Sectoral Risk Briefings:
Insights for Financial Institutions

UN environment programme

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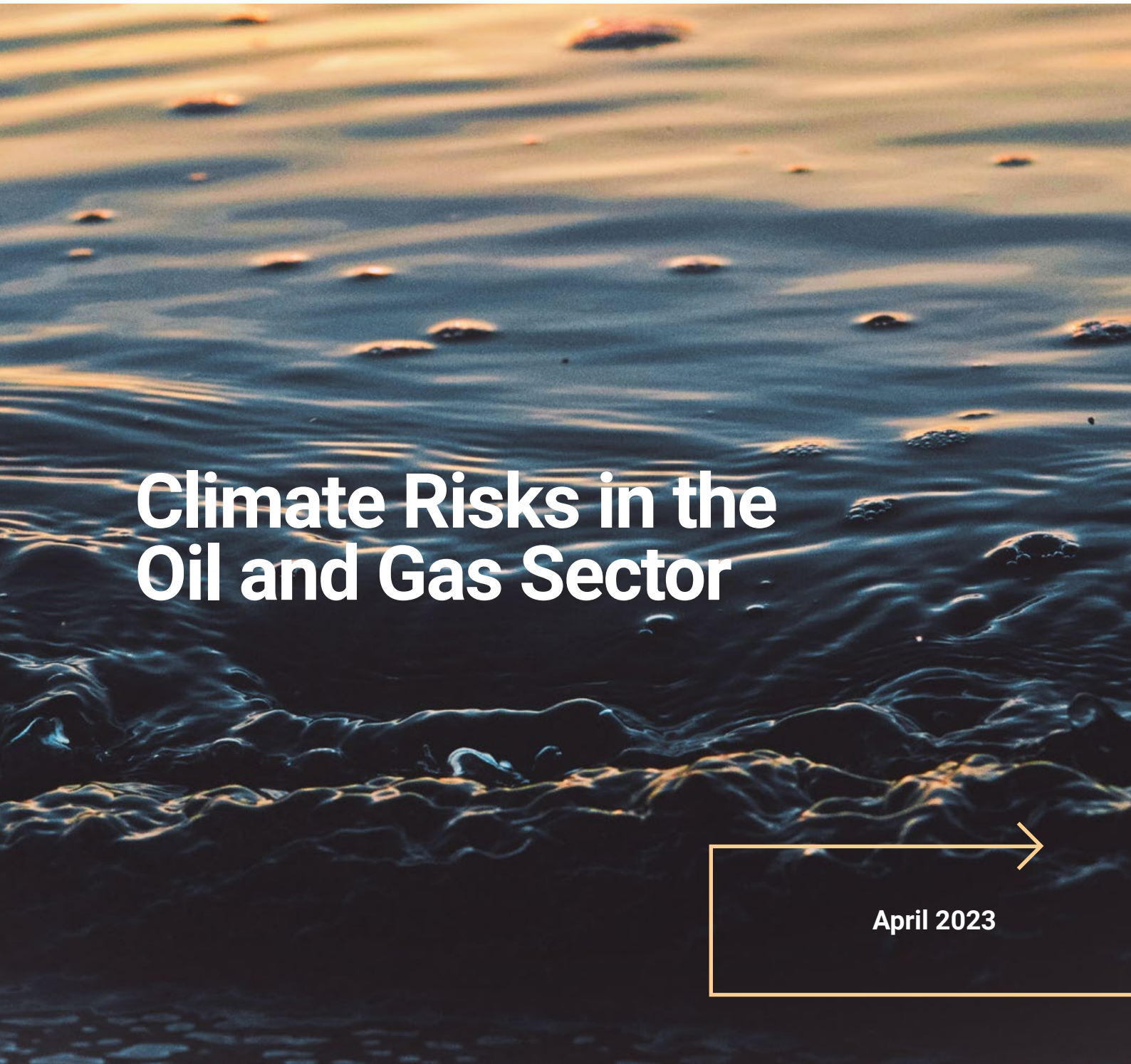

Climate Risks in the Oil and Gas Sector

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Acknowledgments

Authors

UNEP FI

David Carlin
Head of Climate Risk and TCFD
(david.carlin@un.org)

Maheen Arshad
Climate Risk Manager
(mahaeen.arshad@un.org)

Katy Baker
Climate Risk Associate
(katy.baker@un.org)

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Introduction

In the past few years, the global economy has been lashed by the COVID-19 pandemic, geopolitical conflict, supply chain disruptions, an energy crisis, and high inflation. These challenges are occurring against the backdrop of the mounting planetary emergency of climate change. Climate change can exacerbate all other challenges, increasing geopolitical conflicts over resources, crippling infrastructure and supply chains, extending the range of dangerous pathogens, and collapsing the natural systems upon which we depend. As the US Pentagon presciently stated: "climate change is a threat multiplier." While the transition to a sustainable, net-zero future is critical, it demands fundamental shifts in nearly all economic sectors. These shifts are not without risk for companies and communities impacted by them.

Financial institutions face an array of risks from this rapidly changing, and often chaotic, world. Their clients are exposed to physical hazards as well as transition risks, which can have major credit, market, and operational implications. The prudent financial institution will explore these climate-related risks and prepare strategies to meet them. Future resiliency and success are contingent on thoughtful planning and good decisions today.

UNEP FI has been working at the intersection of sustainability and finance for over 30 years. Its programmes for financial institutions develop the tools and practices necessary to positively address the most pressing environmental challenges of our time. UNEP FI's Climate Risk and TCFD Programme has now worked with over 100 financial institutions to explore physical and transition risks posed by climate change. Through this work, a need has been identified to provide financial institutions with a baseline understanding of climate-related risks and their manifestations across different sectors.

This brief is part of a series of notes that cover major economic sectors and their associated climate risks. Each brief also provides specific guidance and recommendations for financial institutions to more effectively manage their risks and those of their clients.

UNEP FI intends for the resources and perspectives included within these notes to empower financial colleagues to communicate these risks throughout their institutions and across the financial sector more generally. The hope is that the communication process will not only enhance awareness of climate risks, but also begin conversations that will lead to tangible changes in strategy and operations. It is the integration of the insights that will be the truest test of the effectiveness of this series. This particular brief covers the physical and transition risks facing the oil & gas sector.

Oil & gas sector overview

Unabated combustion of all the present fossil fuel reserves will emit three times more carbon dioxide (CO_2) emissions than the remaining carbon budget for 2˚C of global warming, pushing temperatures to potentially catastrophic levels (IEA, 2020). As the world moves towards the goal of net-zero emissions by 2050, the oil & gas sector's substantial contribution to global emissions means it has a vital part to play in the decarbonisation of the global economy.

The world is already transitioning towards a low-carbon future. As this process accelerates, the oil & gas sector will have to seriously consider what role, if any, fossil fuels can justifiably play in such a scenario. The sector faces increasing pressure to reduce its global greenhouse gas (GHG) emissions and to evaluate the risks to its existing business model from the energy transition (IEA, 2020). These risks vary widely, ranging from increased policy pressures through to the implementation of carbon prices. Technological advances and decreasing costs for renewable energy will also impact the market share of the oil & gas sector. According to the latest calculation, 60% of global oil and gas reserves will need to remain unextracted by 2050 to meet the 1.5˚C target (Welsby *et al.*, 2021). This could see over US$1 trillion of oil & gas assets becoming stranded (Carbon Tracker, 2022). Without major changes to their current business models, companies in the sector are consequently expected to rapidly lose market value.

The oil & gas sector's vulnerability to physical risks emphasises the urgent need to address climate change. The sector's reserves are widely distributed and are often located in regions that are subject to extreme climatic conditions. Extreme weather events predicted to become more frequent and severe, essential operations could be threatened and sectoral performance could consequently be affected. Below we explore in depth the key physical and transition risks faced by the oil & gas sector (Table 1).

Table 1: Key climate risks for the oil & gas sector

	Risk	Summary
Transition Risks	**Increasing carbon prices**	The oil & gas sector is a major contributor to global emissions. As a result, the sector will be significantly impacted by carbon pricing. Carbon prices will increase the cost of emissions, which will have implications for production processes and the price of end-use products.
	Public policy restrictions	Governments are exerting increasing pressure on some of the highest emitting and most environmentally impactful methods of extraction in the oil & gas sector, such as gas flaring and fracking.
	Technology and rise in low-carbon alternatives	Continued technological advances and the falling costs of renewables are making the energy market more competitive for oil & gas firms and potentially reducing demand for their products.
	Emerging legal risk	Recent cases have demonstrated that environmental activists and governments are increasingly using the courts to pursue the oil & gas industry for climate-related issues.
	Market risk and asset stranding	The need to leave most current reserves of fossil fuels in the ground means that firms in the sector could face rapid reductions in market value or be forced to take significant write downs
	Consumer and societal pressure	Greater consumer and societal awareness of climate change has increased the desire to transition away from oil & gas and towards low/no carbon energy sources. It has also increased protests against new oil & gas projects.
Physical Risks	**Intensification of storms and flooding**	Storms and floods are expected to intensify due to climate change. These events can damage extraction, production, and refining infrastructure and disrupt the operations of oil & gas pipelines.
	Water-related issues(drought, extreme heat, and water scarcity)	Climate change shifts precipitation patterns and brings more frequent extreme heat, which creates problems for worker safety and also for extractive operations that require large quantities of water.
	Shifting permafrost	A warming world will see increasing thawing of permafrost. With pipelines and extraction in the far Northern hemisphere, this thawing can cause damage to oil & gas infrastructure and disrupt operations and transportation networks.
	Wildfires	Wildfires are expected to increase in many regions due to climate change. Oil & gas fields located in areas vulnerable to wildfires may face property damage and disruptions in operations.

SECTION A:

Transition risks

The emissions of the oil & gas sector have been a focus for activists,consumers, and governments. The sector faces competition by low-carbon alternatives across end-uses such as power generation, transportation, and industrial processes and pressures from policies such as carbon taxes. A 1.5°C trajectory requires that the majority of oil & gas reserves remain un-burned. However, many oil & gas companies have already invested significantly into machinery, equipment, and infrastructure for fossil fuels. The sector is highly capital intensive and requires long periods of production to compensate for initial investments. As a result, it will encounter significant transition risks.

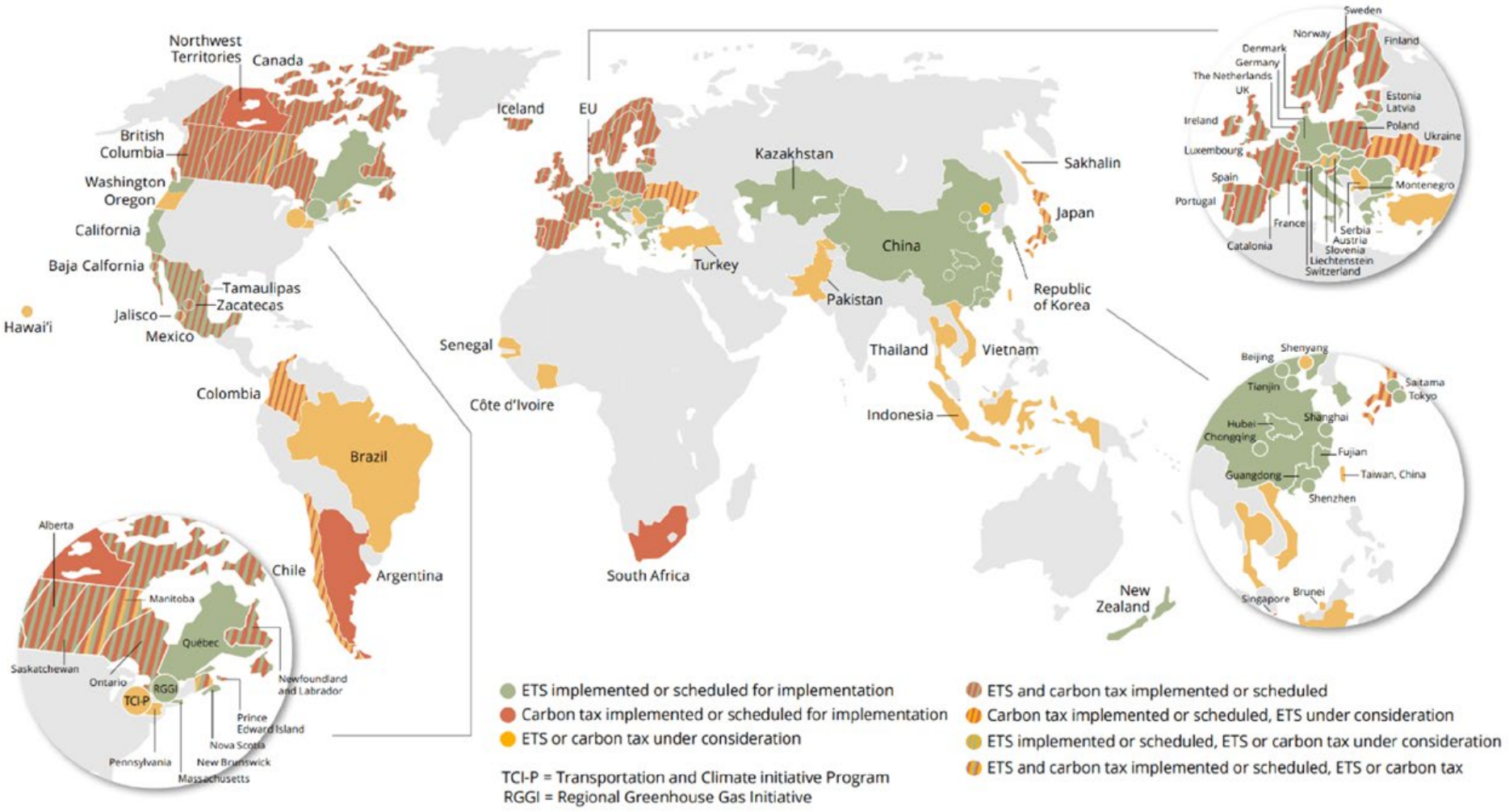
The transition risks facing the oil & gas sector also pose a risk for workers and communities that rely on the sector for jobs and income. It is therefore important to align financing with a just transition approach that considers the impact of the transition on groups at risk to operations in the oil and gas sector, including workers, Indigenous Peoples and local communities.

