



Beyond Expectations: Ocean Solutions to Prevent Climate Catastrophe

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Stopping the expansion of offshore oil and gas drilling along with other ocean-based solutions can contribute nearly 40% of the emission reductions needed to prevent the worst impacts of the climate crisis.

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Ocean Solutions to the Climate Crisis

New drilling for oil and gas offshore threatens to be a major source of greenhouse gas (GHG) emissions. Conversely, a significant contribution to reducing climate change can be captured by stopping new offshore oil and gas drilling.

We already know that the oceans can play a role in mitigating climate change. In 2019, the High Level Panel for a Sustainable Ocean Economy (HLP) released a report showing that five ocean-based solutions can deliver 25% of the annual GHG emission reductions needed by 2050 to prevent devastating climate impacts. These reductions come from: Ocean-Based Renewable Energy; Ocean-Based Transport; Coastal and Marine Ecosystems; Fisheries, Aquaculture, and Dietary Shifts; and Carbon Storage in the Seabed.¹

Taking less oil and gas from under the ocean will achieve GHG reductions over and above those identified in the HLP report. This analysis, based on a model by the International Energy Agency (IEA), quantifies how emissions can be further reduced by stopping the

expansion of offshore oil and gas drilling, as well as through the phasedown of production from existing offshore wells due to policies and changes in consumer behavior that decrease fossil fuel demand. Reducing ocean-based oil and gas production in these ways will deliver greater emission reductions than any one of the other HLP solutions — an additional 13% of needed reductions.

Combining this analysis with the HLP report, these six ocean solutions can contribute nearly 40% of the emission reductions needed to keep average temperature rise below 2 degrees Celsius (°C) (Figure 1).²

The analysis presented here assumes emission reductions targets aimed at keeping warming well below 2°C, as the 1.5°C target looks increasingly difficult. That said, 2° of warming would bring devastating impacts to the planet and to society, so every fraction of a degree between the two matters.

Ocean Solutions Deliver Significant Greenhouse Gas Emission Reductions

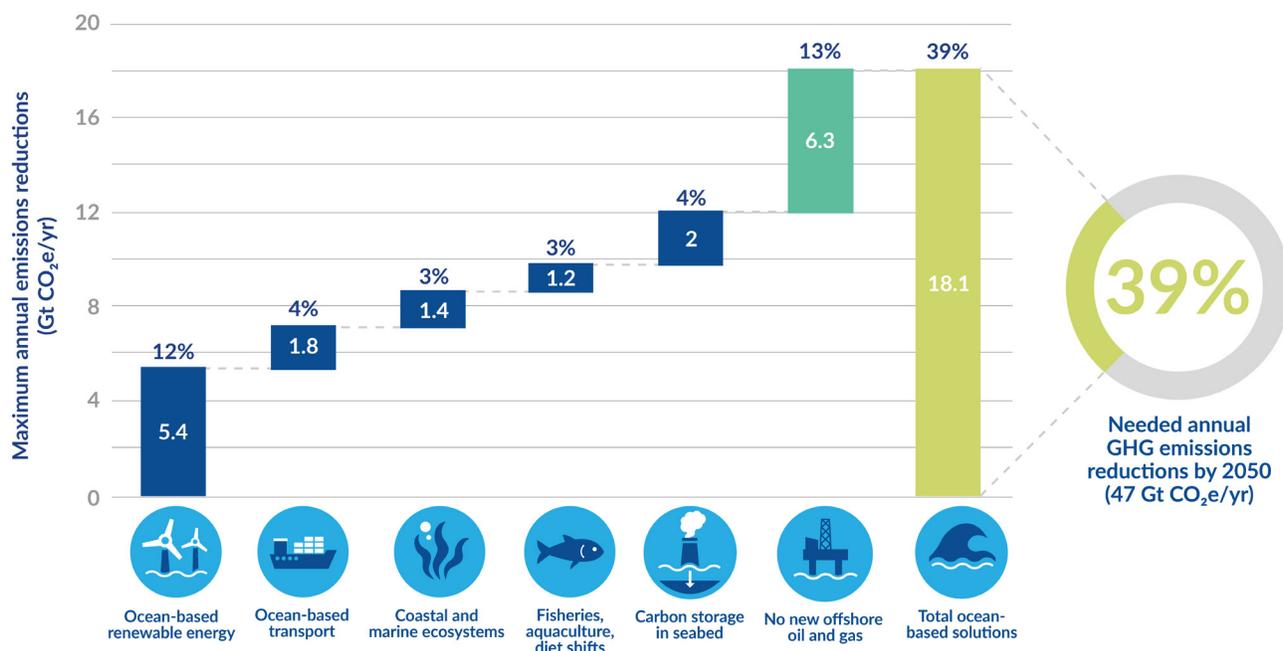


Figure 1: No new offshore oil and gas, when added to the five HLP ocean-based solutions, can provide nearly 40% of the emission reductions needed by 2050 to limit average temperature rise to 2°C.



