

Working Paper

The Bottom of the Barrel: Saudi Aramco and Global Climate Action

Jim Krane, Ph.D.

Wallace S. Wilson Fellow for Energy Studies

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ABSTRACT

For Saudi Arabia’s absolute monarchy, climate action represents a combined threat and opportunity in retaining the oil rents that underpin domestic political institutions and the kingdom’s international influence. Saudi Aramco, the largest source of greenhouse gas-emitting fossil fuel among all firms worldwide, is exposed to numerous risks around continued use of fossil fuels. However, Aramco is also the producer with the world’s lowest cost basis and lowest intensity of greenhouse gas emissions per barrel produced. These attributes suggest that oil from the kingdom should retain a prominent role in oil markets, particularly under climate constraints. While Saudi Aramco’s April 2019 bond prospectus outlines steps the company is taking to ensure that it continues marketing oil far into the future, this paper argues that Aramco’s quest to remain the “last man standing” in global oil depends not just on its substantial cost advantages. Declining social acceptance of fossil fuel combustion suggests that Aramco’s pursuit of carbon competitiveness will assume growing importance.

INTRODUCTION¹

In a world beset by intensifying climate change mainly produced by combustion of fossil fuel, Saudi Arabia is ground zero. The firm accountable for the single largest contribution to that warming is the kingdom’s national oil company, Saudi Aramco. Oil and gas produced by Aramco was responsible for roughly 4.8% of global emissions in 2018 and about 4.3% of total atmospheric accumulations since 1965, the largest share of any single firm.² At the same time, the kingdom’s intense summer climate faces the potential of being warmed into intolerability by century’s end.³ Despite the implied climate damage to its homeland, Saudi Aramco is moving to expand, streamline and protect its system of oil monetization, so that the Saudi NOC can produce and market the kingdom’s prodigious below-ground reserves “for generations to come,” as its prospectus states.

¹ This working paper was first presented at the Gulf Research Meeting, University of Cambridge, July 2019, and forms the basis for a chapter in the forthcoming edited volume “Domestic Policy Making and Governance in Saudi Arabia” edited by Mark C. Thompson and Neil Quilliam, to be published in summer 2021 on IB Tauris-Bloomsbury.

² Climate Accountability Institute, “Carbon Majors 2018 Data Set,” Database (Snowmass, Colo.: Climate Accountability Institute, December 2020), https://climateaccountability.org/carbonmajors_dataset2020.html.

³ Jeremy S. Pal and Elfatih A. B. Eltahir, “Future Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability,” *Nature Clim. Change* 6, no. 2 (February 2016): 197–200.

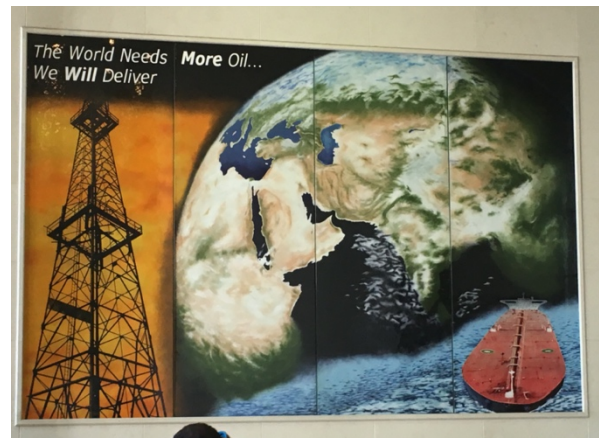
“The Company intends to maintain its position as the world’s leading crude oil producer by production volume,” states the company’s bond prospectus of April 2019. “Its reserves, operational capabilities and spare capacity allow it to increase production in response to demand.”⁴

The kingdom’s former energy minister, Khalid al-Falih, gave voice to the strategic plan outlined here, when he predicted in 2019 that no other oil producer would survive longer. “Saudi Arabia is the most prolific basin for oil and gas. We have the best resources and the best capabilities and *we are going to produce the last drop of oil,*” al-Falih said.⁵

The expansion of hydrocarbon production, refining, conversion, and marketing outlined in Saudi Aramco’s 2019 bond prospectus

amounts to a determination to be the “last man standing” in global oil markets. That ambition runs at cross-purposes to global decarbonization efforts, and presumes that oil will be difficult to replace in transportation sectors like aviation, while retaining increasing non-combustion applications in chemical and plastics manufacture.⁶ Aramco’s plan appears to leverage world-leading advantages in unit costs (\$7.50 per barrel) and upstream carbon intensity (5g CO₂ per megajoule), along with a 40-year exclusive concession agreement – which can be extended another 60 years until 2117 – to perpetuate a revenue stream far larger in 2018 than that of any other company in the world: \$244 billion in EBITDA.⁷

The Aramco bond prospectus and other company statements infer that Saudi Arabia will not voluntarily phase out oil production and concede the market to competitors while oil demand still exists. Rather, the company will await signals from the global oil-consuming public that demand



Above: The lobby mural in one of Saudi Aramco’s headquarters buildings in Dhahran, Saudi Arabia, provides an abbreviated description of the kingdom’s future oil strategy. (Author photo)

⁴ Saudi Aramco, “Base Prospectus: Saudi Aramco Global Medium Term Note Programme” (Saudi Aramco, April 1, 2019), 89.

⁵ Anjali Raval and Ed Crooks, “Oil Groups Face Dilemma on Climate Change,” *Financial Times*, March 13, 2019, Online edition, <https://www.ft.com/content/ec42c3d8-4540-11e9-b168-96a37d002cd3>. Emphasis added.

⁶ David Chiaramonti, “Sustainable Aviation Fuels: The Challenge of Decarbonization,” *Energy Procedia* 158 (2019): 1202–7.

⁷ Earnings before interest, taxes, depreciation and amortization. See: Saudi Aramco, p. 48.

for oil is finally satiated.⁸ The \$244 billion in 2018 revenues cited above were split almost evenly with the Saudi government: \$111 billion for Aramco and \$102 billion paid to the government in the form of taxes and royalties. Those payments, in turn, provided 63% of government revenues. In 2018 overall, Aramco contributed 43% of Saudi Arabia's GDP.⁹

The Saudi gamble is that oil retains a role in a climate-stressed world, and that Saudi Arabia retains its business model even after other oil companies have failed or moved to other lines of business. At its core, Aramco's "last man standing" approach amounts to a response to three important calculations:

- First, that regime survival and external security remain reliant on regime control over oil rents, replacement of which constitutes a lengthy and uncertain process.
- Second, that the risks to Saudi Arabia implied by a loss of oil rents outweigh the risks (in the view of Saudi elites) of a changing climate, whether to the climate of the Arabian Peninsula or the Earth more broadly. This view is bolstered by interpreting petro-state climate strategy as a collective action problem, i.e., that climate damage will be little affected by a premature winding up of Saudi Aramco, if other firms continue to market oil.
- Third, even in a world that is serious about decarbonization, some uses for oil remain. Saudi Arabia, as the most competitive producer, retains a strong cost advantage that is complemented by the low carbon intensity of Saudi oil production.¹⁰ These attributes allow Saudi Aramco to present itself as the optimal choice to serve a climate-stressed market, even one in decline.

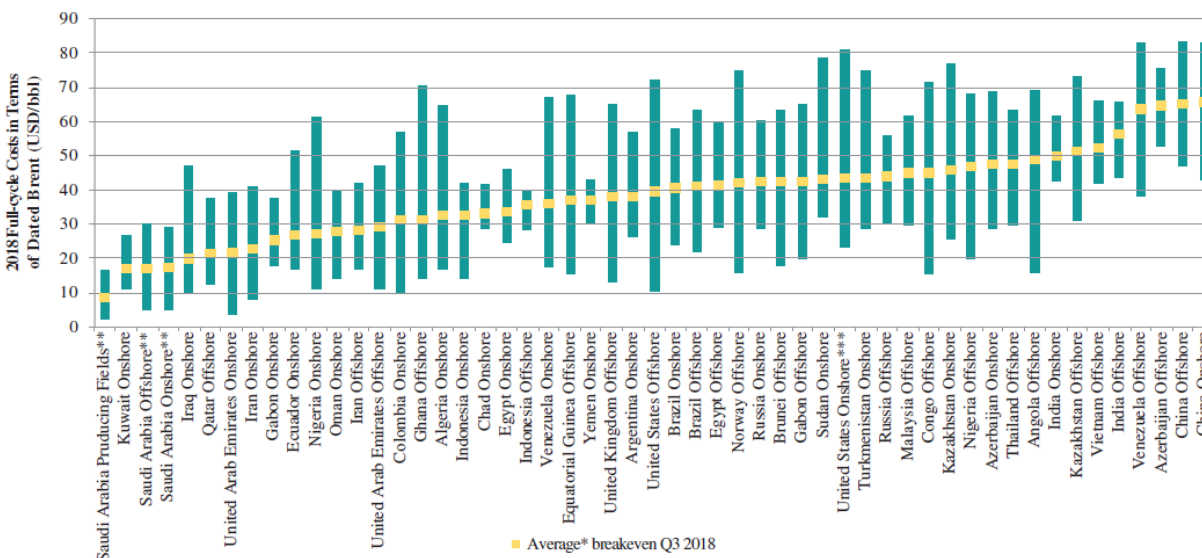
Saudi climate policy calculations are far from unique, however. Myriad fossil fuel producing states are confronting similar calculations. In autocratic polities in particular, policymakers are unlikely to find attractive replacements for the copious oil rents deployed to achieve social

⁸ For instance, Saudi Aramco's 2017 Annual Review implies that the company's long-term strategy aims to maintain or increase its role in global oil sector as long as possible. "By tempering production from mature fields, accelerating younger fields and secondary reservoirs, and developing fresh reserves from new increments, we plan to create and sustain value for generations to come." See: "Upstream Operations," in *Saudi Aramco Annual Review 2017* (Saudi Aramco 2018): 20, https://www.saudiaramco.com/-/media/images/annual-review-2017/pdfs/en/06-upstream-operations_en.pdf

⁹ Saudi Aramco, "Saudi Aramco Bond Prospectus," 19.

