in Sami Mahroum & Yasser al-Saleh (eds), "Economic Diversification Policies in Natural Resource Rich Economies", Routledge, 2017, pp.310-312

At present, by continuing to award massive new acreage for oil licensing, the Norwegian government appears to be pursuing the opposite of a just transition.

What is clear is that economic diversification takes time. So a rational approach in Norway would be to begin that process now, while the production from existing fields gradually declines, rather than waiting until later, when the necessary changes would be abrupt, and hence much more difficult and costly.

JUST TRANSITION

The Norwegian government estimates that about 185,000 jobs depend directly or indirectly on the oil industry.[51] Protecting the livelihoods of those workers and their families must be a priority in the transition away from the oil economy. However, that does not diminish the need to make the transition. As the International Trade Union Confederation puts it, "there are no jobs on a dead planet"[52].

Those workers would not be served by postponing the transition for some later date, when carbon budgets are almost depleted. An unmanaged decline would mean a sudden change, throwing everyone out of work. At present, by continuing to award massive new acreage for oil licensing, the Norwegian government appears to be pursuing the opposite of a just transition.

As noted above, we are not proposing a sudden end to the oil industry. This gives an opportunity for a planned process, taking into account the employment needs of the industry as it goes through a managed decline, taking advantage of natural retirement to minimize premature job loss, and identifying where skills can be redeployed in the economy (or where new skills are needed), and providing the necessary support.

Norwegian trade unions and environmental organizations, the state church, and researchers have come together in the Bridge to the Future initiative, to demand a democratic, planned, just transition that creates 100,000 climate jobs.[53]

Trade unions and others have developed a framework for a just transition in relation to climate change, the importance of which is recognized in the preamble of the Paris Agreement. Key elements of a just transition include[54]:

- Sound investments in low-emission and job-rich sectors and technologies.
- Social dialogue and democratic consultation of social partners (trade unions and employers) and other stakeholders (such as communities).
- Research and early assessment of the social and employment impacts of climate policies.
- Training and skills development to support the deployment of new technologies and foster industrial change.
- Social protection alongside active labor market policies.
- Local economic diversification plans that support decent work and provide community stability in the transition.

Oil workers have made an important contribution to the Norwegian economy. The government must recognize that contribution and ensure those workers have a meaningful role in the future economy too. Just as important, the transition will also affect the indirect workforce, from mechanics to taxi drivers, whose positions are often more precarious than jobs directly in energy companies. Communities may be hit by a loss of revenue or local economic activity, and cultural impacts in places where a community has been long associated with a particular employer or industry. These are all issues that can be addressed rationally by planning ahead.

51. Ministry of Petroleum and Energy / Norwegian Petroleum Directorate, "Employment in the petroleum industry", http://www.norskpetroleum.no/en/economy/employment/
52. International Trade Union Confederation, Climate Justice: There Are No Jobs on a Dead Planet, March 2015, https://www.ituc-csi.org/IMG/pdf/ituc_frontlines_climate_change_report_en.pdf pp. 16
53. http://broentilframtiden.com
54. International Trade Union Confederation, *Climate Justice: There Are No Jobs on a Dead Planet,* March 2015, http://www.ituc-csi.org/IMG/pdf/ituc_frontlines_climate_change_ report_en.pdf

7. CONCLUSION

The global carbon budget is finite and dwindling. As the world moves to curb its addiction to fossil fuels, both consumption and supply are going to decline. Producing countries face an inflection point: do they embrace the inevitable and proactively manage the decline of the sector, or continue on a status quo trajectory? The former offers opportunities for leadership and innovation in defining the course for a post-carbon economy, while the latter threatens workers, communities, and finance that have become dependent on the fossil fuel-based economy.

In the case of Norway, the opportunity for precedent-setting leadership is tremendous. The country does not need to progress through the century as a major emissions exporter. Norway is well-positioned to use its climate values and wealth to drive a transition that redefines how fossil fuel exporters will thrive in a clean energy economy. It must go well beyond domestic efforts to reduce emissions and extend to limiting and phasing-out the production of the very source of the climate crisis.

Norway is well-positioned to use its climate values and wealth to drive a transition that redefines how fossil fuel exporters will thrive in a clean energy economy.

In conclusion, we recommend that Norway:

- Freeze further leases or permits for new oil and gas extraction projects or transportation infrastructure that would incentivize additional exploration.
- Publicly commit to managing the decline of the fossil fuel industry within the Paris goals of 1.5 degrees Celsius or well below 2 degrees Celsius.
- Redefine global climate leadership by setting a global precedent to manage the decline of existing production in line with climate safe limits while ensuring a just transition for affected workers and communities.

These actions will necessitate bold and decisive action by a government on a scale not seen thus far. But the conclusions are also remarkably straightforward at their core. To keep from burning more fossil fuels than our atmosphere can withstand, we must stop digging them out of the ground. With this report, we put forward recommendations on how to go about doing just that in a sufficient, equitable, economically efficient, and just fashion.


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