Ocean-based renewable energy — replacing fossil-based power production with renewable sources like responsibly sited offshore wind, and wave and tidal power. Offshore wind is becoming cheaper and more competitive compared to fossil fuel energy generation.



Fisheries, aquaculture, diet shifts — improving catch efficiency, decreasing fuel use in fishing effort, and incentivizing marine food sources as a climate-friendly alternative to more GHG-intensive land-based agriculture. The Aquatic Blue Food Coalition is raising the prominence of ocean-based foods in international forums.



Ocean-based transport — improving shipping efficiency, shifting to batteries and lower/zero carbon fuels, and decreasing speeds. Recent initiatives and proposals from the Global Maritime Forum, the International Chamber of Shipping, and the European Union aim to help meet the emission reductions needed in the shipping sector.



Carbon storage in seabed — injecting CO₂ emitted from power plants directly into the seabed, containment vessels, and the deep ocean, as well as alkalinity addition and ocean fertilization to capture atmospheric CO₂. More research is needed before this could be considered a safe and viable net emission reduction solution, given the serious issues around sequestration projects associated with offshore gas production and uncertainty over whether storage is truly durable.



Coastal and marine ecosystems — protecting and restoring coastal ecosystems like mangroves and seagrass beds, which account for nearly half of global natural marine carbon sequestration. International efforts like the Blue Carbon Initiative and the International Partnership for Blue Carbon are underway and hold promise.



No new offshore oil and gas — stopping expansion of offshore oil and gas drilling and phasing down production in existing wells. This new addition models halting new development and restricting any leases not already under production, while accelerating clean and efficient energy policies to reduce offshore oil and gas demand and production over time.



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Our Analysis

Currently, nearly 30% of all oil and gas production comes from offshore areas.^{3,4} Offshore drilling generates GHG emissions through the entire process, starting with exploration and extraction from below the seafloor; through onshore emissions during intensive processing, refining, and transportation; and finally, and most significantly, when the fuels are burned.^{5,6} Unintentional leaks and intentional burning of excess gas during oil extraction also release large amounts of methane — an especially powerful GHG — into the atmosphere.⁷

In 2018, the IEA created a scenario that projected the expansion of offshore oil and gas drilling, assuming current policies and trends continue unchanged.⁸ In this business-as-usual (BAU) scenario, the world would greatly exceed emission targets and would not meet the Paris Agreement’s goal of reducing emissions sufficiently by 2050 to prevent catastrophic 2°C warming. Compared

to BAU, IEA’s “Net Zero Emissions” (NZE)ⁱ scenario from 2021 would result in a reduction of 6.3 billion metric tons (Gt) of CO₂ equivalent annual emissions (CO₂e — i.e., CO₂, methane, nitrous oxide) by 2050 (Figure 2).⁹

The NZE scenarioⁱ shows what is necessary for the global energy sector to achieve net-zero CO₂ emissions by 2050: no new offshore oil and gas development and a contraction in production from existing wells driven by a sharp decline in fossil fuel demand.⁹ In addition, this scenario supports a range of other decarbonization levers (such as energy efficiency measures, renewables expansions, greater electrification, and the use of hydrogen), which will help reduce offshore oil and gas demand and production over time from 44 million barrels of oil equivalent (Mboe)/dayⁱⁱ in 2016 to 17 Mboe/day by 2050 — in line with a well-below 2°C emission reduction pathway (see supplemental Figure 1 in Appendix).ⁱⁱⁱ

ⁱ Offshore oil and gas production from existing wells will continue over the course of the NZE transition, with measured year-over-year declines. The NZE scenario requires this maintained phasedown, where production volumes fall but not as quickly as they would naturally. If offshore production is phased out too quickly, new sources of conventional onshore oil and gas would need to come online in the near term to replace that fuel, diverting new investment away from renewables and other low-carbon technologies.

ⁱⁱ A barrel of oil equivalent (boe) is a unit describing the energy produced from burning one barrel, or 42 U.S. gallons, of crude oil. Global gas production volume in billion cubic meters is converted to million barrels of oil equivalent (Mboe) to be comparable with crude oil production.