¹⁰ Note that other oil firms are already competing in the realm of lowest carbon intensity of their crude oil. Norway's Equinor and Occidental Petroleum of the United States are among those pursuing carbon-neutral or carbon negative oil by sequestering as much or more carbon during the production process than is emitted upon combustion.

quiescence amid minimal taxation or political participation. Low-cost producers that manage to achieve low fiscal breakevens appear to be best placed to participate the longest.¹¹ (Fig.1)



- (*) Average is not a weighted or arithmetic average but a selection of what a typical new oil project in that country would cost in today’s market. New oil projects selected by country from 2018-onwards.
- (**) The breakeven price for producing fields in Saudi Arabia is forward-looking and hence excludes all exploration and development costs. The break-even price for Saudi Arabia (for the three categories—producing fields, onshore and offshore) is calculated assuming an income tax rate of 50%. The analysis is carried out for typical new projects starting in 2018.
- (***) The break-even for US Onshore excludes land acquisition cost.

Figure 1: Major oil producers ranked by post-tax breakeven costs for new oil production (assuming a 10% rate of return) through 2030 (Source: Saudi Aramco bond prospectus, p. 82)

Internally, Saudi Aramco’s extraordinary rents are the substantive element that persuades the Saudi public to support the al-Saud, the family that so dominates political life that the kingdom bears its name. Externally, oil and the capacity to adjust production – and the willingness to do so in concert with US interventions – are behind the kingdom’s strategic power, its embrace and defense by powerful allies, and its lofty geopolitical stature. These are elusive accomplishments for exporters of primary products. Protecting the business – regardless of its environmental drawbacks – is therefore a strategic and economic imperative for the kingdom and its ruling family.

¹¹ Andreas Goldthau and Kirsten Westphal, “Why the Global Energy Transition Does Not Mean the End of the Petrostate,” *Global Policy* 10, no. 2 (May 2019): 279–83, <https://doi.org/10.1111/1758-5899.12649>.

Even so, Saudi Arabia has begun to adopt an economic diversification plan.¹² Press reports suggest that Saudi executives remain skeptical of prospects for diversified businesses matching Aramco's profits, or the wisdom of sharing those profits by selling shares to foreign investors.¹³ Numerous scholars have demonstrated that oil rents comprise a durable source of income that supports centralized autocratic regimes.¹⁴ One wonders whether diversifying the sources of fiscal revenue implies increasing pressure for a similar process in the political realm, i.e. *political* decentralization, in the form of increased participation.¹⁵

This paper makes a number of broad observations about climate action and Saudi Arabia by examining the Saudi Aramco bond prospectus, company investments and public statements of its executives, along with literature examining climate risk and policy reactions among economies dependent on hydrocarbon rents. The policy reactions chosen by Saudi Arabia are important because of the size of its national oil company – both in terms of Aramco's share of the oil market and its contributions to atmospheric emissions – as well as the message that its preparations provides to rival oil producers.

LITERATURE REVIEW

Saudi Arabia is an enigmatic case within the international climate action scene. The kingdom has long been an avid participant in multilateral climate talks, but its role has mainly been to obstruct

¹² Government of Saudi Arabia, "Vision 2030: Kingdom of Saudi Arabia," Government report (Riyadh: Government of Saudi Arabia, April 25, 2016), <http://vision2030.gov.sa/download/file/fid/417>.

¹³ Summer Said, Rory Jones, and Georgi Kantchev, "Mohammed Bin Salman Meets Resistance—From His Own Bureaucrats," *Wall Street Journal*, February 4, 2019, online edition, <https://www.wsj.com/articles/saudi-crown-prince-meets-resistance-on-economic-overhaulfrom-his-own-bureaucrats-11549295905>.

¹⁴ Articles reaching this conclusion include: Benjamin Smith, "Oil Wealth and Regime Survival in the Developing World, 1960-1999," *American Journal of Political Science* 48, no. 2 (2004): 232–46; Joseph Wright, Erica Frantz, and Barbara Geddes, "Oil and Autocratic Regime Survival," *British Journal of Political Science* 45, no. 2 (2015): 287–306; Jay Ulfelder, "Natural-Resource Wealth and the Survival of Autocracy," *Comparative Political Studies* 40, no. 8 (2007): 995–1018; Jørgen Juel Andersen and Silje Aslaksen, "Oil and Political Survival," *Journal of Development Economics* 100, no. 1 (2013): 89–106; Bruce Bueno De Mesquita and Alastair Smith, "Leader Survival, Revolutions, and the Nature of Government Finance," *American Journal of Political Science* 54, no. 4 (2010): 936–50; Jesus Crespo Cuaresma, Harald Oberhofer, and Paul A Raschky, "Oil and the Duration of Dictatorships," *Public Choice* 148, no. 3–4 (2011): 505–30.

¹⁵ The UAE and Dubai in particular show that it is possible to decentralize fiscal revenue and retain autocratic control. Indonesia presents a counter-case. See: Ehtisham Ahmad and Ali M Mansoor, *Indonesia: Managing Decentralization*, IMF Working Paper, WP/02/136 (Washington: International Monetary Fund, 2002), https://www.researchgate.net/profile/Ehtisham_Ahmad/publication/5123876_Indonesia_Managing_Decentralization/links/00463527a4b04849c8000000.pdf.

progress.¹⁶ The kingdom is also a signatory of the Paris treaty and its former oil minister, al-Falih, has made statements in support of the Paris goals.¹⁷ Saudi Arabia's Nationally Determined Contribution aims to reduce emissions by 130 million tonnes of carbon dioxide equivalent, or MtCO₂eq, from an unspecified business-as-usual trajectory by 2030. However the Saudi NDC is a “conditional” one that requires continued oil export rents to fund decarbonization efforts.¹⁸

The Saudi NDC target is ambiguous. Attempts to quantify it have resulted in differing estimates. One assessment, by the environmental organization Climate Action Tracker, or CAT, finds that Saudi Arabia could claim that it was complying with its NDC and still experience emissions in 2030 that are as much as 77% higher than 2015 levels. CAT has categorized the Saudi NDC as “critically insufficient,” among those of just four others: the United States, Turkey, Ukraine and Russia.¹⁹

Another examination of the Saudi NDC finds similarly, that the kingdom could comply with its NDC and still emit 1,160 MtCO₂eq in 2030, which is above levels published in the kingdom's own current policies scenarios model. Saudi Arabia's proposed emissions peak would be the highest among the G-20 economies, at 32.8 tonnes CO₂eq per person.²⁰

Other examinations suggest the possibility of more optimistic outcomes. Wogan et al. examine three policy scenarios to pursue decarbonization in the kingdom's production of electricity and desalinated water, the source of 40% of the country's carbon emissions. The authors found that eliminating energy subsidies and adopting market prices on fuels used in power generation – and charging full prices for electricity and water – would discourage energy consumption and drive expensive liquid fuels from power generation. Higher fuel costs would push the sector toward

¹⁶ Joanna Depledge, “Striving for No: Saudi Arabia in the Climate Change Regime,” *Global Environmental Politics* 8, no. 4 (2008): 9–35. Suzanne Goldenberg, “Saudi Arabia Accused of Trying to Wreck Paris Climate Deal,” *The Guardian*, December 8, 2016, <https://www.theguardian.com/environment/2015/dec/08/saudi-arabia-accused-of-trying-to-wreck-the-paris-climate-deal>.

¹⁷ Ministry of Energy, Industry & Mineral Resources of Saudi Arabia, “Saudi Arabia Takes Its Place as Global Citizen at COP 22,” Government press release (Riyadh: Ministry of Energy, Industry & Mineral Resources of Saudi Arabia, 2017), https://docs.wixstatic.com/ugd/bc5fc9_455265c3bb8a41db987af3d3f72308cc.pdf.

¹⁸ Kingdom of Saudi Arabia, “The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia under the UNFCCC,” Government pledge (Riyadh: United Nations Framework Convention on Climate Change, November 2015), <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Saudi%20Arabia/1/KSA-INDCs%20English.pdf>.