1. Increasing carbon prices

> **"Today, I am calling on all developed economies to tax the windfall profits of fossil fuel companies."**
>
> **Antonio Guterres, UN Secretary General (BBC, 2022b)**

Increasing implementation of carbon prices by governments may threaten the business models of many oil & gas companies. The OECD estimates that a carbon price of US$147 per metric ton (MT) is necessary by 2030 to put the world on a net-zero emissions by 2050 trajectory (OECD, 2021). In recent years, a growing number of countries and jurisdictions have begun implementing carbon prices and taxes, as shown in Figure 1. Examples of these countries are further explained in the next paragraph. Rising carbon prices or taxes will increase the cost of emissions released in oil & gas production and the costs of end-use products. As a significant source of global emissions, carbon pricing will inevitably impact the oil & gas market (UNEP FI, 2020).

Figure 1: Map highlighting carbon pricing, Emissions Trading Schemes, and other initiatives globally (World Bank, 2021)



Carbon pricing schemes are becoming costly for oil & gas producers in increasing locations, under both carbon taxes and through the implementation of an emissions trading scheme (Wood Mackenzie, 2021). Many European countries have implemented a carbon tax regime as early as the 1990s. Table 2 provides an overview of the different carbon prices implemented by European countries. In Sweden, for example, a carbon tax was introduced in 1991 at SEK 250 (US$24)/MT of CO_2 ($MTCO_2$) and has gradually increased to SEK 1200 (US$113) in 2022 (Government Offices of Sweden, n.d.). Austria planned to implement a carbon tax on fossil fuels from mid-2022, specifically targeting heating fuels, liquified petroleum gas, and natural gas. From a starting rate of €30/$MTCO_2$, the price will increase to €55/$MTCO_2$ in 2025. From 2026, the carbon price will be linked to market prices. The Austrian system for carbon pricing is based on the German system, which was introduced in 2021 at €25/$MTCO_2$ (Oesterreichische Nationalbank, 2022). Countries in Asia have also introduced some form of a carbon price mechanism. Singapore, for instance, has pledged to raise its carbon tax from US$3.7/$MTCO_2$ to US$18.6/$MTCO_2$ in 2024, with aims to increase it further to US$57/$MTCO_2$ by 2030 (UNEP FI, 2022).

Table 2: Overview of carbon tax regimes (Oesterreichische Nationalbank, 2022)

Carbon tax rate (per ton of CO_2 equivalent, April 2021) (EUR)		Share of jurisdiction's greenhouse gas emissions covered (%)	Year of implementation
Denmark	23.78	35	1992
Estonia	2.00	6	2000
Finland	62.00	36	1990
France	45.00	35	2014
Germany	25.00	40	2021
Ireland	33.50	49	2010
Latvia	12.00	3	2004
Luxembourg	20.00	65	2021
Netherlands	30.00	12	2021
Poland	0.07	4	1990
Portugal	24.00	29	2015
Slovenia	17.30	50	1996
Spain	15.00	3	2014
Sweden	116.33	40	1991
United Kingdom	21.23	23	2013

Countries are also implementing a cap-and-trade approach to regulate emissions, such as the European Union's (EU) Emission Trading Scheme (ETS). Under the EU ETS, a limit is placed on the maximum amount of GHG emissions that can be emitted by regulated entities. The cap is regulated through permits called European Union Allowances (EUAs), which grant the permit holder the right to emit a tonne of CO_2 within a year. Companies can receive, buy, or trade these permits (European Commission). Launched in 2005,

the EU ETS has proved to be an effective tool for decarbonisation by reducing 30% of emissions by 2020 (Oesterreichische Nationalbank, 2022). China launched its national carbon market in 2021 with the daily weighted average price of an emission allowance at US$9.11/ $MTCO_2eq$. China's carbon market is expected to grow to US$77 billion in a few years (S&P Global, 2022c). Norway is an example of a growing list of countries implementing both a carbon tax and a cap-and-trade approach. Already a member of the EU ETS, Norway has proposed to increase its carbon tax from US$60 (NKR 590)/ $MTCO_2eq$ emitted to US$205 (NKR 2000)/$MTCO_2eq$ emitted by 2030 (Government of Norway, 2021). This stringent carbon pricing policy will make oil & gas companies in Norway some of the highest payers of carbon taxes globally.

Oil & gas companies facing higher carbon costs will either need to absorb these new carbon costs (which lowers profit margins) or pass them on to consumers (which increases prices). Higher prices can incentivise consumers to shift to less carbon-intensive alternatives. For example, a carbon tax on oil can encourage consumers to switch from internal combustion engine (ICE) vehicles to electric vehicles (EVs) or it can push them to drive less (UNEP FI, 2022). A study on the effects of an incremental increase in an Irish carbon tax (starting at €40 in 2019 and increasing by €5 annually) showed that liquefied petroleum gas (LPG), diesel, and gasoline prices could increase by 15 to 20% by 2030. An increasing carbon price impacts the energy and transport sectors most as these sectors have a high demand for fuel, with households bearing the cost of the increased prices (De Bruin *et al.*, 2019). Major knock-on effects of price shifts are demonstrated by the economic repercussions of Russia's invasion of Ukraine, which has caused large increases in the prices of fossil fuels around the world. Higher oil & natural gas prices in 2022 have led to increases in household expenditures for energy, transportation costs, and costs for industrial processes (Wall Street Journal, 2022).

The oil & gas sector has been central to geopolitics for decades. Russia's invasion of Ukraine caused an average eightfold increase in natural gas prices in the EU (New York Times, 2022). In August 2022, natural gas prices spiked to €321 per megawatt-hour, compared to €27 last year (Euronews, 2022). Before the invasion, Russian natural gas accounted for almost 40% of EU gas demand (IEA, 2022). Large pipelines have been built to connect natural gas producers such as Russia and Norway to EU markets (Figure 2) (Bruegel, 2019). Due to the war, oil & gas supply chains in Europe have become disrupted, with gas flows from Russia being partially reduced or completely stopped for European countries. In August 2022, one of the main natural gas pipelines, the Nord Stream 1, from Russia to Germany, was shut down (Figure 3). This has further reduced supply volumes by an additional 20%, thus exacerbating the natural gas price shock (ESM, 2022; CNBC, 2022). Oil & gas prices have caused prices to rise rapidly worldwide, with inflation in the Euro Area increasing to 9.1% in August 2022 and the United States' Consumer Price Index peaking at 9.1% in June 2022, a 41-year high (Trading Economics, Forbes, 2022). Rising costs are forcing many consumers to reduce their fossil-fuel usage (Wall Street Journal, 2022). Without low-carbon alternatives, high oil & gas prices due to carbon pricing could also create volatility in energy markets.

Figure 2: Oil & gas pipelines from Russia to Europe (ICIS, 2022)

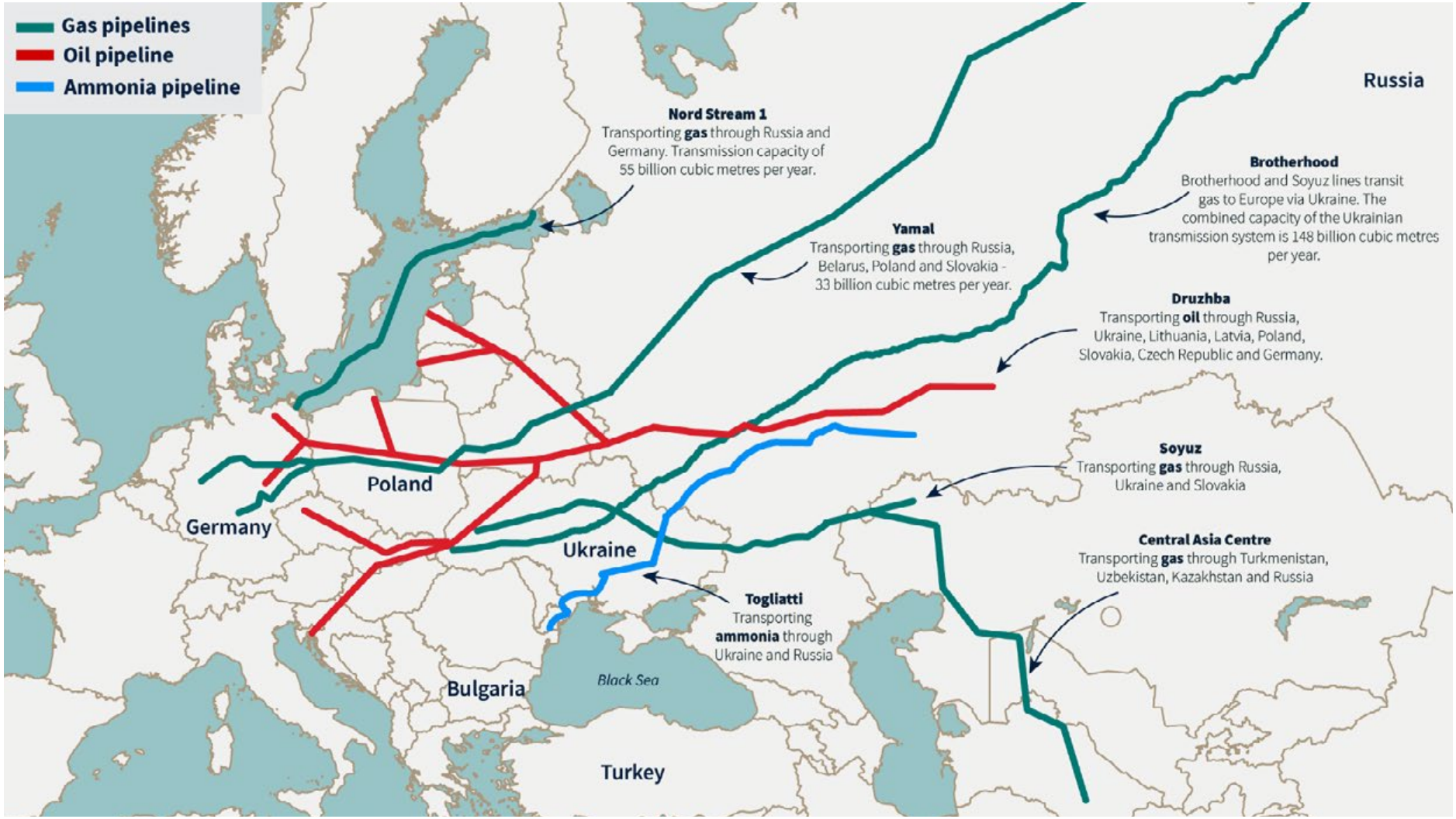
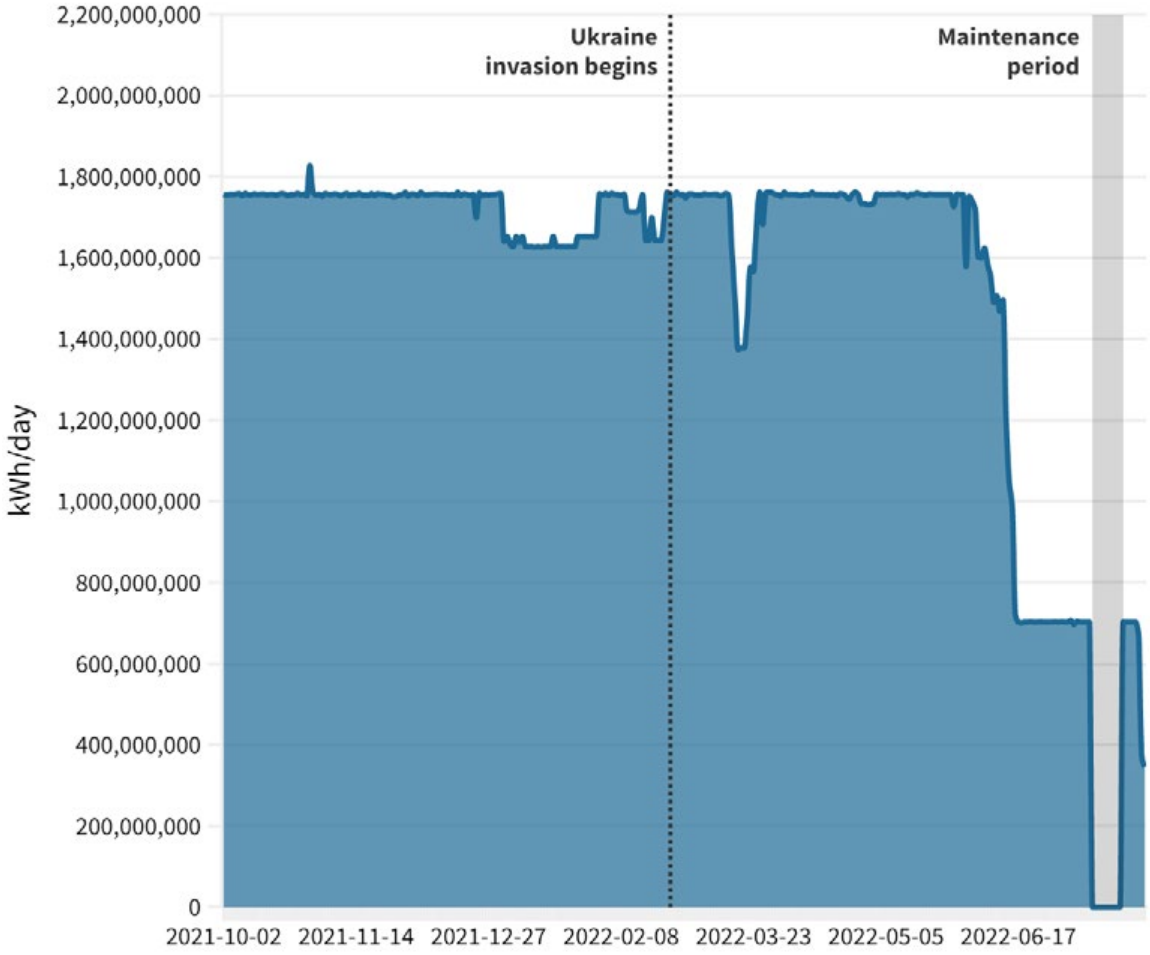