ⁱⁱⁱ The NZE scenario by IEA is consistent with around a 50% chance of limiting the long-term average global temperature rise to 1.5°C by 2050. Our estimates show that applying the 6.3 Gt CO₂e/year reduction to the needed emission reductions in a 1.5°C pathway would result in offshore oil and gas contributing to 11% of needed reductions (as opposed to 13% in a 2°C pathway).

By 2050, the emissions saved by stopping new offshore drilling and phasing down production is equivalent to taking 1.4 billion cars off the road.

Photo Credit: Koushik Pal/Unsplash

Stopping New Offshore Drilling Reduces Emissions Over Time

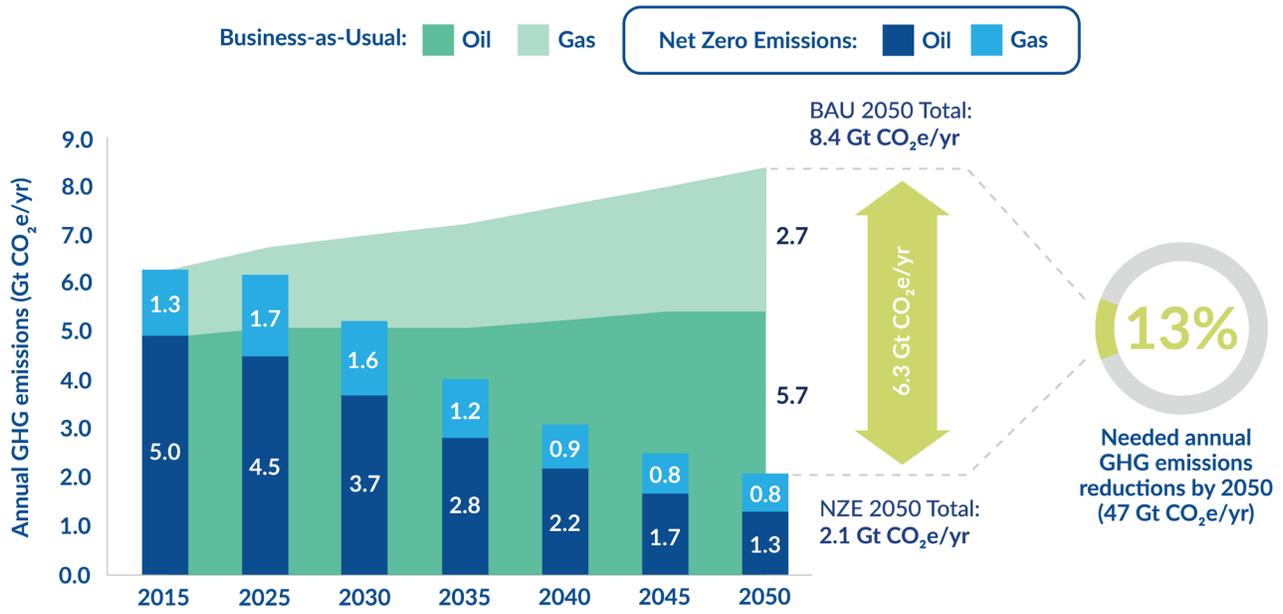


Figure 2: Stopping the expansion of offshore drilling and phasing down production from existing wells could deliver a reduction of 6.3 Gt CO₂e/yr by 2050, roughly 13% of the total emission reductions needed, compared with a BAU scenario (8.4 Gt CO₂e/yr).

Note: Historic data for production only available until 2016 and BAU only as far out as 2040. Calculations are rough estimates based on production changes for each scenario multiplied by the average emissions intensities for one barrel of oil equivalent (boe) for oil and gas. Data for 2045 and 2050 calculated estimating production change based on trajectory over previous five years. Source: IEA (2018) Special Report: Offshore Energy Outlook; IEA (2021) Net Zero by 2050: A Roadmap for the Global Energy Sector; RMI, Oil Climate Index plus Gas Model v.1.0, 2022.



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Policy Opportunities

By halting the expansion of offshore drilling and promoting clean energy policies that would push a phasedown of production levels worldwide, we could reduce emissions by 6.3 Gt CO₂e/yr by 2050 compared to BAU. Countries that currently produce the most offshore oil and gas are logical places to start (Figure 3). Between 2021 and 2025, 355 major offshore crude oil

and gas projects are expected to start operations in 48 countries.¹⁰ Under IEA's NZE scenario, none of these projects where the final investment decision was taken after 2021 should go forward, even if exploration and development leases have already been awarded.