¹⁹ Climate Action Tracker, “Saudi Arabia: Country Summary,” Online database (Climate Action Tracker Partners, September 19, 2019), <https://climateactiontracker.org/countries/saudi-arabia/>.

²⁰ Michel Den Elzen et al., “Contribution of the G20 Economies to the Global Impact of the Paris Agreement Climate Proposals,” *Climatic Change* 137, no. 3–4 (2016): 655–65.

cleaner natural gas and PV solar. Utility sector carbon emissions would fall by about 20%, from 250 to about 200 MtCO₂eq between 2018 and 2030. The change would be nearly sufficient to meet the cumulative Paris target of 130 MtCO₂eq, and would also raise more than \$900 billion for the government in recovered costs by 2030.²¹

Inside the kingdom, however, there is little public pressure for climate action. Independent civil society groups that might lobby for action are prohibited. Public opinion appears to show that little can – or should – be done within the kingdom. A 2019 public opinion survey by YouGov put Saudi Arabia on the low end of 28 countries in citizens’ beliefs that human factors were the dominant cause of climate change. Saudis were the least likely among respondents of any country to say that they or their country could do more to mitigate climate change.²²

High levels of energy intensity in the kingdom and continued state subsidization of energy suggest that large gains in efficiency could be had with straightforward changes in government policy. Data from BP (Fig. 2) show that Saudi carbon emissions as a percentage of global emissions have increased from about half a percent in the 1970s and early 1980s to a high of 1.8% in 2015-17, a disproportionate amount for a population that was just 0.44% of the global total in 2018.

²¹ David Wogan, Elizabeth Carey, and Douglas Cooke, “Policy Pathways to Meet Saudi Arabia’s Contributions to the Paris Agreement,” Research paper (Riyadh: King Abdullah Petroleum Studies and Research Center, February 2019).

²² YouGov, “YouGov - International Climate Change Survey,” Public opinion survey in 28 countries (London: YouGov, September 17, 2019), <https://mena.yougov.com/en/news/2019/09/17/international-poll-most-expect-feel-impact-climate/>.

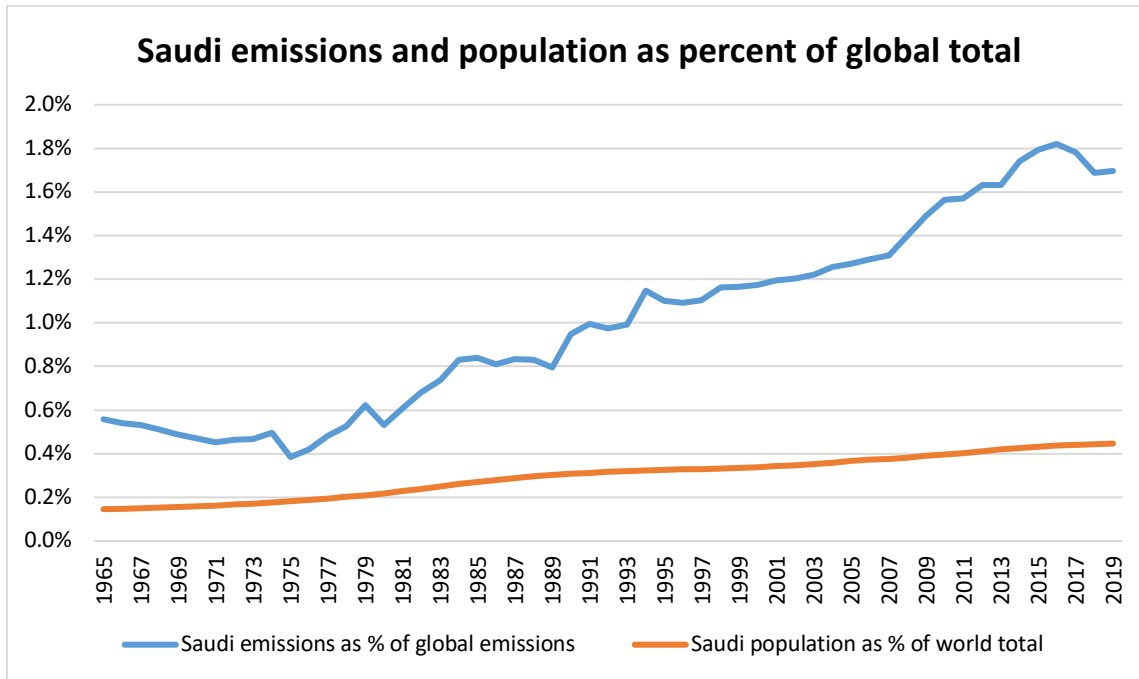


Figure 2: Saudi carbon emissions growth has outpaced its population growth as a share of the global total. (Sources: World Bank World Development Indicators 2020, BP Statistical Review of World Energy 2020)

However, this paper is less concerned with assessing Saudi participation in the global climate regime than in determining the potential effects of that regime on the Saudi political economy. Several authors have written on this subject albeit using differing methodologies than that deployed here. The consensus appears to be that Saudi Aramco will remain an important player in the global oil market even under declining profitability.

Russell frames Saudi Arabia’s climate challenge as a conflict of interest with environmental progress. “The central strategic problem facing Saudi Arabia is simply this: it depends on pumping increasing amounts of oil out of the ground to keep the state afloat for the foreseeable future at a time when the world is attempting to limit the carbon release produced by burning fossil fuels.”²³

Other authors tackle questions of transforming petro-states into more competitive economies with diverse forms of fiscal revenue. Manley et al. find that producer countries are generally unprepared to deal with a decline in demand for oil and gas, with many holding enormous underground assets relative to GDP that suggest the potential for large stranded assets. Countries

²³ James A. Russell, “Saudi Arabia: The Strategic Dimensions of Environmental Insecurity,” *Middle East Policy* 23, no. 2 (2016): 44–58, <https://doi.org/10.1111/mepo.12194>.

exacerbate their risk through policies that expose even greater portions of their economies to fossil fuel, including by developing “local content” requirements and subsidized energy services that exacerbate energy intensity of economies, and create industries at risk of decline.²⁴ Luciani argues that climate action undermines prior incentives to leave reserves in the ground in anticipation of higher oil prices, and now portends a shift toward “panic and pump” strategies of stepping up oil production.²⁵

Soummane et al. triangulate the risk faced by Saudi Arabia of exposure to the level of decarbonization implied by the IEA’s Sustainable Development Scenario. By 2030, the authors find that Saudi Arabia remains a major oil exporter, but falling demand brings reduced rent, increased unemployment, a substantial decrease in trade surplus, and large budget deficits. By 2030, the accumulated deficit is nearly as large as 2030 GDP.²⁶ Advocacy group Oil Change International finds similarly that Saudi Aramco’s future stock valuation as a partially privatized company depends on investors’ perceptions on how large a portion of Saudi Arabian oil reserves are produced, and what portion is ultimately left stranded by climate action. The authors argue that such calculations are behind Aramco’s accelerating time frame for privatization and depletion.²⁷

On the other hand, Goldthau and Westphal argue against premature demise of petrostates, suggesting that countries enjoying access to cheap fossil fuels may benefit by accruing energy-intensive industrial sectors driven out of the OECD by carbon taxes and other environmental restrictions. Ability to maintain oil export economies amid declines in demand and oil prices depends not just on cost competitiveness of oil production but also costs of social welfare underwritten by oil. Low cost producers able to rationalize welfare outlays could “outlast” high-

²⁴ David Manley, James Frederick Cust, and Giorgia Cecchinato, “Stranded Nations? The Climate Policy Implications for Fossil Fuel-Rich Developing Countries,” *The Climate Policy Implications for Fossil Fuel-Rich Developing Countries* (February 1, 2017). *OxCarre Policy Paper* 34 (2017).

²⁵ Giacomo Luciani, “Middle East: Clean Energy Sources and the Diversification of the Oil Economies?” *Revue Internationale et Stratégique*, no. 4 (2016): 143–52.

²⁶ Salaheddine Soummane, Frédéric Gherzi, and Julien Lefèvre, “Macroeconomic Pathways of the Saudi Economy: The Challenge of Global Mitigation Action versus the Opportunity of National Energy Reforms,” *Energy Policy* 130 (2019): 263–82.

²⁷ Greg Muttitt and Hannah McKinnon, “Overheated Expectations: Valuing Saudi Aramco’s IPO in Light of Climate Change,” Climate policy paper (Washington: Oil Change International, August 2017), <http://priceofoil.org/content/uploads/2017/08/Overheating-Expectations.pdf>.

spending, high-cost competitors. The authors envision the oil sector falling to a small group of producers eking out a living by meeting remaining demand even as it declines.²⁸

Further afield, Griffiths envisions producer countries protecting future rent incomes by shifting away from multilateral organizations like OPEC toward bilateral energy relations with major importers. Gulf petrostates would lock-in long-run monetization of their oil reserves, in exchange for assistance with technological diversification. Griffiths outlines the strategic energy partnership between the UAE and China as one that could result in the UAE eventually winding up oil exports in exchange for an economy based on artificial intelligence.²⁹

Van de Graaf and Verbruggen forecast pathways – both cooperative and competitive – that oil export states and the OPEC bloc could pursue to maximize oil rents while avoiding stranded reserves and social chaos.³⁰ The authors proffer a scenario that has Western powers colluding to maintain oil supply from “friendly” producers like the GCC states, Canada and Norway, while keeping that of “hostile” producers like Venezuela and Iran in the ground.³¹ Fattouh, Poudineh and West, along with Sen and Fattouh, argue that oil exporting states should prepare for the transition by building competence in renewables in their domestic markets, while freeing up fossil fuels for export.³² Successful economic diversification, most of these authors argue, is the “ultimate safeguard.”