Figure 3: Natural gas supply volume at Nord Stream 1 (CNBC, 2022)



Increased production costs from carbon taxes will affect the competitiveness of oil & gas companies, though the extent to which this will happen varies by country. Currently, global production costs for oil differ depending on a country's type and the depths of its natural reserves, as well as the cost of capital. For example, it costs US$52.50 to produce a barrel of oil in the United Kingdom, US$49 in Brazil, US$41 in Canada, and US$36 in the United States. For OPEC members, production costs tend to be lower. In Saudi Arabia and Kuwait, for instance, it costs around US$10 to produce a barrel of oil (Green Economy, n.d.) As policies for carbon pricing prices become more ambitious and widespread, producers with the lowest breakeven prices will be able to retain more value and outcompete their competitors. High carbon production will increasingly be disfavoured in the world of rising carbon prices (UNEP FI, 2020). Specifically, oil sands and shale oil extraction are likely to see higher costs due to their emissions intensity per barrel produced.

Case study 1: Carbon price

Eni Annual Report 2020

Climate-related risks

We expect our operating and compliance expenses to increase in the short-term due to the likely growing adoption of carbon tax mechanisms. Some governments have already introduced carbon pricing schemes, which can be an effective measure to reduce GHG emissions at the lowest overall cost to society. Today, about half of the direct GHG emissions coming from Eni's operated assets are included in national or supranational Carbon Pricing Mechanisms, such as the European Emission Trading Scheme (ETS), as a result of which the Company incurs operating expenses. For example, under the European ETS, Eni is obligated to purchase, on the open markets, emission allowances in case its GHG emissions exceed a pre-set amount of free emission allowances. In 2020 to comply with this carbon emissions scheme, Eni purchased on the open market allowances corresponding to 10.5 million tonnes of CO_2 emissions. Due to the likelihood of new regulations in this area and expectations of a reduction in free allowances under the European ETS and of the adoption of similar schemes by a rising number of governments, Eni is aware of the risk that a growing share of the Group's GHG emissions could be subject to carbon-pricing and other forms of climate regulation in the not so distant future, leading to additional compliance obligations with respect to the release, capture, and use of carbon dioxide that could result in increased investments and higher project costs for Eni. Eni also expects that governments will require companies to apply technical measures to reduce their GHG emissions.

Climate-related strategy measures

Eni launched a new organizational structure with two business groups: Natural Resources, active in the sustainable development of the upstream oil & gas portfolio, in marketing of wholesale natural gas, and in promoting forestry conservation (REDD+) and carbon storage projects, and Energy Evolution, to support the evolution of the production, transformation and marketing activities from fossil fuel based to bio, blue and green products, also through the merge of the retail and renewable businesses.

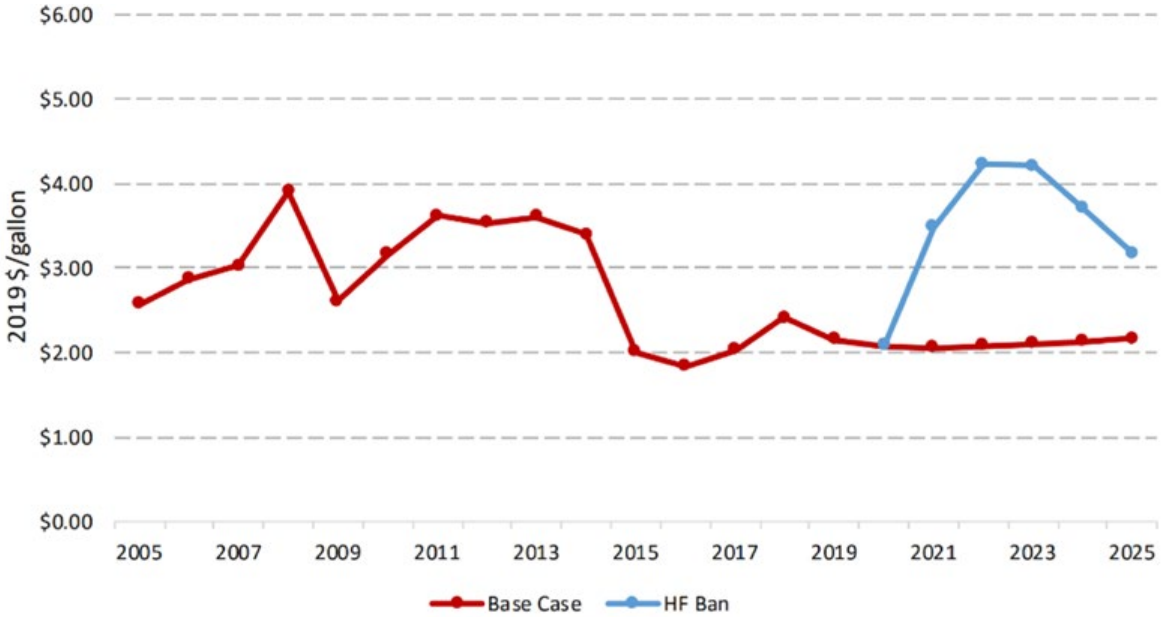
2. Public policy restrictions

The oil & gas sector will also be vulnerable to growing government restrictions. Restrictions on offshore exploration, extraction from oil sands, or new transportation infrastructure such as pipelines present policy risks to the sector. Governments are also under increasing pressure from their citizens and the global community to ban high-emission activities such as gas flaring and fracking (UNEP FI, 2020).

Fracking is a technique used for extracting oil & gas. Still, it often releases large amounts of methane and pollutants that can cause health problems (Center for Biological Diversity, n.d.). Fracking led to accelerated growth in oil & gas production in the United States and turned the country from a net importer of oil & gas to the world's leading producer. A number of countries have already banned fracking, including France, Bulgaria, Germany, the Republic of Ireland, and Uruguay (Global Network for Human Rights and the Environment, 2020). Norse Energy, a Norwegian drilling company, filed for bankruptcy in 2011 and ceased its operations in the United States following a moratorium by the State of New York on hydrofracking drilling permits. The temporary moratorium prohibited the company from drilling for gas on 130,000 acres of land that it has already leased. At the time of the bankruptcy filing, Norse Energy was US$32.6 million in debt and had less than US$50,000 in assets (Natural Gas Intelligence, 2012; Syracuse, 2013). A fracking ban would put producers reliant on fracking out of business, similar to the case of Norse Energy. For example, in the United States, more than 95% of natural gas and oil wells that were developed for fracking (API, 2020) could no longer be used. Were the United States to experience a ban on fracking, 19 million jobs could be lost in the space of four years, an authoritative analysis finds (Global Energy Institute, 2019). Should such a ban be extended to federal natural gas and oil leasing as well, energy costs would inevitably increase. A study from the United States Department of Energy concluded that if the country were to have banned fracking completely in 2021, annual average gasoline prices would have risen to US$4.20 per gallon in 2022 and 2023—as opposed to an estimated US$2.10 per gallon without the ban, which is similar to 2020 price levels (Figure 4) (US Department of Energy, 2021). This compares to a real-world peak in gasoline prices in the United States of US$5 per gallon in June 2022 as a result of the Russian invasion caused (Reuters, 2022).

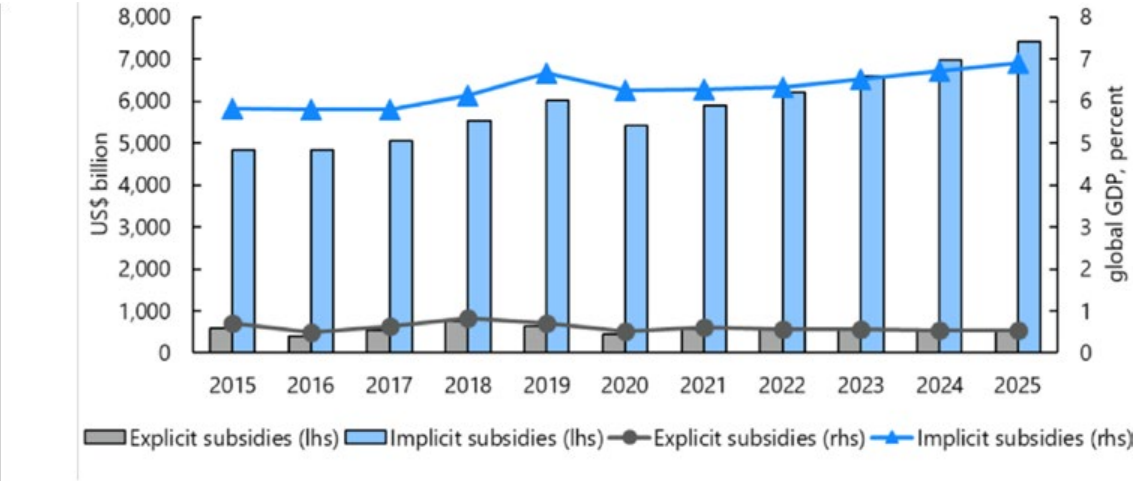
Many governments have also announced various other types of restrictions for the oil & gas sector. In March 2022, for example, Sweden proposed a ban on the extraction of shale oil and natural gas, similar to its ban on uranium extraction (Renewable Energy Industry, 2022). In May 2022, meanwhile, the G7 announced its commitment to end financing for most overseas fossil-fuel projects by the end of the year (S&P Global, 2022a).