Just 10 Countries Produce About 65% of All Offshore Oil and Gas

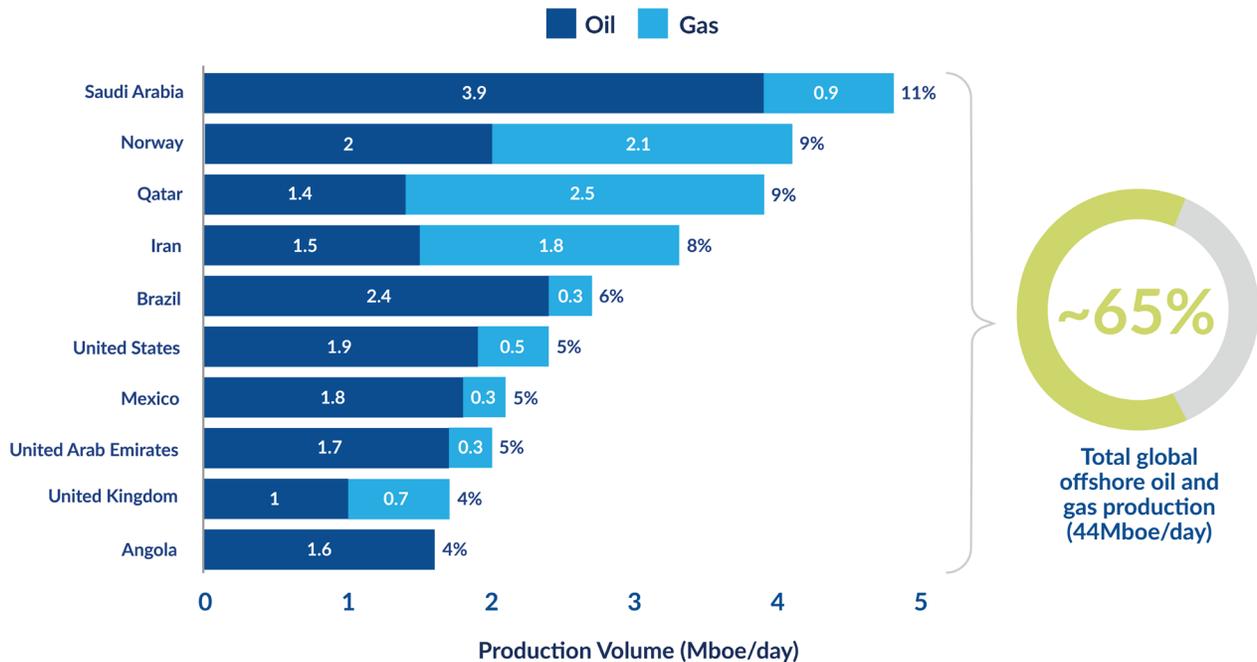
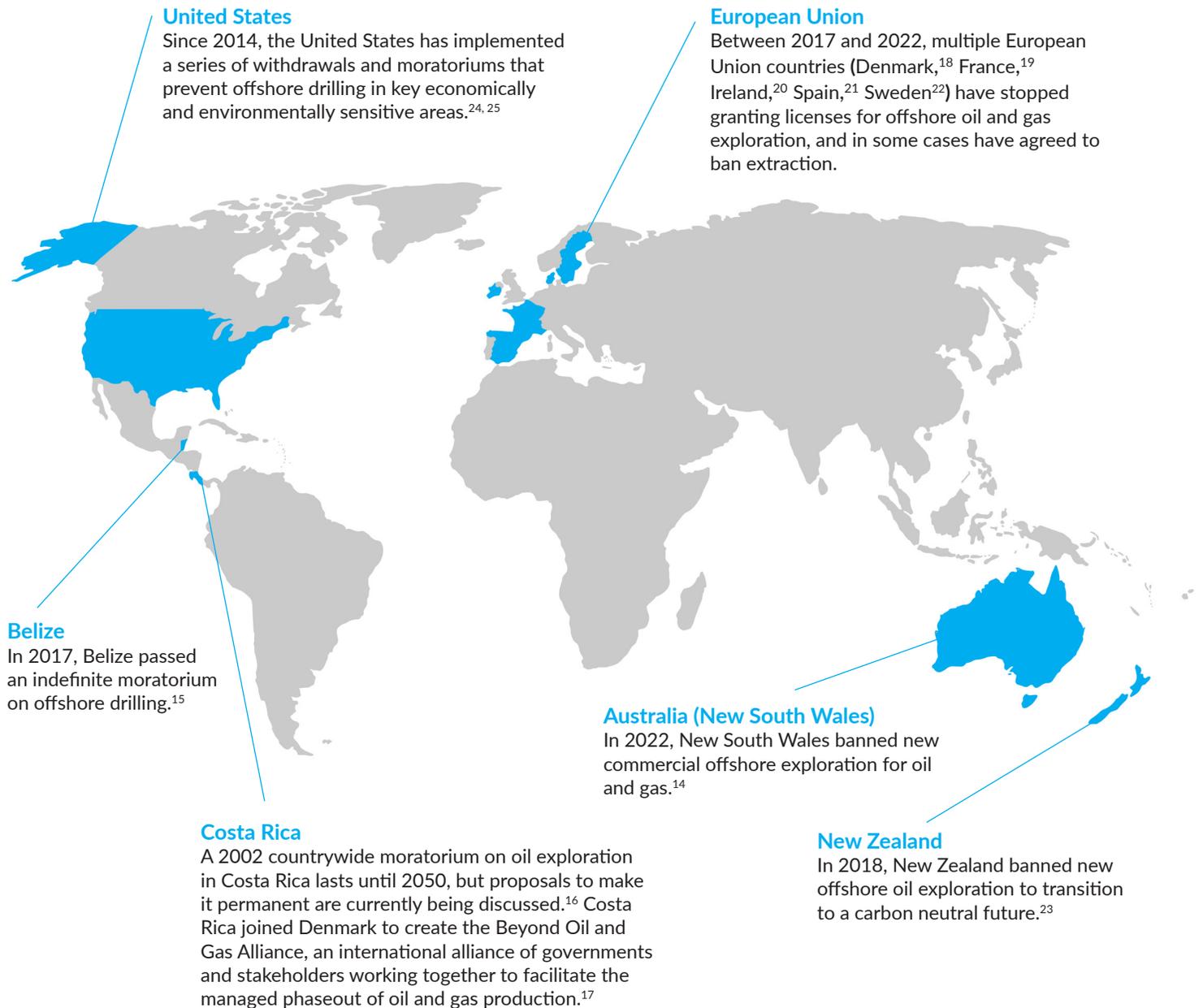