SAUDI ARAMCO’S CLIMATE RISK DISCLOSURES

Saudi Aramco describes its own views of climate risks and potential legal liabilities facing the company in its detailed bond prospectus of April 2019, as required by financial governance

²⁸ Goldthau and Westphal, “Why the Global Energy Transition Does Not Mean the End of the Petrostate.”

²⁹ Steven Griffiths, “Bilateral Energy Diplomacy in a Time of Energy Transition,” Government-sponsored research, EDA Insight (Abu Dhabi: Emirates Diplomatic Academy, December 2018).

³⁰ Thijs Van de Graaf and Aviel Verbruggen, “The Oil Endgame: Strategies of Oil Exporters in a Carbon-Constrained World,” *Environmental Science & Policy* 54 (2015): 456–62; Aviel Verbruggen and Thijs Van de Graaf, “The Geopolitics of Oil in a Carbon-Constrained World,” *IAEE Energy Forum* 2, no. 2 (2015): 21–24.

³¹ Aviel Verbruggen and Thijs Van de Graaf, “Peak Oil Supply or Oil Not for Sale?,” *Futures* 53 (September 1, 2013): 74–85, <https://doi.org/10.1016/j.futures.2013.08.005>.

³² Bassam Fattouh, Rahmat Poudineh, and Rob West, “The Rise of Renewables and Energy Transition: What Adaptation Strategy for Oil Companies and Oil-Exporting Countries?,” Academic paper (Oxford: Oxford Institute for Energy Studies, 2018), <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/05/The-rise-of-renewables-and-energy-transition-what-adaptation-strategy-for-oil-companies-and-oil-exporting-countries-MEP-19.pdf>. Anupama Sen and Bassam Fattouh, “Economic Diversification in the MENA in the Context of Peak Oil and the Energy Transition,” in *Workshop on Sustainability in the GCC* (Gulf Research Meeting, University of Cambridge, UK, 2018).

authorities in various jurisdictions where Aramco’s debt was sold. (The company raised \$12 billion in the April 9, 2019 sale.) For instance, the US Securities and Exchange Commission in 2010 issued guidance requiring companies that are publicly traded in the United States to disclose climate-related risks that are “reasonably likely” to affect their finances or operations.³³ Aramco noted several possible risks, the effects of which it described as “difficult to predict” since the company has no control over “the impact of climate change on the demand for, and price of, hydrocarbons.”³⁴ Aramco’s risk disclosures include the following:

“Climate change concerns manifested in public sentiment, government policies, laws and regulations, international agreements and treaties and other actions may reduce global demand for hydrocarbons and propel a shift to lower carbon intensity fossil fuels such as gas or alternative energy sources. In particular, increasing pressure on governments to reduce GHG emissions has led to a variety of actions that aim to reduce the use of fossil fuels, including, among others, carbon emission cap and trade regimes, carbon taxes, increased energy efficiency standards and incentives and mandates for renewable energy and other alternative energy sources. In addition, international agreements that aim to limit or reduce GHG emissions are currently in various stages of implementation. For example, the Paris Agreement became effective in November 2016, and many of the countries that have ratified the Paris Agreement are adopting domestic measures to meet its goals, which include reducing their use of fossil fuels and increasing their use of alternative energy sources. The landscape of GHG-related laws and regulations has been in a state of constant re-assessment and, in some cases, it is difficult to predict with certainty the ultimate impact GHG-related laws, regulations and international agreements will have on the Company. . . . In the future, areas in which the Company and its subsidiaries operate that are not currently subject to GHG regulation may become regulated and existing GHG regulations may become more stringent.”

“Existing and future climate change concerns and impacts, including physical impacts to infrastructure, and related laws, regulations, treaties, protocols, policies and other actions could shift demand to lower carbon intensity fossil fuels, reduce demand for

³³ U.S. Securities and Exchange Commission, “Commission Guidance Regarding Disclosure Related to Climate Change” (U.S. Securities and Exchange Commission, February 8, 2010), <https://www.sec.gov/rules/interp/2010/33-9106.pdf>.

³⁴ Saudi Aramco, “Saudi Aramco Bond Prospectus,” 12.

hydrocarbons and hydrocarbon-based products, have a material adverse effect on the Company's business, financial condition and results of operations."³⁵

"... [I]ncreasing attention on climate change risks may result in an increased possibility of litigation against the Company and its affiliated companies. Claims have been filed by private parties, shareholders, public interest organizations, cities and other localities, especially in the United States, against companies in the oil and gas industry relating to climate change matters, including that the extraction and development of fossil fuels has increased climate change. ... Claims such as these could grow in number and the Company could be the subject of similar claims in the future."³⁶

The Aramco bond prospectus identifies or infers further risks and potential remedies, which this paper will address in the sections that follow. These include stranded reserves, changing social preferences, the global backlash against plastics, and issues with economic diversification and strategic influence conferred upon oil exporters.³⁷

CLIMATE CHANGE OPPORTUNITIES DESCRIBED IN THE PROSPECTUS

Just as significant as the risks, however, is the revelation that Aramco executives also view climate concerns as an *opportunity* to differentiate the company from its competitors based on significant advantages in energy intensity of production. Climate change has caused scholars to begin to assess the carbon intensity of crude oil industry, contrasting firms based on emissions from "upstream" production, "midstream" transport, and "downstream" refining and distribution, all of which take place before the oil products are combusted. (Fig. 2)

Intensity of upstream emissions differs broadly among crude grades. Upstream contributions to lifecycle emissions (including final combustion) might render one type of crude oil as much as 25 percent less carbon-intense than a competing grade. Upstream emissions range from roughly 5 grams of CO₂ per megajoule of energy output (for efficient producers like Saudi Arabia, Norway, Denmark and some Angolan and US grades), to more than 30g CO₂/MJ for extra-heavy

³⁵ Saudi Aramco, 21-22.

³⁶ Saudi Aramco, 16.

³⁷ A useful compendium of climate risks for fossil fuel producers is contained in: Jim Krane, "Climate Change and Fossil Fuel: An Examination of Risks for the Energy Industry and Producer States," *MRS Energy & Sustainability* 4 (2017), <https://doi.org/10.1557/mre.2017.3>.

Canadian, Venezuelan and Californian crudes. Upstream emissions comprise anywhere from 5% to 30% of total emissions, which includes greenhouse gases released during combustion as well as in transport, refining and distribution of oil-based fuels. For instance, full lifecycle emissions from Saudi Safaniyah crude have been estimated at 88g/MJ, while those of Canadian oilsands are estimated at 117g/MJ, a difference of 25%.³⁸

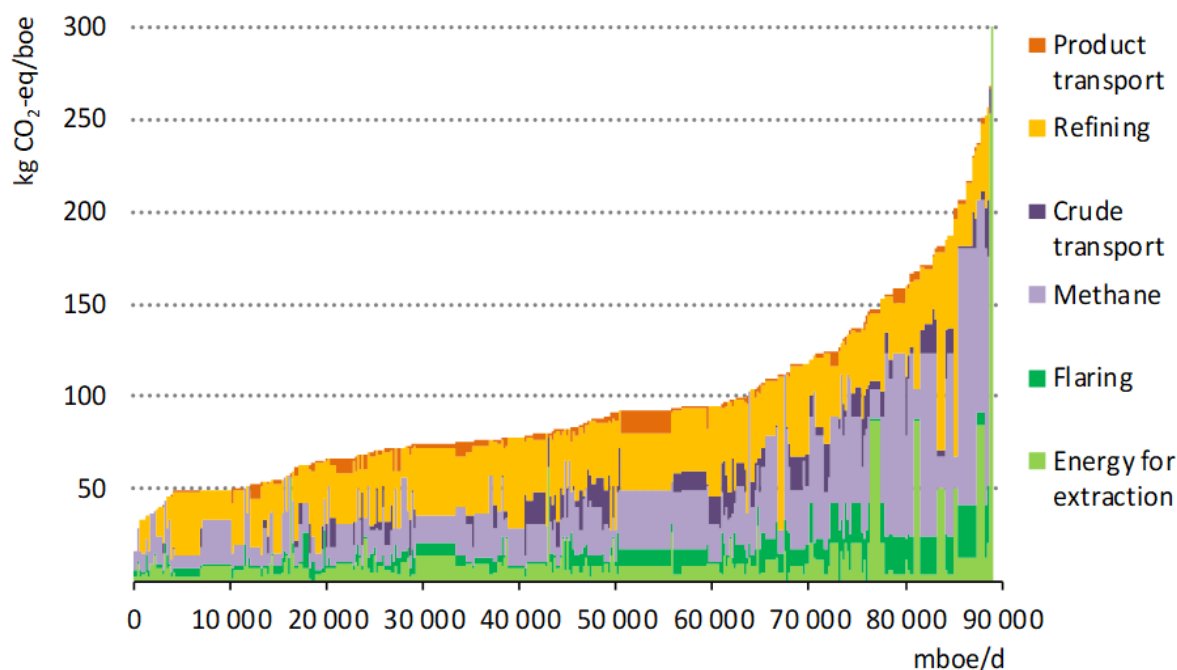


Figure 3: Emissions intensity of global oil production by source, 2017. Note that the emissions intensity of the top 10% of barrels produced (including high-carbon sources like Canada’s oilsands and Venezuelan extra-heavy) is more than four times that of the lowest 10%, when all pre-combustion emissions are tallied. Saudi Arabia's oil is among the lowest. (Source: World Energy Outlook 2018, International Energy Agency)