Figure 4: The impact of a fracking ban on forecasted retail gasoline prices in the United States (US Department of Energy, 2021)



It is estimated that governments spend about half a trillion dollars per year globally on artificially lowering the price of fossil fuels. As the impacts of climate change worsen, governments are also under increasing pressure to reduce annual subsidies given to the oil & gas sector. Fossil fuel subsidies worth an average of US$555 billion were provided annually by 52 advanced and emerging economies from 2017 to 2019. Of this total, 95% went towards oil & gas (Timperley, 2021). In 2020, despite a drop in demand due to the COVID-19 pandemic, public subsidies for oil, natural gas, and coal reached US$11 million per minute (IMF, 2021). In 2021, subsidies totaled US$440 billion (IEA, n.d.). Such subsidies are given in two forms: (i) as tax breaks or direct payments to reduce production costs, which often lead to infrastructure lock-ins, such as oil pipelines and gas fields; and (ii) as consumption subsidies to cut oil & gas prices for end users (Timperley, 2021). Figure 5 illustrates global fossil fuel subsidies over time.

Figure 5: Global fossil fuel subsidies from 2015 to 2025 (IMF, 2021)



Source. IMF staff.

Note. 2019 and 2021 onwards use projections for fuel use and fuel prices, respectively.

Globally, research has found that the removal of fossil fuel subsidies could reduce carbon dioxide (CO_2) emissions by 0.5–2.2 Gt annually by 2030, which is equivalent to a 1–5% reduction in CO_2 emissions compared to a business-as-usual scenario (Jewell *et al.*, 2018). The G7 and G20 nations have released statements on ending support for subsidies for the oil & gas sector. Fifty-three countries reformed their oil & gas subsidies between 2015 and 2020, and the US President Joe Biden has vowed to eliminate them. The International Energy Agency (IEA) has emphasised that all governments must eliminate fossil-fuel subsidies in the next few years to reach net-zero carbon emissions (Timperley, 2021).

Removal of oil & gas subsidies can highly affect consumers, firms, and other end users due to increased energy, transportation, and raw materials costs. The increase in prices is comparable to the price increase of a carbon tax. Subsidy removal can quickly impact energy input prices, providing a shock to companies' energy costs. In 2016, Saudi Arabia announced a reduction in fossil-fuel subsidies due to decreasing government reviews. Removal of subsidies across different fuel types led to price hikes for consumers and industries. The subsequent increase of 50% in gasoline prices hit motorists hard, for example. Similarly, a 67% price rise in natural gas prices severely impacted electricity producers and the industrial sectors. Petrochemical companies were also badly affected by the subsidy removal, positing profit reductions of between 6.5 and 44.1%. The impact on the Saudi Cement Company was no less serious, with production costs increasing by US$18.1 million. A similar story played out in Egypt. Subsidy removals there led to a doubling in energy prices. This provoked a sharp fall in profits for firms in energy-intensive sectors. Cement firms, for instance, witnessed a decrease in their profit margins of between 29 and 39%. Fertilizer firms and steel companies, meanwhile, reported a fall in profits of 22 and 13%, respectively (Rentschler *et al.* 2017).

3. Technology and rise in low-carbon alternatives

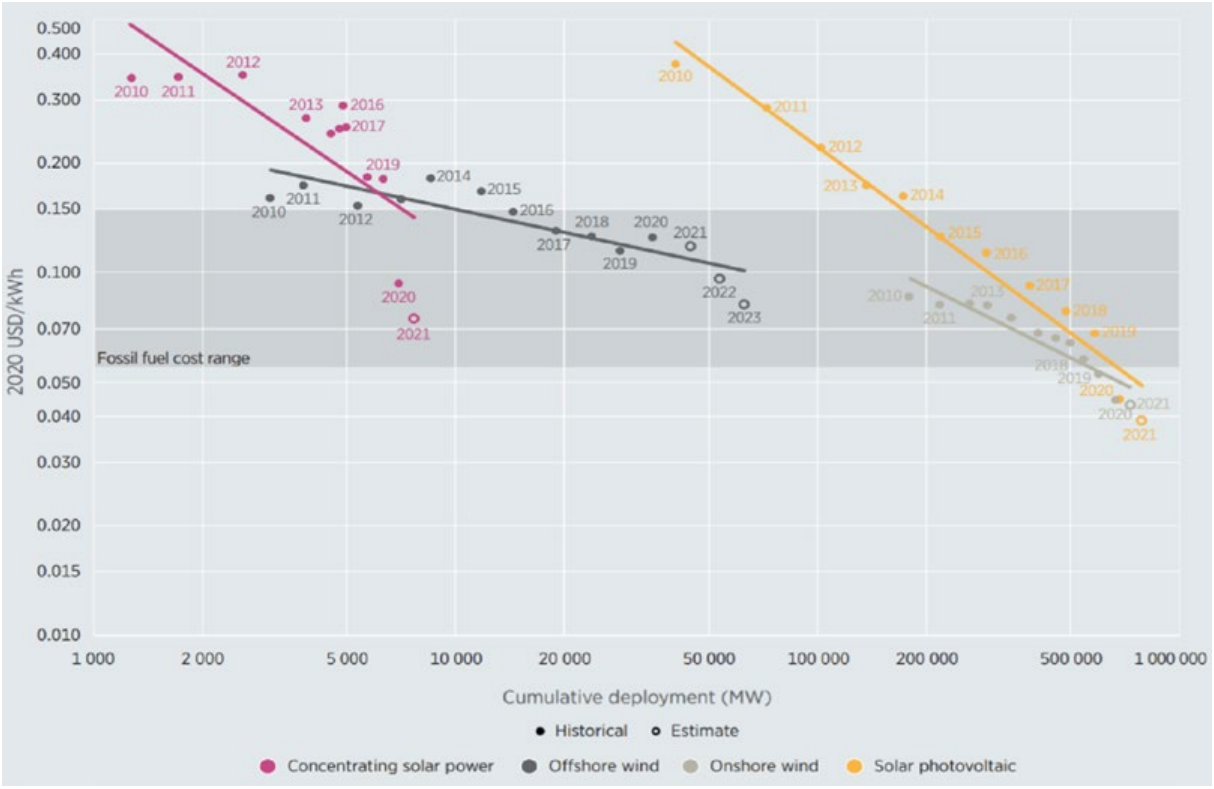
Continuing technological developments and government support for low-carbon energy sources threaten the dominance of fossil fuels in the global economy. Governments are increasing their support for cleaner energy through a range of support mechanisms, from grants and investments through to subsidies, tax rebates, and loan guarantees. An illustrative example comes from Shenzhen, China, where three major bus operators received an annual subsidy of US$75,500 per vehicle to incentivise their transition to EVs (EY, 2022). The growth of private capital now linked to environment, social, and governance (ESG) considerations is also causing investors to turn an increasingly eye towards the impact of oil & gas production. In the decade leading up to December 2020, renewable energy investments outperformed fossil fuel investments in developed and emerging economies. A global portfolio of renewable energy companies averaged an annual return of 18% for the decade. In comparison, fossil fuel stocks had a return of 4.7%. The total return for renewables was 426%, which is seven times more than the return for fossil fuels (IEA, 2021a; Bloomberg, 2021). The oil & gas sector is facing challenges from the speed at which clean-energy solutions are now being developed and deployed—helped along in no small part by combined investments from governments and the private sector. Nevertheless, projections show that energy investments need to triple to reach net-zero CO_2 emissions by 2050 (IEA, 2021c).

Technological advances and falling costs of renewables will also cut into gas power generation and oil fuel demand, bringing about technological risks to the oil & gas sector. According to the International Renewable Energy Agency (IRENA), about 62% of total renewable power generation added in 2020 had lower costs than "the cheapest new fossil fuel" alternative (IRENA, 2021). IRENA also reported that year-on-year costs for renewable energy has continued to decrease. The average cost of concentrated solar power, for example, tumbled by 16% in 2020. The same year witnessed falls of 13 and 7%, respectively, for onshore wind and solar photovoltaics (PV) (IRENA, 2021). Figure 6 illustrates the cost and deployment trends of wind and solar energy, in comparison to fossil fuels. As the shift away from fossil fuels gains momentum, oil & gas companies are responding by diversifying their portfolios and expanding outside of fossil fuels. Oil majors including Shell (Shell, n.d.), Total (TotalEnergies, n.d.), BP (B.P., n.d.) and Eni (Eni, n.d.) have all begun adding renewable resources to their portfolios.

Renewable energy has already begun cutting into the market share of natural gas. Since 2021, natural gas prices have increased by more than 170% in Europe. This is due to rising energy demand following the COVID-19 pandemic, constrained supplies from Russia and Norway, and growing energy needs from Asian countries. As the cost

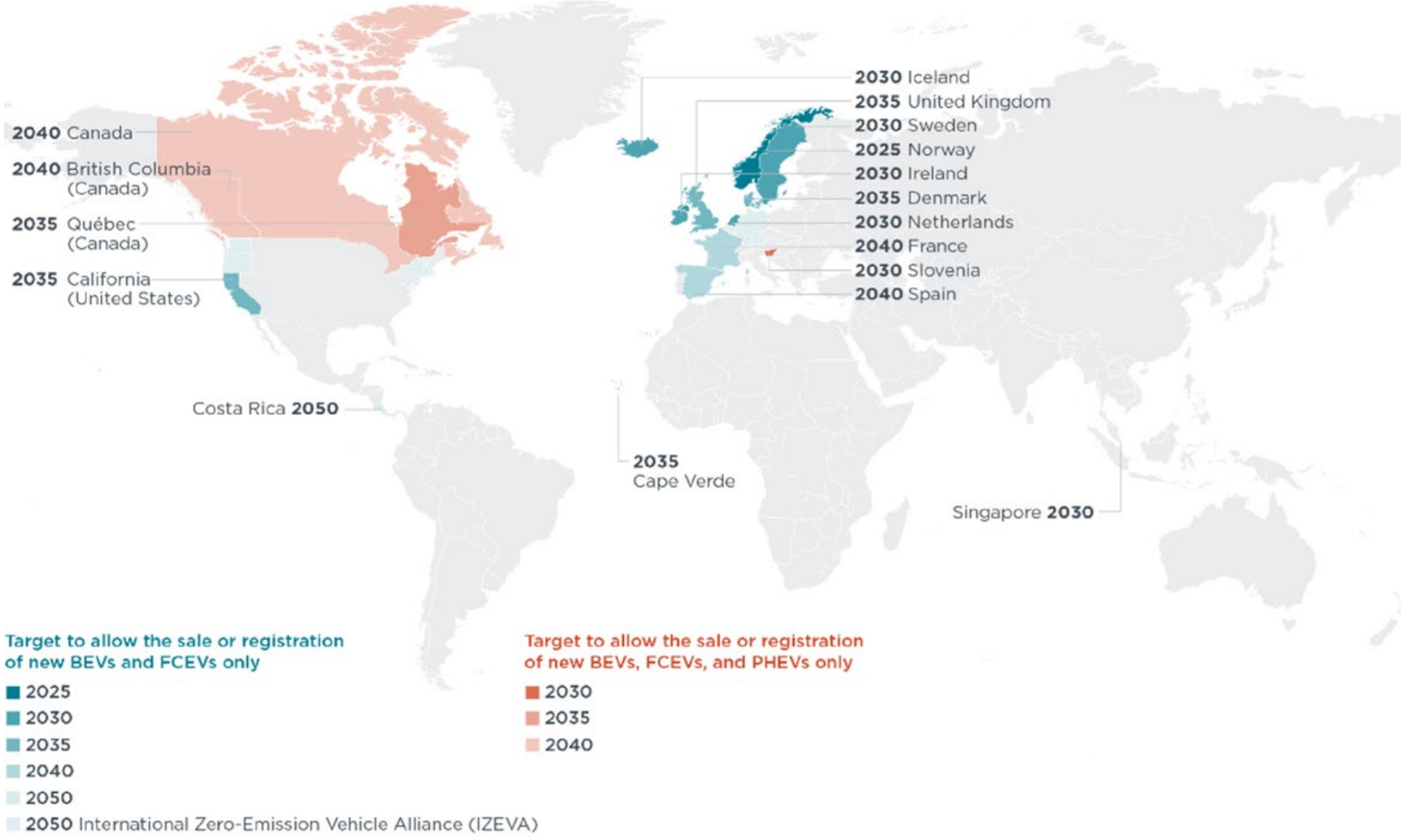
of natural gas is going up, meanwhile, the price of renewable energy is decreasing, as mentioned above (Carbon Action Network, 2021). In 2020, for example, 100 gigawatts (GW) of onshore wind projects and 45.5 GW of solar PV projects had lower costs than the cheapest fossil fuels, including natural gas (IRENA, 2021). The US Energy Information Administration reported in 2020 that electricity generation from non-hydropower renewable sources would grow by 15%. This compares to a mere 1.3% in the case of electricity produced from natural gas (EIA, 2020).