Figure 3: Largest offshore oil and gas producing countries in 2017. Production figures are rounded and percentage estimates are based on a total of 43.5 Mboe/day offshore oil and gas production in 2017. Source: Rystad via Offshore Magazine (2017) Top offshore producing countries in 2017; IEA (2018) Special Report: Offshore Energy Outlook.

Countries Already Taking Action to Stop Offshore Drilling



Preventing the development of new offshore drilling is necessary and, thankfully, feasible. The map above shows examples from around the world where policies preventing the expansion of offshore drilling have succeeded. The NZE scenario, which is necessary to prevent the most catastrophic effects of climate change, assumes that any additional energy demand beyond current extraction will be met by clean energy sources.

Not only are drilling phasedowns underway, ramping up of alternative energy sources is also accelerating. Offshore wind is becoming cheaper and more competitive compared to fossil fuel energy generation worldwide.¹¹ Globally, offshore wind farms generated 1,592 terawatt hours in 2020, and their share of new wind energy installations is projected to grow from 23% in 2021 to 30% by 2030.^{12, 13}

Climate Justice

All over the world, the people who contribute the least to the climate crisis are feeling its effects the most, particularly in the global south.²⁶ In the summer of 2022, roughly a third of Pakistan flooded.²⁷ Unprecedented rains attributed to climate change displaced millions of people in the country. Yet Pakistan contributes less than 1% of global greenhouse gases.²⁸ Petrochemical plants and climate impacts tend to disproportionately affect frontline communities, usually lower-income people.²⁹ Toxic oil and gas infrastructure tends to be located in poorer areas in the U.S. Gulf Coast, with one notorious stretch of polluted land dubbed “Cancer Alley,” leading the United Nations to call for rectifications of the environmental racism that allowed people of color to be disproportionately impacted.^{30, 31} Therefore, oil and gas development is also a justice issue – these communities have often been excluded from policy decision-making processes, while bearing the brunt of the harm.

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Action Needed

Stopping the expansion of offshore drilling, along with a measured phasedown of production, is a vital step for meeting our climate goals. This, along with the other HLP ocean-based solutions, meets nearly 40% of the global emission reductions needed by 2050 to stay below 2°C of warming.