Aramco sees competitive advantage in informing consumers about the lower average carbon intensity of oil produced by Saudi Aramco³⁹ in comparison to high carbon-intensity crudes from competitors which resort to flaring off associated natural gas (Russia, the United States, Nigeria, Iraq), or which require energy-intensive recovery techniques (Canada, Venezuela, Oman, Indonesia) or complex refining (Canada, Venezuela, Nigeria).

³⁸ Carnegie Endowment for International Peace, “Oil-Climate Index: Profiling Emissions in the Supply Chain” (Washington: Carnegie Endowment for International Peace, 2015), <https://oci.carnegieendowment.org/>.

³⁹ Saudi Aramco, “Saudi Aramco Bond Prospectus,” 91.

“Climate change concerns may cause demand for crude oil with lower average carbon intensities to increase relative to those with higher average carbon intensities. The Company has a commitment to emissions reduction and a GHG emissions management program. The Kingdom has a small number of large and productive oil reservoirs, low per barrel gas flaring rates and low water production, resulting in less mass lifted per unit of oil produced and less energy used for fluid separation, handling, treatment and reinjection, all of which contribute to low upstream carbon intensity.”⁴⁰

As Table 1 shows, a \$50 per metric ton carbon tax that differentiates among grades of crude oil by the intensity of upstream emissions would also reward Saudi Aramco with a competitive price advantage, in the form of a nearly \$9/barrel discount, relative to Venezuelan extra-heavy. However, offsetting GHG emissions via carbon sequestration during production, as planned by Occidental Petroleum (discussed below), would produce even greater discounts.

Table 1: Differentiating among crude oil types by upstream carbon emissions could result in lower taxes for less carbon-intensive producers, like Saudi Arabia, compared with high-carbon producers like Venezuela. Final prices are based on average oil price of \$50/barrel. This table also analyzes tax effects on crude oil produced by firms that deliberately sequester carbon during the production process, as proposed by Occidental Petroleum in its Permian Basin operations. Tax assumptions include differentiation among crude grades by upstream emissions and reductions for GHG offsets. (Source: Baker Institute, Masnadi et al. 2018, Carnegie Endowment for International Peace 2015)

Upstream carbon intensity and its effects on carbon taxation				
assuming \$50/barrel oil and \$50/tonne carbon tax				
Crude oil source	Upstream GHG intensity (g CO₂eq/MJ)	Upstream GHG tax per barrel @ \$50/t	Total GHG tax @\$50/t*	Oil price per barrel given \$50/t GHG tax
Saudi average	3.5	\$ 1.07	\$ 23.28	\$ 73.28
Venezuela Orinoco	31.9	\$ 9.76	\$ 31.97	\$ 81.97
Permian (Spraberry),	6.9	\$ 2.10	\$ 24.31	\$ 74.31

⁴⁰ Saudi Aramco, 92.

Texas				
Permian with 50% GHG offset	3.4	\$ 1.05	\$ 12.15	\$ 62.15
Permian with 100% GHG offset	n/a	n/a	\$ -	\$ 50.00

CHANGING DEPLETION STRATEGY

For Saudi Arabia, the scale of reserves – and the time required to monetize them – necessitate a climate strategy that differs from those of its smaller competitors, including shareholder-owned international oil companies, or IOCs. Saudi 2018 proven reserves of 260 billion barrels were more than five times larger than those of any of the five major IOCs, ExxonMobil, Shell, Chevron, Total and BP. Saudi Aramco retains at least 52 years of production from domestic reserves at current rates (~11 million barrels per day), a timeline that would be extended by further discoveries. Given the strong likelihood of additions to its proven reserves, the Saudi government has made allowances for Aramco to maintain its monopoly over the Saudi oil concession for as long as 100 years – until the year 2117. By contrast, IOCs’ proven reserves of just over 200 billion barrels would be collectively depleted in nine to 15 years based on current rates of output.⁴¹

Mineral deposits like oil reserves represent an unrealized financial asset in a state’s wealth portfolio. By producing and marketing oil and gas, depletable resource stocks are converted into forms of above-ground wealth and development, which, optimally, generate income for future generations. The principle of “intergenerational equity” in reserves depletion has commanded strong influence in Saudi Arabia. The intergenerational principle implies a constrained approach to production; a strategy that also happens to stimulate global market prices for oil, which, in turn, underwrite generous social benefits for Saudi citizens. Constraints on production have also

⁴¹ Saudi Aramco, “Saudi Aramco Bond Prospectus;” pp. 31, 87-88.

been calibrated to lengthen the lifespan of the Saudi oil economy, and thereby maximize the duration that oil revenue can support al-Saud family rule. Production constraints are occasionally referenced publicly. In 2008, King Abdullah noted that he had ordered to Saudi Aramco to deliberately leave viable fields untapped on behalf of future generations.⁴² In this way, geologic, economic and political factors converge to reinforce Aramco's long-term depletion horizon and underproduction relative to its reserves base, which contrasts with those of more short-term oriented IOCs.

Shareholder-owned oil companies produce from smaller resource bases at much higher depletion rates. If IOC executives decided to recast their business models in a new direction, they could run down their reserves without replacing them while shifting investment from fossil fuels toward new types of business. Many IOCs demonstrated their ability to complete major transformations when their foreign oil concessions were nationalized, mainly in the 1970s. The companies shifted oil exploration and production to new parts of the globe, or moved into services and technology businesses, and remained viable. For them, climate change appears like a slow-moving reprise of the disruptions they experienced during the heyday of nationalization, rather than a threat to their existence. Significant progress in transitioning to new area of business might be accomplished over a decade or two.

For a large national oil company, a decade is the short term. As mentioned, Saudi Aramco could have monopoly access to remaining underground reserves for a century, on top of the 85 years of oil production that have already taken place in the kingdom. Given the intensifying pace of climate change – the physical effects as well as the growing public acceptance of the necessity of drastic action – multi-generational depletion horizons like those of Aramco face considerable uncertainty.

The onset of climate risk appears to be altering Saudi Aramco's calculations. The statements of the company and its executives have taken on a more short-term, expansion-oriented flavor, with terms “growth strategy” and “expansion strategy” appearing frequently, even during periods

⁴² Reuters, “Saudi King Says Keeping Some Oil Finds for Future,” *Reuters Oil Report*, April 13, 2008, online edition, <https://uk.reuters.com/article/saudi-oil/saudi-king-says-keeping-some-oil-finds-for-future-idUKL139687720080413>.

when oil markets were oversupplied.⁴³ Operating costs and competitiveness have been accorded increased attention, given the possibility of slower oil demand growth and lower prices. There is a sense that the kingdom's actions to rein in the growth of social welfare provision is, in part, to prepare Saudi society for an era of uncertain rents and potential difficulty in meeting the "social breakeven" costs that depend on inflated oil prices.

CHANGING SOCIAL PREFERENCES

Another risk factor cited in the Aramco bond prospectus was the change in social preferences around fossil fuels. Global public concern about climate damage has increased in recent years. The 2018 Pew Global Attitudes Survey found 67% of those surveyed in 26 countries chose climate change as the No. 1 threat facing the world, up from 63% in 2017 and 56% in 2013. Climate change was the No. 1 issue in a diverse array of countries, including Greece, South Korea, France and Mexico (where it was chosen by 80-90% of respondents) as well as in Japan, Argentina, Brazil, Germany, Kenya, and the Netherlands, where it was chosen by more than 70% of respondents. In the United States, climate concerns lagged those of cyberattacks and terrorism in the 2018 Pew survey.⁴⁴ A separate Pew opinion survey found that 65% of American respondents wanted to prioritize alternative energy sources versus 27% who preferred expanded production of oil, natural gas and coal.⁴⁵

Individuals, companies and governments are taking measures to reduce emissions and move away from fossil fuels. In some cases, consumers are making choices based on improved cost competitiveness of alternate technology and vehicles, or through state subsidies for substitutes like biofuels or wind-generated electricity. But in some cases, shifts to non-emitting or more

⁴³ For instance, CEO Amin Nasser said in 2018: "Today, we are further expanding our relationship with agreements and MOUs with leading French companies and organizations to support Saudi Aramco's long *business growth strategy*. At Saudi Aramco we have real, tangible and meaningful opportunities to collaborate and build partnerships now and in the future. The strengths of French businesses and industry can play a role in Saudi Aramco's business plan including in our diversification and *expansion strategies* underscored by the framework of Vision 2030." (italics added) See: "Saudi Aramco announces commercial cooperation worth over \$12 billion with French companies during Saudi-France CEOs forum in Paris." Saudi Aramco press release, April 10, 2018; <https://www.saudiaramco.com/en/news-media/news/2018/commercial-cooperation-saudi-france-ceos-forum>

⁴⁴ Spring 2018 Global Attitudes Survey, Pew Research Center, 2019, <https://www.pewresearch.org/global/2019/02/10/climate-change-still-seen-as-the-top-global-threat-but-cyberattacks-a-rising-concern/>

⁴⁵ 2016 Pew Public Attitudes Survey, Pew Research Center 2017, <https://www.pewresearch.org/science/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/>

efficient technology are being made regardless of comparative cost calculations. In some rich countries, higher-cost substitutes are preferred over lower-cost but emitting options.