Figure 6: Cost and deployment trends of wind and solar energy from 2010–2021/23 (IRENA, 2021)



In addition, many jurisdictions are now beginning to consider renewable energy as a replacement for oil in transportation needs. Road transport provides a clear case in point. Cars, trucks, and other motor vehicles collectively consumed more than 40% of total oil demand in 2019 (BNEF, 2020). In the United States, oil currently accounts for 90% of total energy use in the transportation sector (EIA, 2022). With a view to reducing emissions, moves are now afoot to introduce alternatives to oil. Leading the way is the use of biofuels for internal combustion engine vehicles (ICEVs), electricity for battery electric vehicles (BEVs), and hydrogen for fuel cell electric vehicles (FCEVs) (Morfeldt *et al.*, 2021). To encourage this transition, a growing number of countries, provinces, and states have announced forward-looking policies to ban ICEVs and to only allow sales of BEVs, ICEVs and FCEVs, as shown in Figure 7 (Internal Council on Clean Transportation, 2021). As more jurisdictions propose similar policies, global demand for oil will drop. In its 2020 Road Fuels Outlook, for example, BloombergNEF estimated that oil demand from road transport will peak in 2031 at 47 million barrels a day. It is then expected to decline to 41.2 million barrels per day in 2040. This projection comes despite a growing demand for transport (BNEF, 2020).

Figure 7: Government targets to phase out 100% of sales and registrations of new ICE cars (Internal Council on Clean Transportation, 2021)



* Includes countries, states, and provinces that have set targets to only allow the sale or registration of new battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). Countries such as Japan with pledges that include hybrid electric vehicles (HEVs) and mild hybrid electric vehicles (MHEVs) are excluded as these vehicles are non plug-in hybrids.

4. Emerging legal risks

The oil & gas sector faces increasing climate-related legal risks. Environmental activists and governments have begun to demonstrate a greater willingness to pursue legal action to hold oil & gas companies accountable for climate change caused by fossil fuels. In 2021, a Dutch court ordered Shell to reduce its global carbon emissions by 45% by 2030. The decision followed the court's conclusion that the oil company's sustainability policy was insufficient (Guardian, 2021a). The decision reflects a larger theme of growing climate ambition in the Netherlands. In 2019, for example, after a six-year legal battle, the Dutch supreme court upheld a ruling ordering the Dutch government to reduce GHG emissions by 25% (compared to 1990 levels) by the end of 2020. The court determined that the country's government has a duty to protect its citizens' human rights, which are threatened by climate change (Guardian, 2019).

Action against individual countries is also increasingly commonplace. Recent years have seen a growing number of local and state governments in the United States filing lawsuits against oil & gas companies, for example. In 2020, the District of Columbia issued a lawsuit against ExxonMobil, BP, Chevron, and Shell for concealing the dangers of fossil fuels from consumers (Greenpeace, 2020). More recently, Massachusetts' supreme judicial court ruled that ExxonMobil will have to go on trial to face accusations that it helped cover up the role of the fossil-fuel industry in climate change (Guardian, 2022). Increasing legal action against oil & gas companies creates bad publicity and potential liability, resulting in greater uncertainty for the sector (KPMG, 2022).

Case study 2: Emerging legal risks

Eni Annual Report 2020

Eni is exposed to the risk of material environmental liabilities in addition to the provisions already accrued in the consolidated financial statement

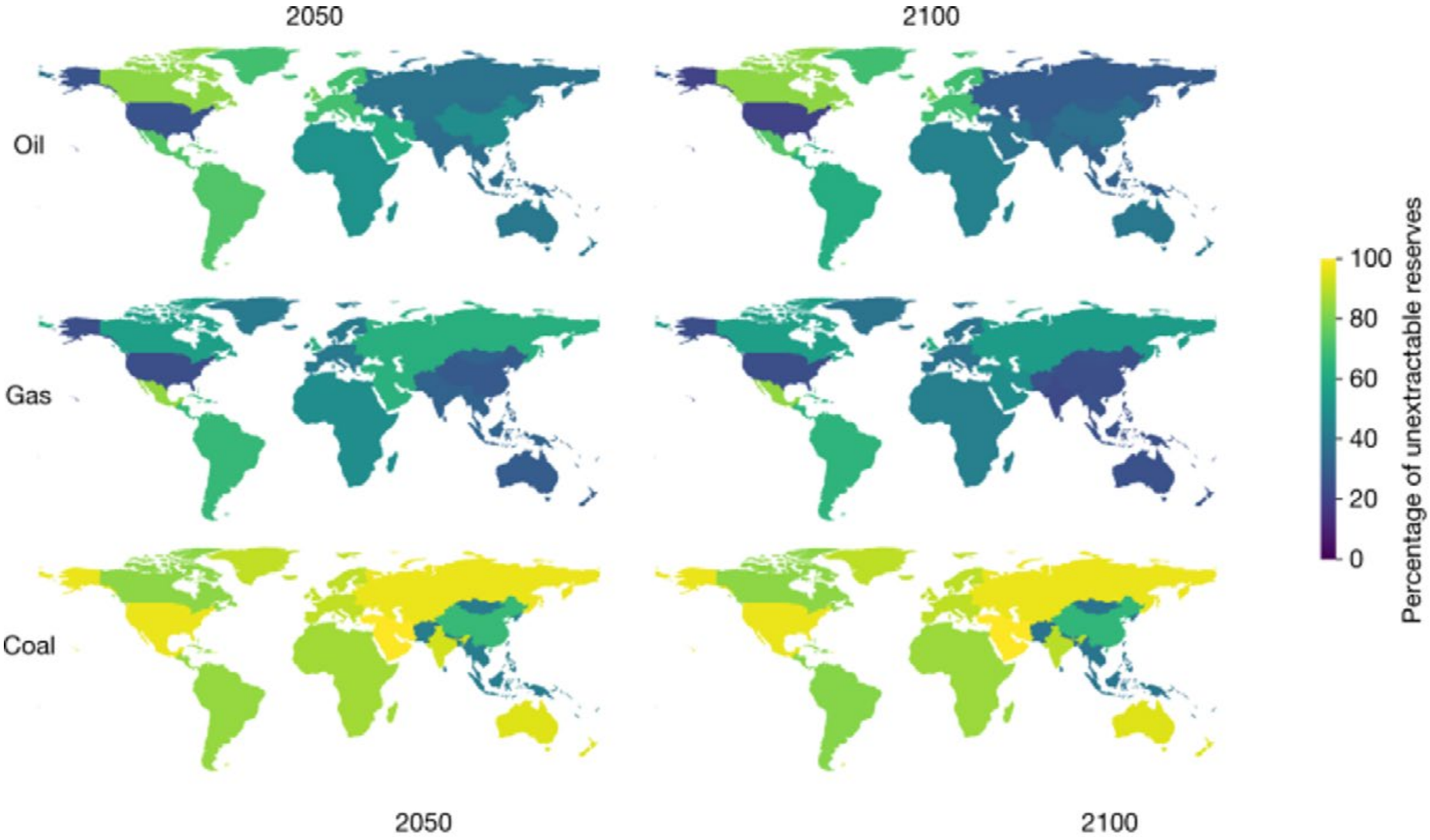
Eni is exposed to the risk of material environmental liabilities in addition to the provisions already accrued in the consolidated financial statement Eni has incurred in the past and may incur in the future material environmental liabilities in connection with the environmental impact of its past and present industrial activities. Eni is also exposed to claims under environmental requirements and, from time to time, such claims have been made against us. Furthermore, environmental regulations in Italy and elsewhere typically impose strict liability. Strict liability means that in some situations Eni could be exposed to liability for clean-up and remediation costs, environmental damage, and other damages as a result of Eni's conduct of operations that was lawful at the time it occurred or of the conduct of prior operators or other third parties. In addition, plaintiffs may seek to obtain compensation for damage resulting from events of contamination and pollution or in case the Company is found liable of violations of any environmental laws or regulations.

In Italy, Eni is exposed to the risk of expenses and environmental liabilities in connection with the impact of its past activities at certain industrial hubs where the Group's products were produced, processed, stored, distributed or sold, such as chemical plants, mineral-metallurgic plants, refineries and other facilities, which were subsequently disposed of, liquidated, closed or shut down.

5. Market risk and asset stranding

As decarbonisation gains momentum, the oil & gas sector could face rapid contraction in market value as economies try to achieve net-zero emissions by refraining from burning proven reserves (Carbon Tracker, 2017; World Bank, 2020). A study by McGlade and Etkins (2015) showed that to limit warming to below 2°C, one third of current oil reserves, half of current gas reserves, and four-fifths of current coal reserves globally need to remain underground and unused until 2050 (McGlade & Etkins, 2015). This would mean that the majority of existing coal reserves in China, Russia, and the United States would need to remain in the ground, as well as millions of barrels of oil reserves in the Middle East. To limit warming to below 1.5°C, 60% of oil and 90% of global coal reserves would need to remain unextracted by 2050, respectively (Welsby *et al.*, 2021) (Figure 8). Additionally, the Intergovernmental Panel on Climate Change's (IPCC) latest publication as part of Assessment Report 6 from Working Group III concluded that to limit warming to 1.5°C, no new oil & gas fields can be developed and some fields will need to be retired early (IPCC, 2022).

Figure 8: Unextractable reserves of fossil fuels by region in 2050 and 2100 under a 1.5°C scenario (Welsby *et al.*, 2021)



The need to leave fossil-fuel reserves unburned in order to limit global warming means that the sector will need to re-evaluate its future production outlook. This will significantly impact producers, energy companies, and investors, especially in economies reliant on fossil fuels. The problem of unburnable reserves will also lead to huge transition risks for Middle Eastern countries, such as Bahrain, Saudi Arabia, and Kuwait, should they fail to diversify their economies. At present, fossil fuels make up 65 to 85% of the region's government revenues (Welsby *et al.*, 2021). A net-zero pathway in which large amounts of fossil-fuel reserves remain unextractable could cause the sector to encounter financial difficulties linked to capital unavailability, as well as balance sheet concerns arising from potential asset strandings or write-offs in the billions of US dollars (IEA, 2021b).

Over US$1 trillion of oil & gas assets are at risk of becoming stranded, of which US$600 billion are held by listed companies. The risk of a stranded assets is mostly concentrated in the financial centres of New York, Moscow, London, and Toronto (Carbon Tracker, 2022). A recent study by the Massachusetts Institute of Technology concluded that stringent climate policies lead to a large volume of unextractable fossil fuels, which result in higher potential asset value losses for fossil-fuel owners and investors. The study puts the global net present value of untapped fossil fuel output at US$30.6 trillion by 2050 under a net-zero-2050 scenario (Chen *et al.*, 2022).

Case study 3: Market risk and asset stranding

Equinor 2021 Annual Report

Upstream oil & gas (stranded assets)

The transition to renewable energy, technological development and reduction in global demand for carbon-based energy, may have a negative impact on the future profitability of investments in upstream oil and gas assets, in particular assets with long estimated useful lives, projects in an early development phase and undeveloped assets controlled by Equinor.