The ocean is already showing us some of the most dire impacts of climate change. Sea level rise will displace millions of people.³² Without action, the world’s coral reefs will see catastrophic die-offs by 2050.³³ Ocean acidification from carbon pollution is slowly destroying countless shell-building organisms vital to the marine food web.³⁴ Our oceans have protected us from the worst impacts of climate change by absorbing much of the heat produced by the fossil fuel industry’s relentless expansion. But now we are at a tipping point. Life has been inextricably connected to the oceans since its beginning. Without bold and forceful action, a hotter and more acidic ocean will no longer be able to sustain the diversity of life as we know it.³⁵

Moreover, the pollution impacts of offshore drilling lay in stark contrast to the healthy oceans we need for a livable future. In the few years before this report, the

world has seen major spills in Peru, the Mediterranean, and the United States.^{36,37,38} Where the industry drills, it spills. Experts conclude that the likelihood of another disaster on the scale of the BP *Deepwater Horizon* that occurred in the U.S. Gulf of Mexico is simply a matter of time.³⁹ This pollution wreaks havoc on local ecosystems and economies, with long-lasting effects.⁴⁰

The climate crisis is an all-hands-on-deck moment for humanity. Multiple solutions across all sectors must be adopted, and fast.⁴¹ But the ocean has an especially vital role to play. The HLP ocean-based solutions are critical approaches for curbing emissions to meet mitigation targets. This report shows one more major and essential pathway to get us where we need to be to curtail GHG emissions. Ocean solutions are climate solutions. Protecting the oceans from offshore drilling will help protect this planet and the life that calls it home.



Acknowledgments

The research and analysis behind this report was conducted by Systemiq. Systemiq is a system-change company founded in 2016 to drive the achievement of the Paris Agreement and the Sustainable Development Goals, by transforming markets and business models in four key economic systems: regenerative land use, materials and circularity, energy, and sustainable finance. A certified B Corp, Systemiq combines strategic advisory with high-impact, on-the-ground work, and partners with business, finance, policy-makers, and civil society to deliver change. Systemiq's people are based in Brazil, France, Germany, Indonesia, the Netherlands, and the United Kingdom.

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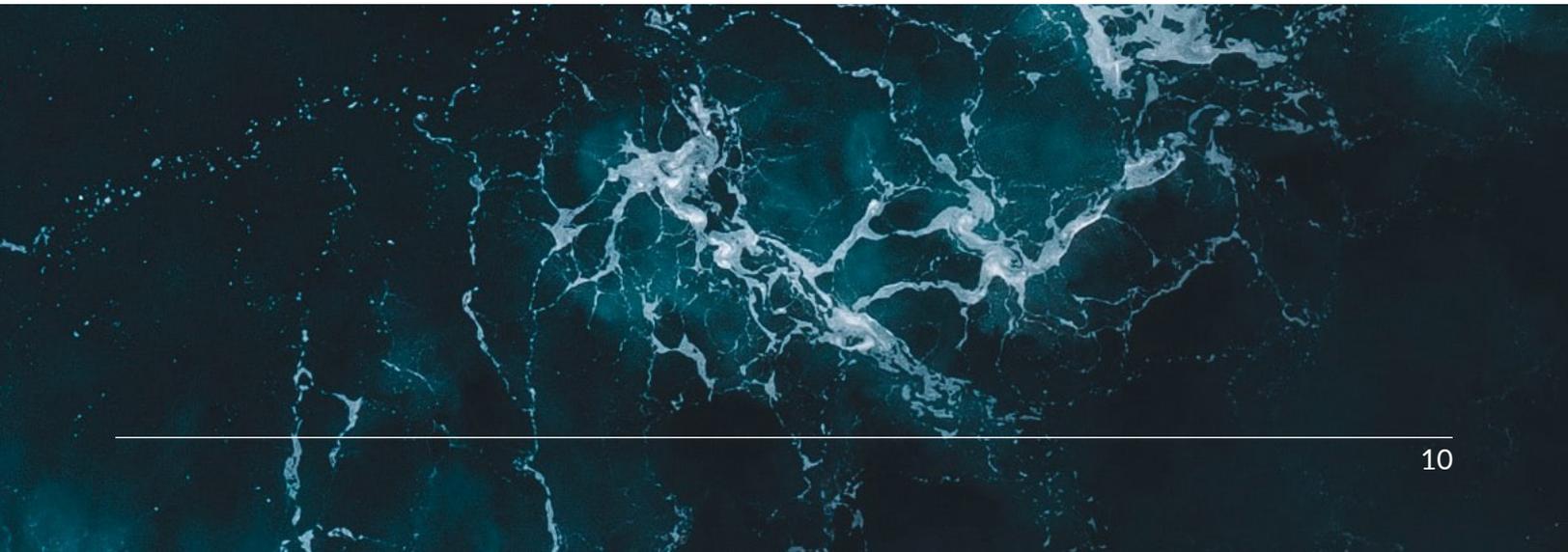
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For Oceana's full methodology and analysis, please visit [Oceana.org/ClimateSolutions](https://www.Oceana.org/ClimateSolutions)