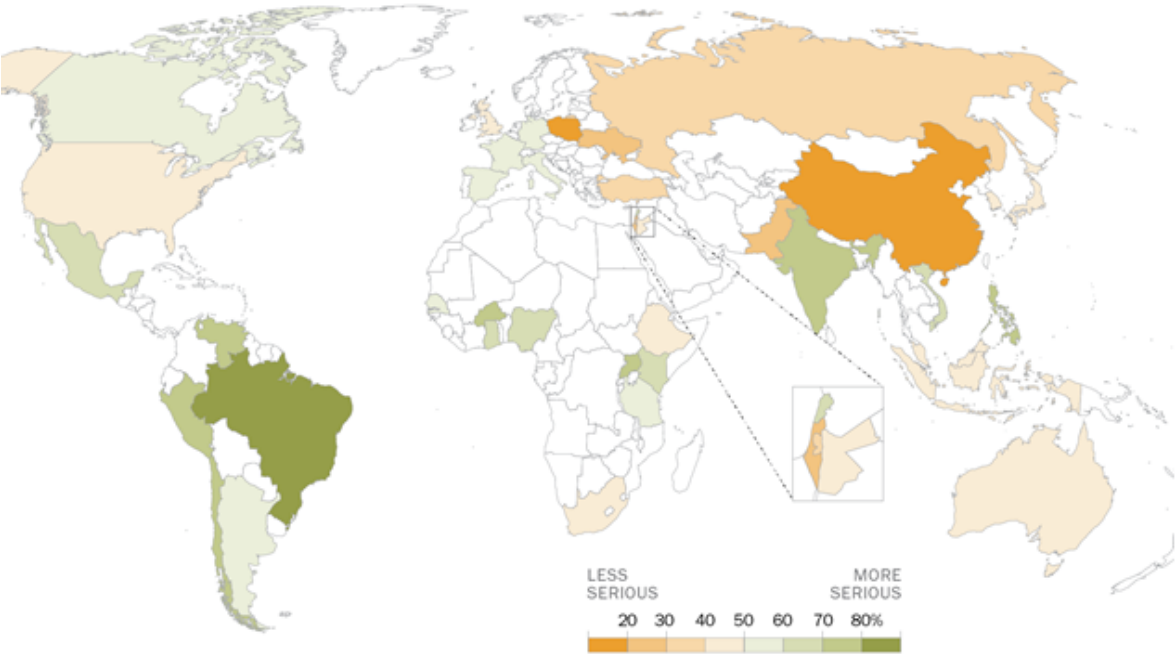
However, changing global opinion had not coincided with reduced demand for fossil fuels, prior to the coronavirus outbreak in 2020. Among the 92 regions and countries assessed in the BP Statistical Review of World Energy 2020, oil demand rose in 60, and shrank in just 32.⁴⁶ In few of the countries where oil demand declined did climate concerns appear to play a material role.

It remains possible that political institutions in multiple jurisdictions could be pushed to confront entrenched fossil fuel interests. Policymaking in several important countries appeared to be shifting in late 2020 toward increasing restrictions on pollution and GHG emissions and stronger regulation of consuming technology. However, another factor could temper the aggregate affects. In countries where energy intensity and carbon emissions were highest – i.e. large consuming countries like China, the United States and Russia – climate concerns tended to be lower. (Fig. 3)

⁴⁶ BP, “Statistical Review of World Energy 2020,” statistical report (London: BP, June 2020), <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>

Latin America, Africa Most Concerned about Climate Change

Percent saying global climate change is a very serious problem



Source: Spring 2015 Global Attitudes survey, Q32.

PEW RESEARCH CENTER

Figure 4: Respondents in countries with high per-capita levels of carbon emissions exhibited less concern with climate change than counterparts in developing countries. (Source: Pew Research Center 2015 Global Attitudes Survey. Note: Survey polled 40 countries.)

Aramco’s bond prospectus acknowledges these risks. The company is already subject to climate change policies that affect demand for oil, as well as anti-pollution regulations. In the future, Aramco could face direct challenges from lawsuits and litigation based on climate damage based on extraction and marketing of fossil fuel. Exclusive sovereign ownership of Aramco by the Saudi government once protected it from legal action targeting antitrust behavior and its role in climate change. Saudi Aramco’s 2019 decision to sell equity shares to private investors may have increased its exposure to legal risk.⁴⁷

Downstream expansion in high growth geographies, particularly East and South Asia, insulates Aramco from some near-term pressure. But oil demand and prices are still affected by social

⁴⁷ Gabriel Collins and Jim Krane, “NOPEC’s Extraterritorial Overreach Would Harm Core U.S. Economic and Energy Interests,” Policy brief (Houston: Baker Institute for Public Policy, March 6, 2019), <https://www.bakerinstitute.org/files/14114/>.

pressures in the OECD which are transmitted globally through the multilateral institutions funded by OECD governments. Border tariffs, reduced or conditional financing and aid, intensified focus on supply chain emissions for Western-headquartered firms, and even importer embargo are conceivable policies that pose future risks for emissions-dependent states and firms, including Saudi Aramco.

NONCOMBUSTION USES FOR CRUDE ARE UNDER SEPARATE PRESSURE

Non-combustion uses for crude oil and natural gas, particularly production of petrochemicals, have become niche markets for oil producers to extend their business models into the era of decarbonization. Oil and gas are mainly used as feedstocks that are converted to plastic resins and polymers, which, as long as they are unburned, retain the carbon content of the fossil fuels within final product.⁴⁸ For rentier states overseeing large reserves with long depletion horizons, such “climate compliant” uses for natural resources appear as a revenue lifeline.

From a demand growth and jobs perspective, petrochemicals offer further attractions. Demand for ethylene, a key base product for chemical precursors to plastic, is forecasted to grow at an average yearly rate of 3.6% to 2030, up from 3.3%/year during the past decade. That growth looks attractive compared to Aramco’s 0.5% per year pre-coronavirus growth forecast for global oil demand for the 2030s.⁴⁹ The virus, still spreading in mid-2020, had deeply undermined transportation and global oil demand, rendering the future of transport-based oil demand even more fraught in comparison to that of plastics. And, while production of plastic resins is capital intensive and requires only small numbers of workers, diverse manufacturing can be built around domestic resin production that are far more labor intensive than the oil sector.

However, the global plastics industry also faces problems with social acceptance. Plastic has an enormous and increasing worldwide pollution footprint from improper disposal. Like oil, plastics also face increasing restriction and regulation. However, the long-term durability of plastic – one

⁴⁸ Jim Krane, “Climate Strategy for Producer Countries: The Case of Saudi Arabia,” Working Paper (Houston: Baker Institute for Public Policy, Rice University, 2018), <https://scholarship.rice.edu/bitstream/handle/1911/102798/ces-krane-climate-strategy-082818.pdf?sequence=1>; Jim Krane, “Decarbonization in the Oil Kingdom: Saudi Arabia’s Energy Policy and Climate Strategy,” in *Energy Policy-Making in a Cross-National Comparison: Energy Resources, Policy Processes and Law*, ed. Patrice Geoffron, Lorna A. Greening, and Raphael Heffron (New York: Springer US, 2019).

⁴⁹ Saudi Aramco, 79, 88.

of the characteristics that makes plastic persist so long in the environment – may actually be an advantage from a carbon emissions standpoint, since the carbon stays locked into the plastic waste that finds its way into landfills and oceans. Globally, 58% of plastic is discarded or landfilled.⁵⁰

Unfortunately for oil producers, the plastic industry is also far from a “climate compliant” use for oil and gas. Zheng and Suh found that global plastic production and disposal emitted 1.7 gigatonnes of CO₂ in 2015, accounting for about 4% of worldwide emissions. Based on current demand growth trends, plastics emissions could comprise 15% of global emissions by 2050. The most viable way to decarbonize plastics is to replace oil or gas feedstocks with biomass feedstocks based on corn or sugar cane, and to replace the fossil-fuel energy used as heat source in resin production with renewable fuels, while maximizing plastics recycling (and landfilling waste that cannot be recycled).⁵¹ The GHG reduction strategies outlined would all but purge fossil fuels from plastics.