Any future exploration may be restricted by regulations, market and strategic considerations. Provided that the economic assumptions would deteriorate to such an extent that undeveloped assets controlled by Equinor should not materialize, assets at risk mainly comprise the intangible assets oil and gas prospects, signature bonuses and the capitalised exploration costs, with a total carrying value of US$4.6 billion. See note 12 Intangible assets for more information regarding Equinor's intangible assets.

Strategic response to asset stranding

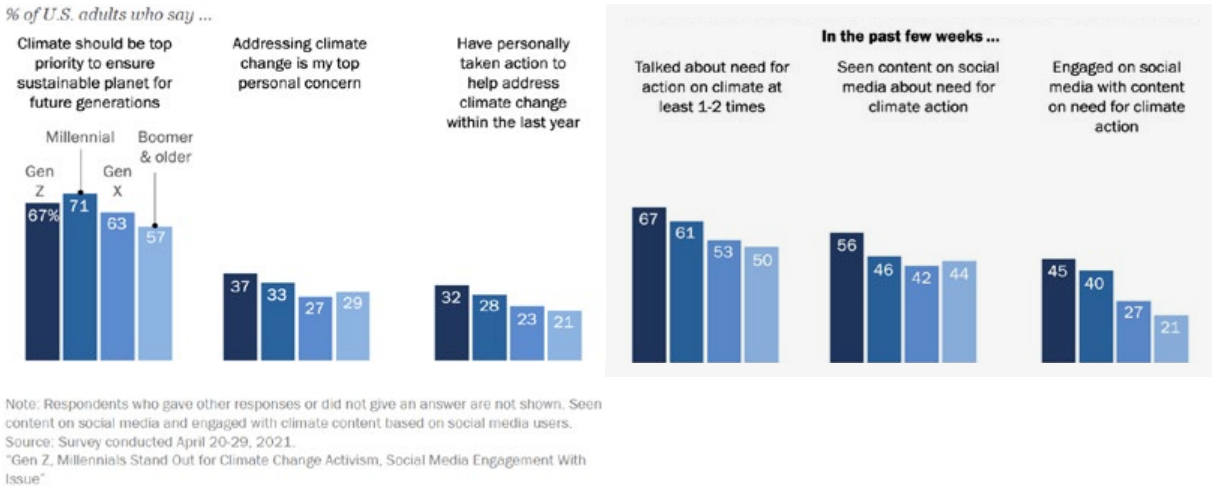
Equinor seeks to mitigate this risk by focusing on improving the resilience of the existing upstream portfolio, maximising the efficiency of our infrastructure on the Norwegian Continental Shelf and optimising our high-quality international portfolio.

Equinor will also continue to selectively explore for new resources with a focus on mature areas that can make use of existing infrastructure to minimise emissions and maximise value. During the transition, Equinor will allocate less of our capital budget to oil and gas in the coming years and eventually decrease the volume of production over time. Equinor's plans to become a net-zero company by 2050 have not resulted in the identification of additional assets being triggered for impairment or earlier cessation of production as of year-end 2021.

6. Consumer and societal pressure

Awareness among young people of the climate impact of fossil fuels is rapidly growing. Social media has allowed messages of climate activists to reach the mainstream. Many traditional and social media companies are also being pressured to reject advertising from fossil fuel companies. The expansion of social media in recent years has accelerated the shift in consumer demand from oil & gas products to clean energy alternatives (KPMG, 2022).

Figure 9: Younger generations are increasingly using social media to address climate change compared to older generations (Pew, 2021)



Note: Respondents who gave other responses or did not give an answer are not shown. Seen content on social media and engaged with climate content based on social media users.
Source: Survey conducted April 20-29, 2021.
"Gen Z, Millennials Stand Out for Climate Change Activism, Social Media Engagement With Issue"

Case study 4: Uncertainties and write-downs for the oil & gas sector

The shifting political realities of today's world can cause rapid write-downs for the oil & gas sector and exits from reserves by its participating companies. Planned projects becoming suddenly unprofitable can force companies to write them off. This was most recently observed during the COVID-19 pandemic and the Russian invasion of Ukraine.

Russia's invasion of Ukraine has forced several oil & gas companies to swiftly end their operations in Russia, resulting in billions of dollars of write-downs in the first quarter of 2022. BP was the first major oil company to announce its exit, with the sale of its 20% stake in the Russian oil producer Rosneft. This could result in a write-down of approximately US$25 billion (Bloomberg, 2022). Shell also announced its withdrawal from the country and offloaded its various Russian assets, including a 27.5% stake in Sakhalin-2, an offshore gas field that supplies 4% of global liquified natural gas (BBC, 2022a). As a result, Shell is facing write-downs between of US$4–5 billion (Sky News, 2022). Meanwhile, ExxonMobil was forced to write-off about US$3.4 billion from its accounts following its exit from the Sakhalin-1 oil drilling project in Russia (Quartz, 2022).

Rapid market downturns can also result in significant write-downs for oil & gas companies. At the peak of the COVID-19 pandemic in 2020, for example, ExxonMobil announced plans to write down US$17 to US$20 billion in natural gas assets, the largest such asset depreciation by the company ever (NPR, 2020). Greater climate action and tougher climate policies can similarly create uncertainty for oil & gas producers around the profitability of their planned projects. Among the scenarios that could compel oil & gas companies to write down assets are: an increase in demand for EVs; government bans on internal combustion engines; reductions in the cost of renewable energy; and the widespread introduction of carbon pricing by a growing number of jurisdictions.

7. Transition risk guidance

Key transition risk questions for financial institutions to consider

1. **Gathering information**
   - Are there any new governmental restrictions on oil & gas activities or new low-carbon initiatives in our portfolio's footprint?
   - How rapidly is the low-carbon transition progressing across our portfolio footprint? What does the energy mix look like across our portfolio footprint?
   - What have our clients disclosed in their financial, sustainability, and climate reports regarding their transition risks?
   - Are any of our clients facing legal action related to their oil & gas activities?
   - How many of our clients have transition plans? Do they incorporate just transition considerations into these plans?
   - Do we have emissions data for our clients?
2. **Assessing the risks**
   - Have we looked at transition scenarios to see how those risks will evolve over time? Have we considered short-term, medium-term and long-term risks?
   - What does our exposure to higher-risk clients look like? What are the terms of our financial relationship (e.g. debt/equity, tenor)?
   - How does the emissions intensity of our clients compare to industry and regional averages?
   - What is the cost of production for our clients? How does that compare to industry and regional averages?
   - How much are clients investing in low-carbon energy? How much of their revenue is derived from low-carbon sources?
3. **Engaging with clients and updating strategy**
   - Do our senior leaders understand the transition risks of our clients?
   - How are we helping our clients to transition to a low-carbon future? How are we supporting their efforts to advance a just transition?
   - How will the transition risks identified and assessed influence our strategy in the oil & gas sector?
   - What specific updates to risk management practices or business activities will be needed to appropriately consider these transition risks in our operations?

Recommendations for risk management

1. Determine potential stranded assets

Similar to the risks posed by physical hazards, transition risks may be concentrated within a set of vulnerable oil and gas assets. Valuations in the oil and gas sector are highly dependent on fossil fuel reserves, meaning that a write-off of these reserves as unburnable or unextractable has major implications for market value. Likewise, on the credit side, these reserves are often pledged as collateral, and their unburnability may render that collateral worthless. Therefore, financial institutions with exposure to oil and gas clients must carefully assess the major reserves of these clients to identify which assets are most likely to become stranded. In a transitioning world of decreasing fossil fuel production assets where production costs are high, emissions intensity is high, and local environmental impacts are high are at the greatest risk of stranding. Financial institutions should explore both the proportion of assets likely to be stranded under different transition scenarios and then consider these three risk drivers to identify particularly vulnerable assets and clients.

2. Evaluate transition progress

Firms in the oil and gas sector will face challenges to their current business models in the decades ahead. Many of the most farsighted firms in the sector recognize this reality and are developing (or have developed) transition plans. Many of these transition plans involve significant investments in renewable energy production and the shift from fossil fuel production to diversified, low-carbon energy sources. However, the combination of government transition policies, new competitors, and technological change may render some existing oil and gas firms obsolete. Financial institutions should carefully scrutinize the transition plans of their clients and compare them to others in the oil and gas sector. There are a number of frameworks that exist to support this assessment from the detailed Assessing Carbon Transitions framework of CDP to the guidance issued by the TCFD on effective transition plans. The exercise of evaluating transition plans is fundamentally a process of evaluating a firm and sector's future prospects. As a result, a financial institution's industry analysts should play an active role in working with their climate risk colleagues to assess the viability of client transition plans.

Adaptive and mitigating actions of clients

1. Diversification and transition

Firms in the oil & gas sector are certainly not green today, but some are taking steps towards a low-carbon operating model. That involves diversifying their operations from oil and gas to broader energy production, ideally with a growing focus on renewables. This process of "greening" involves investing in necessary capital assets as well as research and development of low-carbon energy sources. The ultimate result of this reprioritized focus should be seen in the firm's declining emissions intensity and a growing share of energy production from renewable sources. A firm should develop a transition plan in order to outline their journey to low-carbon energy production and specify how different parts of the business will evolve during the transition.

2. Environmental and social stewardship

Strong environmental and social practices are essential for any company operating today. However, given the historic (and ongoing) environmental issues associated with the oil & gas sector, from oil spills devastating ecosystems and community livelihoods to refineries harming human health, environmental and social stewardship needs to be a top priority for firms in the oil & gas sector. Environmental and social responsibility begins with strong controls and processes throughout the organization that reduce the potential of spills, leaks, and other harmful activities. Extraction methods matter, as unconventional production methods (e.g. tar sands) are known to have a greater environmental impact than conventional ones. For gas, recent research on leaks and flaring has shown that methane leaks are a much more significant contributor to emissions than previously thought. Amid rising legal and reputational risks to oil & gas firms, those that wish to maintain their social license to operate must adhere to the highest environmental standards.

Aligning to net zero

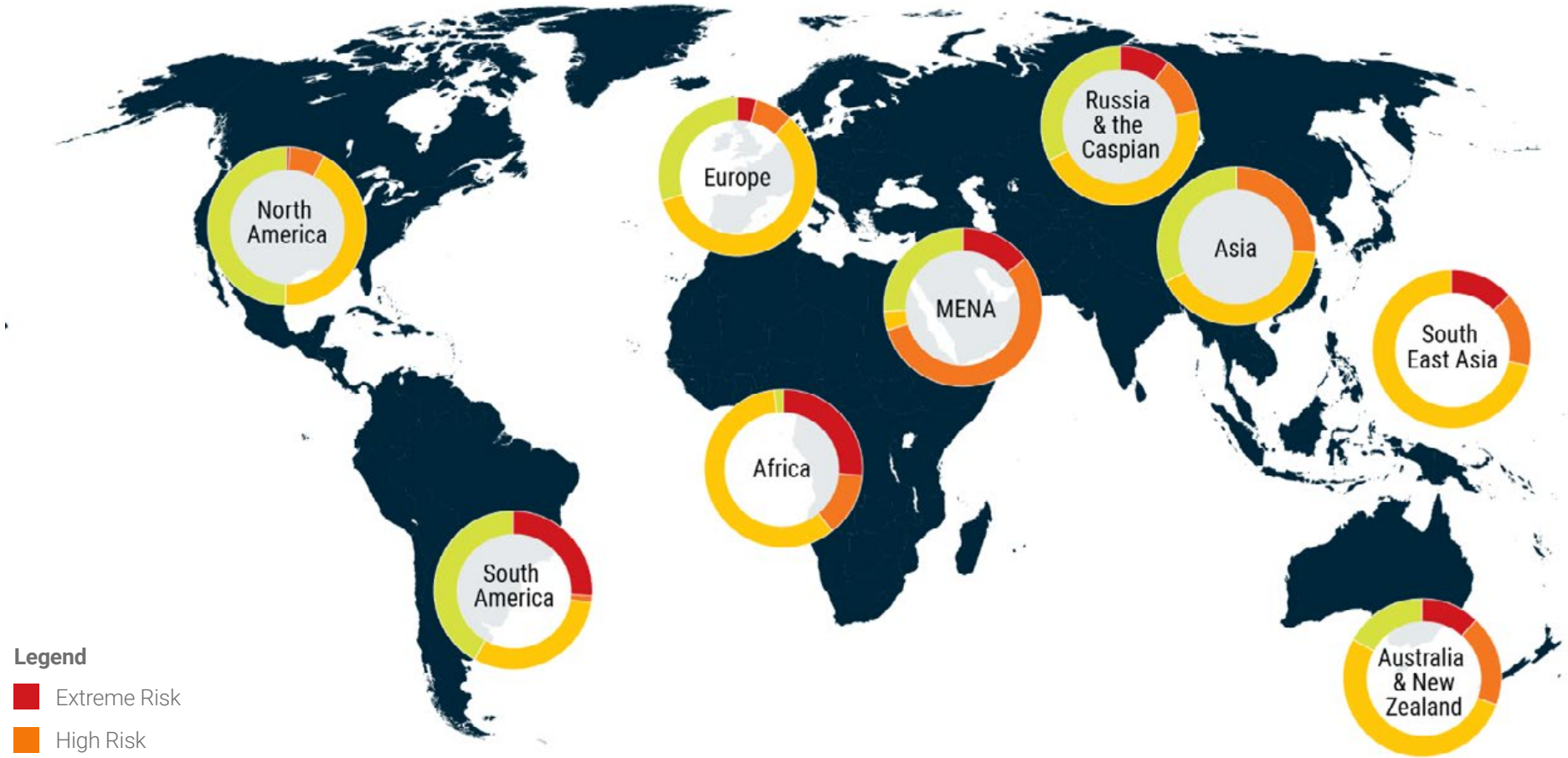
Financial institutions looking to manage their transition risks in the oil & gas sector should engage directly with clients and support client transitions. However, while necessary, this client-level approach must complement a more strategic approach to reducing the firm's financed emissions. Over the past few years, hundreds of major financial institutions have committed to net zero by 2050 across their portfolios. Most of these institutions have joined one of the industry-specific decarbonisation alliances (e.g., Net-Zero Banking Alliance, Net-Zero Asset Owner Alliance) to support them in fulfilling their climate goals. Beyond the financial sector, net-zero alignment has also gone mainstream in government policies worldwide, with nearly 90% of global emissions now covered by a net-zero commitment. Amid growing pressures on high-carbon sectors and the decarbonisation ambitions of financial and government actors, financial institutions can consider a credible and actionable net-zero commitment a way to mitigate both the systemic and idiosyncratic risks of the transition. The process of operationalising a net-zero commitment begins by assessing baseline financed emissions. Then, institutions set targets for their portfolios and specific sectors, such as the oil & gas sector using science-based scenarios. After the targets are set, financial institutions develop holistic strategies to reduce their financed emissions. These processes can be explained to stakeholders in a transparent transition plan that demonstrates not only the net-zero commitment but how the firm is mitigating its transition risks.