References

- ¹ Hoegh-Guldberg O, et al. (2019) The Ocean as a Solution to Climate Change: Five Opportunities for Action. Washington, DC: World Resources Institute. 111p.
- ² Hoegh-Guldberg O, Jacob D, Taylor M et al. (2018) Impacts of 1.5°C global warming on natural and human systems. In: Special Report: Global Warming of 1.5°C. Cambridge, UK and New York, NY: Cambridge University Press.
- ³ U.S. Energy Information Administration (25 Oct 2016) Offshore production nearly 30% of global crude oil output in 2015. Today in Energy. DC: US EIA. Accessed Oct 11, 2022.
- ⁴ International Energy Agency (2019) Offshore oil and gas production by scenario, 2016-2040. Paris: IEA. Accessed Oct 11, 2022.
- ⁵ Wolvovsky E and Anderson W (2016) OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon. BOEM OCS Report 2016-065. DC: U.S. Bureau of Ocean Energy Management. 44p.
- ⁶ Ayasse AK, Thorpe AK, Cusworth DH, et al. (2022) Methane remote sensing and emission quantification of offshore shallow water oil and gas platforms in the Gulf of Mexico. Environmental Research Letters 17: 084039.
- ⁷ Foulds A, Allen G, Shaw JT, et al. (2022) Quantification and assessment of methane emissions from offshore oil and gas facilities on the Norwegian continental shelf. Atmospheric Chemistry and Physics 22: 4303-4322.
- ⁸ IEA (2018) Offshore Energy Outlook. Paris: IEA. 80p.
- ⁹ IEA (2021) Net Zero by 2050: A Roadmap for the Global Energy Sector. Paris: IEA. 224p.
- ¹⁰ Global Data (2021) Global Offshore Oil and Gas Upstream Development Outlook to 2025. London: Global Data 78p. Accessed Oct 11, 2022.
- ¹¹ Jansen M, Staffell I, Kitzing L, et al. (2020) Offshore wind competitiveness in mature markets without subsidy. Nature Energy. 5: 614-622.
- ¹² IEA (2022) Wind Electricity. Paris: IEA. Accessed Oct 11, 2022.
- ¹³ Williams R, Zhao F and Lee J (2022) Global Offshore Wind Report. Brussels: Global Wind Energy Council. 103p.
- ¹⁴ Government of New South Wales (2022) Offshore Exploration and Mining Policy. Sydney: Government of New South Wales. 2p.
- ¹⁵ Government of Belize (2017) Petroleum Operations (Maritime Zone Moratorium) Act. Belmopan: Government of Belize. 5p.
- ¹⁶ Government of Costa Rica (2019) Declara Moratoria Nacional para la explotación petrolera. San José: Government of Costa Rica.
- ¹⁷ Beyond Oil and Gas Alliance (2022) Who We Are. Available: <https://beyondoilandgasalliance.com/who-we-are/>. Accessed Oct 11, 2022.
- ¹⁸ Ambrose, J (4 Dec 2022) Denmark to end new oil and gas exploration in North Sea. The Guardian. Available: <https://www.theguardian.com/business/2020/dec/04/denmark-to-end-new-oil-and-gas-exploration-in-north-sea>. Accessed Oct 11, 2022.
- ¹⁹ Agence France-Presse (20 Dec 2017) France bans fracking and oil extraction in all of -its territories. The Guardian. Available: <https://www.theguardian.com/environment/2017/dec/20/france-bans-fracking-and-oil-extraction-in-all-of-its-territories>. Accessed Oct 11, 2022.
- ²⁰ Government of Ireland (2021) Climate Action and Low Carbon Development (Amendment) Act 2021. Dublin: Government of Ireland. 35p.
- ²¹ Agencia Estatal de España (2021) Ley 7/2021, de 20 de mayo, de cambio climático y transición energética. Madrid: Government of Spain. 44p.
- ²² United Nations Environment Program (5 Jun 2022) Global actions on World Environment Day underscore urgent need to protect the planet. Available: <https://www.unep.org/news-and-stories/press-release/global-actions-world-environment-day-underscore-urgentneed-protect>. Accessed Oct 11, 2022.