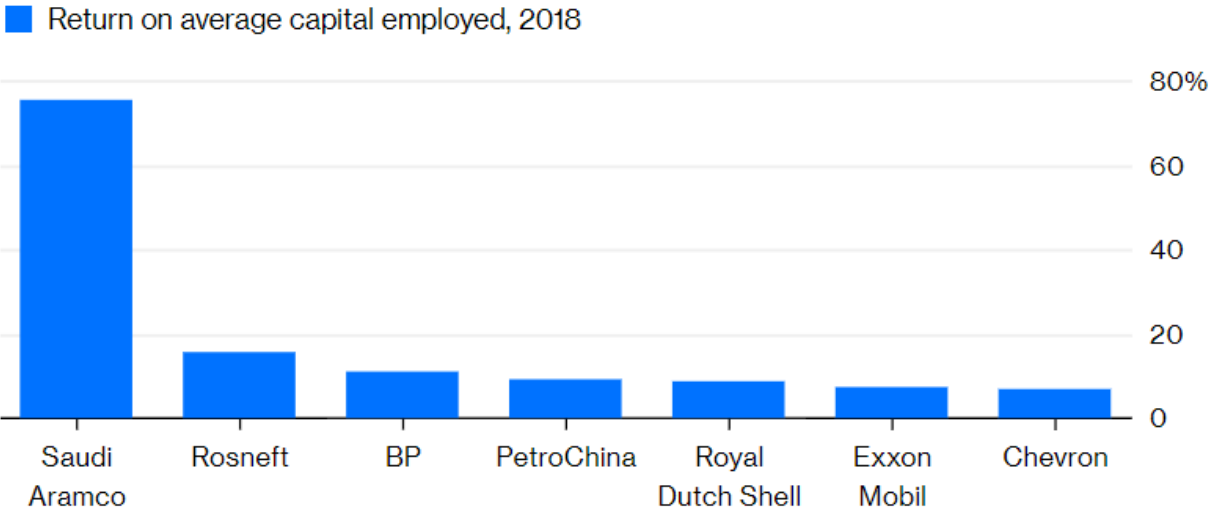
ECONOMIC DIVERSIFICATION VERSUS MAINTAINING OIL RENTS

The attractiveness of the oil business is grounded in the rents, or extraordinary profits, that persist in the oil sector. Rents are more “pervasive, lasting, and protected” in oil markets than in other businesses, which tend to see rents driven out by competition.⁵² Low-cost producers like Saudi Aramco enjoy extremely high profit margins per unit of investment. In 2018, with Brent crude averaging \$71/barrel, Aramco’s returns on capital invested were nearly 80 percent. (Fig. 4) Such profit levels would be nearly impossible to replace in any alternate sector, especially over the multiple decades that oil rents have persisted.

⁵⁰ Jiajia Zheng and Sangwon Suh, “Strategies to Reduce the Global Carbon Footprint of Plastics,” *Nature Climate Change* 9 (April 15, 2019): 374–81, <https://doi.org/10.1038/s41558-019-0459-z>.

⁵¹ Zheng and Suh.

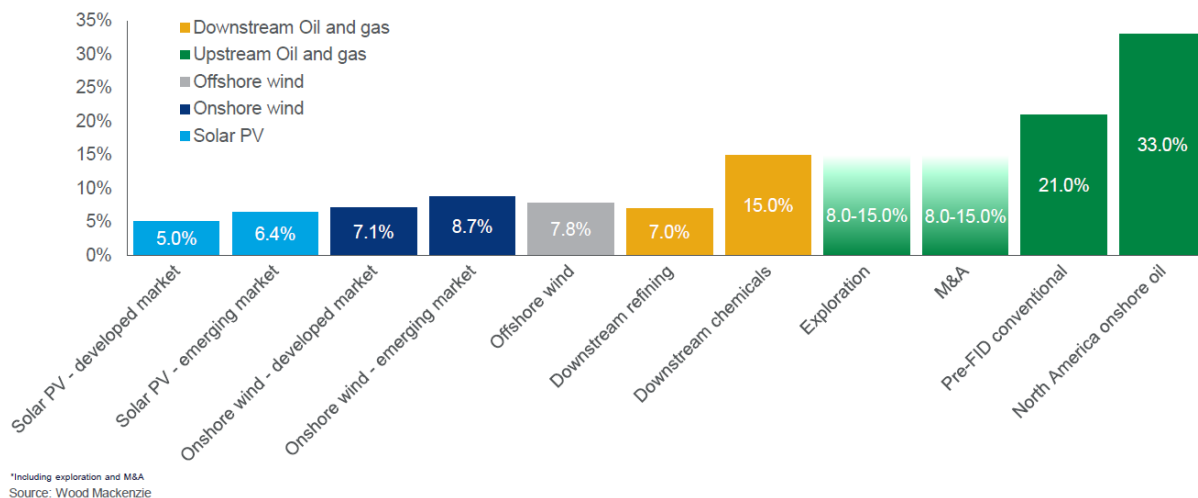
⁵² Albert Bressand, “The Role of Markets and Investment in Global Energy,” in *The Handbook of Global Energy Policy*, ed. Andreas Goldthau (Hoboken: John Wiley and Sons, 2013).



Source: Bloomberg, Saudi Aramco

Figure 5: Saudi Aramco's return on capital employed dwarfs that of its higher-cost competitors. (Source: Bloomberg 2019)

Renewables offer a cautionary example of an energy sector in which Saudi Arabia also holds a strong resource advantage – high levels of insolation and low land costs – but where rents have been driven out by cost competitiveness. Fig. 5 estimates internal rates of return (a similar metric to ROCE in Fig. 4) of 6.4% for solar PV projects in emerging market countries and just under 9% for onshore wind. A \$1 million investment at these rates of return implies a return of \$800,000 in Saudi oil, and just \$87,000 for wind and \$64,000 for PV solar.



5

Figure 6: Internal rates of return for renewable energy projects range between 5% and 9% while those for onshore oil investments in the United States averaged 33%. (Source: Wood Mackenzie, "Oil & gas majors in renewable energy" slide presentation, November 2018.)

Oil rents are well known as advantageous for maintaining autocratic governance and fending off democratic pressures. Beyond simple profitability, oil rents flow directly to regimes. The centralized income has a centralizing effect on governance. By decentralizing or diversifying the sources of fiscal revenue, including through taxation – even tax limited to the commercial sector – autocratic regimes open the door to creating “accountability links” with contributing parties, and, eventually, stimulating demands for political participation.

Despite these risks, economic diversification offers numerous advantages, even for a rentier autocracy. These include countercyclical fiscal buffers that reduce the effects of oil price fluctuations and increase the labor intensity of the economy.

Global decarbonization also presents a strong rationale for Saudi diversification. The International Energy Agency models oil demand under three scenarios, all of which depict Saudi Arabia as a major oil exporter in 2030, as described in the IEA World Energy Outlook 2018. But in the WEO’s low-carbon Sustainable Development Scenario, falling prices present the Saudi kingdom with deep reductions in oil rent – due to falling demand and prices – alongside increased unemployment, decreasing trade surplus, and large budget deficits.⁵³ The possibility of

⁵³ Soummane, Ghersi, and Lefèvre, “Macroeconomic Pathways of the Saudi Economy: The Challenge of Global Mitigation Action versus the Opportunity of National Energy Reforms.”

such an eventuality strengthens the case for seeking out new economic sectors, despite profit margins that cannot match those currently available in oil.

DECLINING GEOPOLITICAL IMPORTANCE OF OIL EXPORTERS

Saudi Arabia faces further risks from any global turn away from oil, which are not discussed in the bond prospectus. The kingdom's strategic importance is largely based on its vital role in oil markets and willingness to vary output in line with US interests. America's provision of hard security for Saudi Arabia and the Gulf monarchies is predicated on those countries remaining important exporters, and on oil enduring as the world's dominant transportation fuel. Should exports falter or oil substitutes gain ground, the strategic stature of oil exporting states will decline.

General trends show global oil demand beginning to decouple from GDP growth, with energy demand growing at roughly half the pace of GDP, and non-carbon fuels and technologies emerging as early-stage oil substitutes. Given the scale of the global transportation sector, the fact that 95% of transportation services are oil-based, and the difficulty of replacing oil in most of its applications, any threat to oil would not come in the short term. In 2019, consultancy McKinsey predicted a peak in global oil demand by 2035.⁵⁴ The coronavirus deepens the uncertainty around such forecasts.⁵⁵

At the same time, sources of oil supply are becoming far more diverse. In the 1970s, there were 38 oil producers of note in the BP Statistical Review. Of those, only 16 produced more than 500,000 b/d. The top 10 producers brought 82% of global oil to market. Today, there are 49 producers, with 28 supplying more than 500,000 b/d. The top 10 are responsible for 65% of the

⁵⁴ McKinsey, "Global Energy Perspective 2019: Reference Case," Consultancy research report (McKinsey, January 2019), https://www.mckinsey.com/~/media/McKinsey/Industries/Oil%20and%20Gas/Our%20Insights/Global%20Energy%20Perspective%202019/McKinsey-Energy-Insights-Global-Energy-Perspective-2019_Reference-Case-Summary.ashx.