SECTION B:

Physical risks

Estimates suggest that 40% of global oil & gas reserves are threatened by the physical impacts of climate change (Figure 10) (Maplecroft, 2021). The sector is vulnerable to a range of physical risks, including increasing temperatures, sea-level rise, flooding, storms, and droughts. These risks are further explored in detail below.

Figure 10: Global oil & gas reserves exposed to physical impacts of climate change (Maplecroft, 2021)



1. Intensifying storms and flooding

Climate change is increasing the severity and frequency of storms and causing the risk of intense rainfalls to rise. Storms and floods caused by heavy precipitation can damage extraction and production infrastructure as well as disrupt the operations of fossil fuel pipelines. In 2021, severe winter storms in Texas knocked out the state's energy infrastructure, resulting in a major power crisis and the lowest oil & gas output in the Unites States for three years (Maplecroft, 2021). Unprecedented rainfall and flash flooding during the summer of 2022 in Fujairah, a city in the north-east of the United Arab Emirates, caused the world's third largest oil bunker centre to close down. Widespread floods caused damaged to the bunker's infrastructure, leading to the loading terminals to remain closed (Argus, 2022). Coastal infrastructure, including coastal power plants, refineries and oil drilling platforms, are at particular risk to storms and flooding (American Petroleum Institute, n.d.). The 2017 hurricane season in the United States reduced crude oil and natural gas production in the Gulf of Mexico by 12 million barrels of crude oil and 18 billion cubic feet of natural gas (EIA, 2018). In 2021, Hurricane Ida caused a record 55 spills in the Gulf of Mexico, damaging offshore oil & gas infrastructure and disrupting the supply of crude oil (Box B) (The New York Times, 2021). In addition, storms and flooding will impact the logistics of the oil & gas sector, interfering with production and supply chains. Companies that operate in areas exposed to greater risks from storms and flooding could potentially face higher costs for extraction and infrastructural development (Maplecroft, 2021). Disruptions in production, transportation, and distribution could further lead to financial losses and uncertainty for oil & gas companies.

Case study 5: Hurricane Ida and its impact on the oil & gas sector

Offshore oil production in the Gulf of Mexico accounts for 16% of daily U.S. oil production (Reuters, 2021). With impacts from climate change being increasingly felt, offshore oil & gas operations in the Gulf of Mexico have become vulnerable to cyclones and extreme waves. In August 2021—on the 16th anniversary of Hurricane Katrina—Hurricane Ida hit the state of Louisiana, becoming the fifth strongest storm to make landfall in the United States (The New York Times, 2021; The Washington Post, 2021).

The severity of the storm resulted in oil spills that could be detected from space. Two weeks after the storm, the National Oceanic and Atmospheric Administration (NOAA) reported a total of 55 spills in the Gulf of Mexico as a result of Hurricane Ida. In comparison, in the two weeks before the storm, NOAA only detected five potential spills in the Gulf (The New York Times, 2021).

In the days following Ida, 88% of offshore oil production remained closed, and more than 100 oil drilling platforms were unoccupied (Guardian, 2021b). Almost a month after the storm, 32 platforms remained unoccupied, and 16% of oil production and 24% of gas production was still offline (The New York Times, 2021).

By September 2021, it was reported that 17.5 million barrels of oil had been lost to the market because of Hurricane Ida (Reuters, 2021). The week of the storm, data shows that crude oil inventories in the Gulf Coast decreased by 2.6 million barrels. U.S. crude oil production decreased by 1.5 million barrels per day, and U.S. crude oil exports decreased by 698,000 barrels per day (EIA, 2021). Risk Management Solutions (RMS) estimated a combined onshore and offshore insured loss of US$25 to US$35 billion due to Ida, with an estimated loss of US$0.7 to US$1.5 billion to offshore platforms, rigs and pipelines from strong wind and waves (Insurance Journal, 2021).

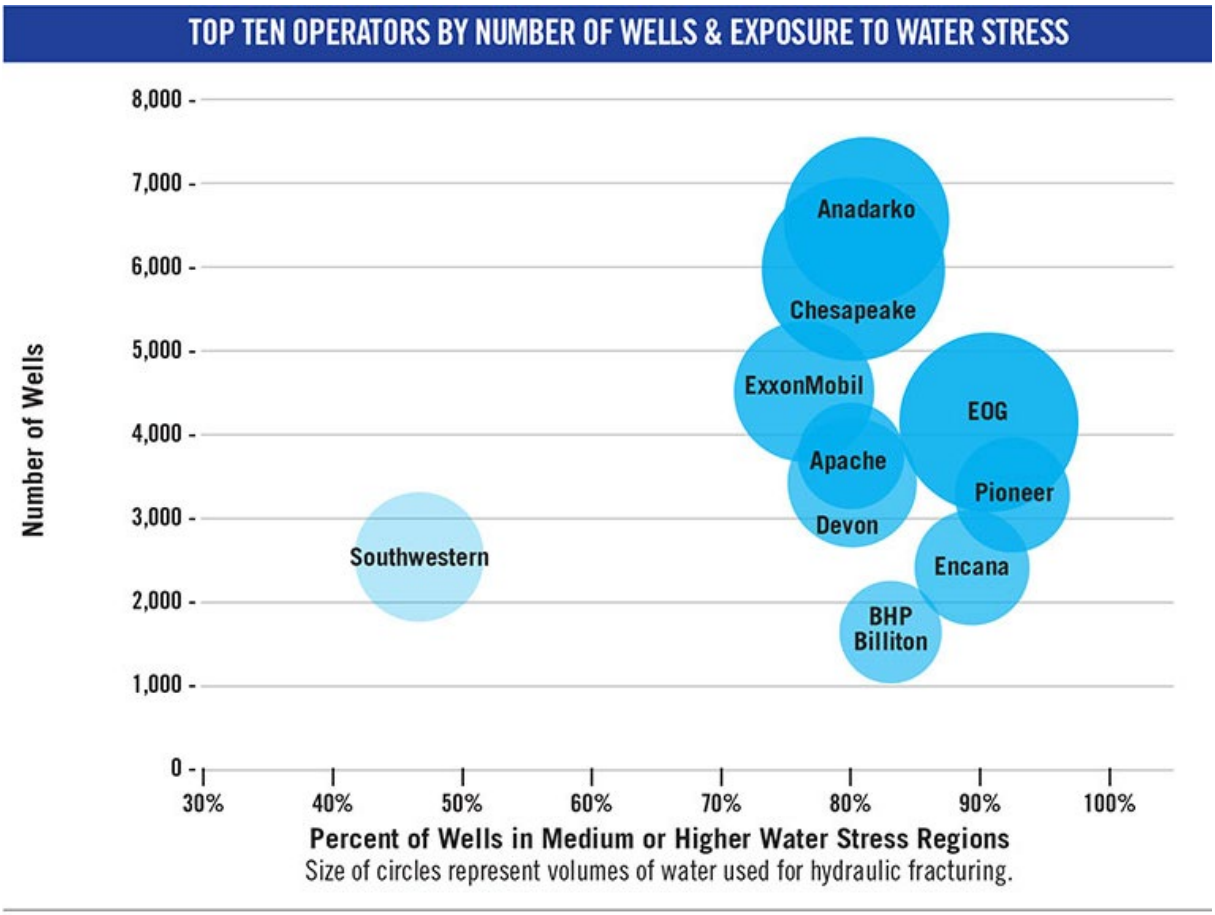
Figure 11: Oil slick on top of floodwaters in Louisiana (CNN, 2021)

Figure 12: A Royal Dutch Shell refinery as Hurricane Ida made landfall (CNN, 2021)

2. Water-related issues (drought, extreme heat, and water scarcity)

Worsening extreme heat and severe droughts also threaten the oil & gas sector. Many activities in oil & gas production processes are extremely water-intensive—for example, fracking can require 1.5 to 9.7 million gallons of water per well (NRDC, 2019). Extreme heat and drought will limit water availability, hindering operations and restricting access to fossil-fuel reserves that demand extraction by hydraulic means (Maplecroft, 2021). A study by Ceres determined that 57% of the United States' 110,000 oil & gas wells are located in high or extremely high water-stressed regions, including key reserves such as Eagle Ford Play and the Permian Basin in Texas. Nine out of the top 10 oil companies analysed by Ceres operated 70% or more of their wells in areas with medium or high water stress (Ceres, 2016). Water-scarce countries with large shale deposits, such as India, Northern Africa and Argentina, will find it increasingly difficult to make use of their deposits as water scarcity grows (Rosa *et al.*, 2018). Furthermore, drought events and extreme hot weather can lead to rising risks to employee health and safety in the work-place. Hazardous working conditions can decrease employee productivity and reduce employment opportunities in the oil & gas sector.

Figure 13: Top 10 US oil operators' exposure to water stress (Ceres, 2016)



Source: Ceres analysis using WRI Aqueduct Water Risk Atlas in combination with well data from IHS via FracFocus.org. Data from January 2011-January 2016.

Case study 6: Water-related issues (i)

TOTAL's 2020 annual report

Operating and financial risks relating to the effects of climate change

The effects of climate change may leave TOTAL exposed to an increase in associated operating and financial costs. TOTAL's businesses operate in various regions, where the potential physical impacts of climate change, including changes in climate prediction models, are uncertain. Climate change potentially has multiple effects that could harm the Group's operations. The increasing scarcity of water resources may negatively affect the Group's operations in some regions of the world, high sea levels may harm certain coastal activities, and the multiplication of extreme weather events may damage offshore and onshore facilities. All these factors may increase the operating costs of facilities and have an adverse effect on the Group's operating income.

Adaptation and assessment measures

The Group also assesses the vulnerability of its facilities to climate hazards so that the consequences do not affect the integrity of the facilities, or the safety of people. More generally, natural hazards (climate-related risks as well as seismic, tsunami, soil strength and other risks) are taken into account in the construction of industrial facilities, which are designed to withstand both normal and extreme conditions. The Group carries out an assessment of the possible repercussions of climate change on its projects. These analyses include a review by type of risk (e.g., sea level, storms, temperature, permafrost) and take into account the lifespan of the projects and their capacity to gradually adapt.