- ²³ New Zealand Parliament (2018) Crown Minerals (Petroleum) Amendment Act 2018. Wellington: Government of New Zealand. 6p.
- ²⁴ Oceana (15 Mar 2016) Oceana Declares Victory in Protecting the Atlantic from Offshore Drilling. Available: <https://usa.oceana.org/press-releases/oceana-declares-victory-protecting-atlantic-offshore-drilling/>. Accessed Oct 11, 2022.
- ²⁵ Oceana (18 Nov 2016) Oceana Celebrates Victory in Protecting Arctic Ocean from Offshore Drilling. Available: <https://usa.oceana.org/press-releases/oceana-celebrates-victory-protecting-arctic-ocean-offshore-drilling/>. Accessed Oct 11, 2022.
- ²⁶ Krause E and Reeves RV (18 Sept 2017) Hurricanes hit the poor the hardest. The Brookings Institute. Available: <https://www.brookings.edu/blog/social-mobility-memos/2017/09/18/hurricanes-hit-the-poor-the-hardest/>. Accessed Oct 11, 2022.
- ²⁷ Sheerazi HA (12 Sept 2022) The flood seen from space: Pakistan's apocalyptic crisis. Columbia Climate School State of the Planet. Available: <https://news.climate.columbia.edu/2022/09/12/the-flood-seen-from-space-pakistans-apocalyptic-crisis/>. Accessed Oct 11, 2022.
- ²⁸ Ramirez R and Dewan A (31 Aug 2022) Pakistan emits less than 1% of the world's planet-warming gases. It's now drowning. CNN. Available: <https://www.cnn.com/2022/08/30/asia/pakistan-climate-crisis-floods-justice-intl/index.html>. Accessed Oct 11, 2022.
- ²⁹ The Climate Reality Project (2022) Frontline Communities and Fenceline Communities. DC: The Climate Reality Project. Accessed Oct 11, 2022.
- ³⁰ Hemmerling SA, DeMyers CA, Parfait J et al. (2021) Tracing the flow of oil and gas: a spatial and temporal analysis of environmental justice in coastal Louisiana from 1980 to 2010. *Environmental Justice* 14: 134-145.
- ³¹ United Nations (2 March 2021) Environmental racism in Louisiana's 'Cancer Alley', must end, say UN human rights experts. UN News. Available: <https://news.un.org/en/story/2021/03/1086172>. Accessed Oct 11, 2022.
- ³² Oppenheimer M, Glavovic BC, Hinkel J et al. (2019) Chapter 4: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge, UK and New York, NY: Cambridge University Press . p321-445.
- ³³ Knowlton N, Grotoli AG, Kleypas J et al. (2021) Rebuilding Coral Reefs: A Decadal Grand Challenge. *International Coral Reef Society and Future Earth Coasts*. 55p.
- ³⁴ Guinotte JM and Fabry VJ (2008) Ocean acidification and its potential effects on marine ecosystems. *Annals of the New York Academy of Sciences* 1134: 320-342.
- ³⁵ Bindoff NL, Cheung WWL, Kairo JG et al. (2019) Chapter 5: Changing Ocean, Marine Ecosystems, and Dependent Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge, UK and New York, NY: Cambridge University Press. p447-587.
- ³⁶ Oceana (20 Jan 2022) Oceana: Repsol must be held responsible for oil spill wreaking havoc on Peruvian oceans and coastal economy. Available: <https://oceana.org/press-releases/oceana-repsol-must-be-held-accountable-for-oil-spill-wreaking-havoc-on-peruvian-oceans-and-coastal-economy/>. Accessed Oct 11, 2022.
- ³⁷ Kourdi E, Salem M, Qiblawi T (2021) Syrian oil spill spreads across the Mediterranean and could reach Cyprus on Wednesday. CNN. Available: <https://www.cnn.com/2021/08/31/middleeast/syria-cyprus-oil-spill-intl/index.html>. Accessed Oct 11, 2022.
- ³⁸ Oceana (3 Oct 2021) Oil Spill Devastating California's Coast, Killing Marine Life. Available: <https://usa.oceana.org/press-releases/oil-spill-devastating-california-coast-killing-marine-life/>. Accessed Oct 11, 2022.
- ³⁹ Mustain P, Giltz S, Ayala C et al. (2020) Hindsight 2020: Lessons We Cannot Ignore from the BP Disaster. DC: Oceana. 68p. Accessed Oct 11, 2022.
- ⁴⁰ Oceana (2021) Permanent Protections from Offshore Drilling Benefit Coastal Economies and Help Fight Climate Change. Available: <https://usa.oceana.org/reports/permanent-protections-offshore-drilling-benefit-coastal-economies-and-help/>. Accessed Oct 11, 2022.
- ⁴¹ Project Drawdown (2022) Table of Solutions. Available: <https://www.drawdown.org/solutions/table-of-solutions>. Accessed Oct 11, 2022.





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