⁵⁵ For instance BP's CEO said it was possible peak demand was reached in 2019. Anjali Raval, Billy Nauman, and Gillian Tett, "BP Chief Sees Risk of Oil Demand Passing Peak as Pandemic Hits," *Financial Times*, May 11, 2020, online edition, <https://www.ft.com/content/21afff2-1e57-4000-a439-62cfef6344fb>.

total.⁵⁶ Increasingly diverse supply renders importers less exposed to political risks and supply issues emanating from the Middle East.⁵⁷

These factors suggest reduced dependence on Middle East exporters and diminishing strategic importance of those states, particularly to North America and Europe. These continents not only source oil elsewhere but have grown more efficient in oil use and substitution. In 2018, 71% of Aramco’s exported oil flowed to Asia at an average rate of 5.3m b/d, versus 1m b/d to North America and 900,000 b/d to Europe.

These trends, in turn, present an opportunity for re-assessing the considerable expense (\$50 billion to \$100 billion per year⁵⁸) of US military support for Persian Gulf. The US-Gulf relationships were once considered so inviolable that they spawned the Carter Doctrine of 1980, which declares that the United States will use force to protect its interests in the region. Slipping geopolitical prestige portends a coming decline in Western provision of hard security, which, in turn, renders these regimes more independent and self-reliant in external security provision.

LEVERAGING DOWNSTREAM INVESTMENTS TO ‘CAPTURE’ MARKETS

Saudi Aramco and its host government have developed a number of strategies aimed at protecting oil’s role in the world economy, Saudi Arabia’s roughly 13% share of the global oil market, and the rent stream that maintains the Saudi monarchy in power. First among these is the firm’s ongoing efforts at vertical integration, which involves combining its mature “upstream” sector, with growing “downstream” importing and conversion businesses configured for Saudi crudes. The vertical integration strategy is driven, in part, by climate risk and the threat of a supply glut.

Saudi Aramco has begun investing in markets, particularly in developing Asian countries where policymaking prioritizes living standards over environmental damage. It is in these countries where oil demand is likeliest to grow strongly in coming decades, even as it falls away

⁵⁶ Note that the breakup of the Soviet Union has split former Soviet production among five current producers. Only Russia is in the top 10. The others, in order of prominence, are Kazakhstan, Azerbaijan, Turkmenistan, and Uzbekistan.

⁵⁷ Jim Krane and Kenneth B. Medlock III, “Geopolitical Dimensions of US Oil Security,” *Energy Policy* 114 (2018): 558–65, <https://doi.org/10.1016/j.enpol.2017.12.050>.

⁵⁸ Michael O’Hanlon, “How Much Does the United States Spend Protecting Persian Gulf Oil?,” in *Energy Security: Economics, Politics, Strategies, and Implications* (Washington: Brookings, 2010), 59–72.

elsewhere. Aramco’s downstream investments are aimed at ensuring that Saudi oil has preferential market access through “captive” ownership and configuration of refining capacity around Saudi oil.⁵⁹ The company’s 2019 bond prospectus acknowledges this strategy in straightforward language.

“The Company is focusing its downstream investments in areas of high-growth, including China, India and Southeast Asia, material demand centers, such as the United States, and countries that rely on importing crude oil, such as Japan and South Korea.”⁶⁰

“The integration of the Company’s upstream and downstream segments provides a unique opportunity for the Company to secure crude oil demand by selling to its captive system of domestic and international wholly owned and affiliated refineries.”⁶¹

By embedding itself in markets where demand growth defies climate concerns, Saudi Aramco can maximize monetization of its below-ground reserves and reduce the quantity eventually abandoned.

DISCUSSION AND CONCLUSION

Saudi Aramco is so profitable that protecting the company and its business is a strategic and economic imperative for the kingdom and its ruling family. It also risks alienating the kingdom in international relations.

Saudi Arabia has taken steps to prepare. The kingdom has launched domestic reforms of social spending, particularly on energy subsidies.⁶² These reforms have reduced the government’s fiscal break-even, which provides some insulation from lower oil prices. The more fiscally restrained the kingdom grows – within social boundaries – the more internationally competitive it becomes, which, in turn, improves its likelihood of retaining oil income.

That is because Saudi Aramco faces dueling pressures in oil marketing strategy. Over the short term, the company is strongly incentivized to constrain production in the name of higher oil

⁵⁹ Jim Krane, “A Refined Approach: Saudi Arabia Moves beyond Crude,” *Energy Policy* 82 (2015): 99–104.

⁶⁰ Saudi Aramco, “Saudi Aramco Bond Prospectus,” 88.

⁶¹ Saudi Aramco, 50.

⁶² Jim Krane, “Political Enablers of Energy Subsidy Reform in Middle Eastern Oil Exporters,” *Nature Energy*, April 2018, <https://doi.org/10.1038/s41560-018-0113-4>. Jim Krane, *Energy Kingdoms: Oil and Political Survival in the Persian Gulf*, Center on Global Energy Policy Series (New York: Columbia University Press, 2019).

prices. Longer term, Aramco's interests are congruent with maximizing the monetization of below-ground oil, which augurs for increasing its share of the global market, and potentially accepting lower prices. The ultra-low unit costs of Saudi oil allow it the luxury of alternating between both strategies. Reduced social dependence on oil rents only increases that flexibility.

But in the long run, the Saudi oil sector cannot maintain the monarchy on the basis of cost competitiveness alone. In a climate-constrained world where regulations are likely to increase alongside the decline in social acceptance of fossil fuel combustion, the kingdom's interests would be better served if Saudi Aramco were able to *increase* the margin of environmental benefits of Saudi oil relative to that of competing grades, and, perhaps, take steps sufficient to market Saudi crude as carbon-competitive, including with substitute fuels and technologies.⁶³

Saudi Arabia and its national oil company appear to be pursuing these goals. However, competing firms are taking similar steps. For example, Houston-based Occidental Petroleum, a midsized oil producer with large operations in the US Permian Basin, already injects carbon dioxide (itself produced during oil and gas output) into its oil wells to enhance recovery. The firm has announced plans to begin injecting carbon dioxide from industrial sources currently emitted to the atmosphere as well as CO₂ captured directly from ambient air. Occidental eventually aims to sequester sufficient carbon to render its oil carbon-neutral.⁶⁴ Royal Dutch Shell, BP and Total are also among the firms pursuing competitive decarbonization strategies due to social pressures around climate change. The International Energy Agency has issued guidelines for firms to reduce emissions across the oil and gas sector, from production to refining and in downstream sectors like petrochemicals and plastics.⁶⁵ As firms adopt these ideas, Saudi Aramco's advantage in carbon intensity will come under challenge.

Within a few years, other producers could tout their products as the climate-compliant choice. Non-Saudi producers could demand that their products receive preferences based on reduced environmental harm. Such attributes would challenge Saudi Aramco's environmental case for

⁶³ Combustion of crude oil products releases about 75g CO₂ equivalent per megajoule, regardless of origin. The idea here is that Saudi Aramco reduce the carbon intensity of its crude oil by sequestering as much or more GHGs per unit marketed than are emitted from that unit's production, refining, transport and final combustion.

⁶⁴ "Climate-Related Risks and Opportunities: Positioning for a Low-Carbon Economy." Occidental Petroleum, 2019; <https://www.oxy.com/SocialResponsibility/overview/SiteAssets/Pages/Social-Responsibility-at-Oxy/Assets/Occidental-Climate-Report-2019.pdf>

⁶⁵ "Innovation and the environmental performance of oil and gas supply," *World Energy Outlook 2018*, pp. 477-514. International Energy Agency, Paris (2018)

remaining “the last man standing” in oil markets. With firms already publicizing investments in reduced carbon intensity, one expects that, at a minimum, some brands of fuel will be advertised as environmentally advantageous.

The advent of carbon taxes structured to differentiate among carbon intensity of fuel products would allow carbon advantages to migrate into fuel prices. At the moment, such a tax would favor Saudi Aramco. But faster carbon innovation by competitors could outstrip Aramco’s advantage. If that happened, the structure of the carbon tax would mean that Saudi crude would also forfeit its cost advantage. (Table 1 above) In short, Saudi Aramco’s quest to remain the “last man standing” in climate-buffed global oil market depends not just on its substantial advantages in lifting and capital costs, but on maintaining and enhancing its advantage in carbon competitiveness.

Climate change is beginning to shift energy systems. In oil’s case, the shift is taking place in a slow and uneven way. Oil consumption will fall away in some sectors, stagnate in others, and continue to grow in still others. Producer states have ample warning and opportunity for response. Saudi Aramco has begun to pursue a multi-pronged climate strategy. The kingdom’s case is an important one, but far from unique. Saudi Aramco’s competitors are equally motivated and convinced by their own exceptionalist rationales for retaining long-term roles in oil supply.

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