Case study 7: Water-related issues (ii)

Shell Annual Report 2020

Impact of physical risks and adaptation measures

The physical effects of climate change may increase Shell's exposure to hazards that could potentially include, for example, higher air and sea temperatures, rising sea levels, an increased chance of flooding and droughts, wildfires and more severe tropical storms. They could potentially impact our operations and supply chains. There could also be potential financial implications, such as increased operating costs and lower revenue because of decreased efficiency.

The potential impacts of physical risks to Shell facilities, where processes, equipment and safety could be affected, are reasonably understood in Shell's oil and gas businesses. For example, rising temperatures could potentially impact the efficiency of our plants, increase equipment corrosion and decrease gas pipeline capacity. Rising sea levels could potentially impact our coastal facilities through increased coastal erosion and flooding, damage to jetties, and salt-water intrusion in freshwater intake.

The potential impacts of physical risks to the wider environment and their indirect effect on our facilities is an area that we continue to monitor and evaluate within the local context. Such risks could potentially disrupt our operations by affecting people, infrastructure or supply chains. For example, wildfires and droughts could disrupt feedstock supply for biofuels or make it difficult to access assets, including areas that support our nature-based solutions programme. Floods, meanwhile, could affect staff and communities in low-lying areas.

3. Shifting permafrost

With rising temperatures comes the risk of thawing permafrost in high latitudes, which can cause damage to oil & gas infrastructure and disrupt transportation networks. Changes in permafrost have also been linked to more frequent landslides (Carbon Brief, 2019). As a result, shifting permafrost may disrupt oil & gas operations and raise maintenance costs (Arctic Institute, 2020), creating potential financial losses for oil & gas companies. An estimated 70% of infrastructure in the Arctic, particularly oil & gas infrastructure, is located in areas where thawing permafrost is expected to intensify by 2050. The risk of damage to infrastructure is especially pronounced in Russia, which produces 80% of its natural gas in the Arctic. Most oil & gas pipelines in the Arctic are underground, rendering them extremely vulnerable to shifting soil (EOS.org, 2021). According to the Russian Academy of Sciences, about US$250 billion worth of Russian physical infrastructure in the Arctic, including oil & gas pipelines, pump stations, and extraction facilities, is at risk from thawing permafrost (IFRI, 2020). In 2020, thawing permafrost weakened the foundations of a storage tank in Norilsk, Russia, causing 20,000 tonnes of diesel to leak into a nearby river (BBC, 2020) (Figure 14). By 2050, up to 45% of Russian Arctic hydrocarbon extraction fields are expected to suffer damage (Hjort *et al.*, 2018). Similarly, over 40% of the Trans-Alaska Pipeline System (TASP) in the United States is located in areas where permafrost is expected to thaw by 2050 (Observer Research Foundation, 2021).

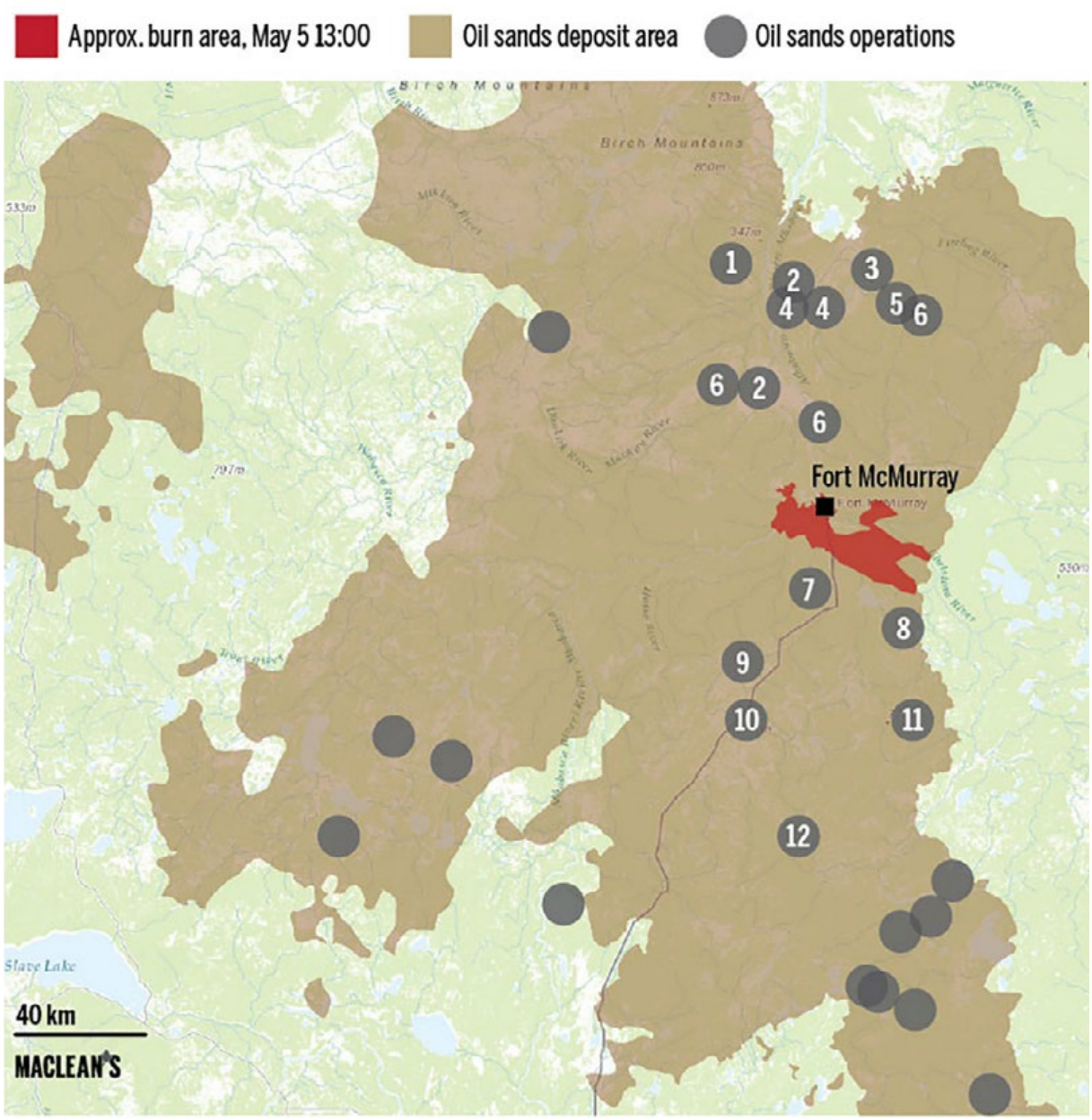
Figure 14: Leaked oil spilling into a river in Norilsk, Russia (BBC, 2020)

4. Wildfires

Oil & gas fields can also be exposed to wildfires. As the global temperature rises, the frequency and severity of wildfires is expected to worsen. Oil & gas fields located in regions vulnerable to wildfires will encounter property damage and disruptions in operations, leading to greater costs and increased financial losses. Airborne embers produced from wildfires near tank openings, structures, and vessels with flammable substances can easily ignite a fire (Khakzad, 2018). Wildfires also have the potential to impact the hydrology of a given area, which can affect the water supply required for oil & gas production and further exacerbate water shortages. Analysis by the Fracktracker Alliance determined that the areas in California that are most vulnerable to wildfires are closely located to oil & gas fields. Nearly one third (31%) of the state's oil fields have been burned by wildfires, affecting about 10,000 oil & gas wellheads (Fracktracker Alliance, 2018). In 2015, a major wildfire in Alberta, Canada, threatened numerous operations of oil sands facilities and forced 10% of the production offline. Two petroleum companies, Canadian Natural and Cenovus, shut down their operations as a safety precaution (Khakzad, 2018). This translated into a loss of between 80,000 and 135,000 barrels a day.

Additionally, wildfires pose a major risk to the health and safety of employees by creating dangerous air quality levels. In some cases, personnel in remote areas will need to be evacuated. In 2016, a wildfire in Fort McMurray, Canada, spread to areas where major oil sands production plants such as Syncrude and Suncor Energy were located (Figure 15). The wildfire caused a 40% decrease in production at the exposed facilities, reducing output by almost one million barrels a day. A worker accommodation camp with 665 units was also burned down (Khakzad, 2018).

Figure 15: Fort McMurray Wildfire and the location of impacted oil sands plants (Khakzad, 2018)



5. Physical risk guidance

Key physical risk questions for financial institutions to consider

1. **Gathering information**
   - What are the most prevalent physical risks across our portfolio footprint?
   - What have our clients disclosed in their financial, sustainability, and climate reports regarding their physical risks?
   - How many of our clients have business resiliency plans?
   - Do we have locational data on the major assets of our clients?

2. **Assessing the risks**
   - How much of our portfolio operates in areas of high physical risk?
   - What does our exposure to higher-risk clients look like? What are the terms of our financial relationship (e.g. debt/equity, tenor)?
   - Have we looked at physical risk scenarios to see how those risks will evolve over time? Have we considered short-term, medium-term and long-term risks?
   - How would physical hazards disrupt our clients' production, transportation, refinement, and distribution activities?
   - How long might disruption last? What might be the potential loss in revenue?
   - How might insurance markets (and insurability) change in the face of worsening physical risks to oil & gas infrastructure? Are our clients currently covered by insurance?
   - Have we explored local adaptation measures being taken that will increase the resilience of assets to climate change?
   - How much are clients investing in adaptation and resiliency measures?

3. **Engaging with clients and updating strategy**
   - Do our senior leaders understand the physical risks of our clients?
   - How are we helping our clients to transition to more resilient infrastructure?
   - How will the physical risks identified and assessed influence our strategy in the oil & gas sector?
   - What specific updates to risk management practices or business activities will be needed to appropriately consider these physical risks in our operations?

Recommendations for risk management

1. Conduct geolocated asset-level analysis

Major oil and gas assets can be exposed to physical hazards such as those covered above. Refineries, offshore platforms, and pipelines are forms of infrastructure most frequently impacted by extreme events. With many of these assets worth billions in US$, temporary operational disruptions or essential repairs may be costly. Financial institutions should have clear knowledge of the major capital assets of their oil and gas clients. This includes knowledge of their locations, the hazards they are exposed to, existing insurance coverage, and any mitigating or exacerbating risk factors. Periodic analysis should be conducted on these assets by the financial institution or its client. This ongoing monitoring should establish the magnitude of the risks as well as any changes in risk levels over time.

2. Review clients' resiliency plans

Many firms in the oil and gas sector have discussed physical risks within their annual reports and other disclosures as noted in the examples above. In some of these disclosures, the firms also discuss business continuity planning and actions undertaken to increase resiliency. For financial institutions, information about the resiliency and adaptive capacity of oil and gas clients is critical. At a minimum, financial institutions should review the sections of client annual reports and climate-related financial disclosures focused on physical risks and resilience. Beyond this, financial institutions should request information on the adaptation measures being undertaken for major capital assets as well as for the client overall. These plans can be compared with national adaptation plans (NAPs) issued by governments as well as other suggested resiliency measures (e.g., those within the IPCC AR 6 WG 2 report).

Adaptive and mitigating actions of clients

1. Resiliency planning

As climatic conditions grow more severe, infrastructure and global supply chains of the oil & gas sector is placed at risk. Firms can develop resiliency and adaptation plans for their most important sites as well as their supply chains. These plans can begin with an assessment of current climate risks and asset vulnerabilities. They should also explore different climate scenarios that focus on how the frequency and severity of climate risks may change over time. Resiliency planning should also create procedures for business units to respond to potential disruptions in upstream supply and downstream consumption. In addition, firms should be aware of changes in the insurance market and potential costs associated with increased climate risks.

2. Climate-ready infrastructure

Given the cost of production, transportation, and refining assets in the oil & gas sector, firms in the sector should invest in climate-ready assets that will stand up to worsening climate hazards. This begins in the planning process for new assets by enacting building standards that are not just appropriate for today's conditions, but for potential tail-risk events in the future. For existing infrastructure, retrofits and climate defenses may be considered such as sea walls and on-site back-up power generation. The most effective of these investments may be ones that offer environmental co-benefits. Examples of projects that build resiliency and support nature include the restoration of mangrove forests and wetlands.

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