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Beyond 12.5: The implications of an increase in Saudi crude oil production capacity

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ABSTRACT

A combination of factors is encouraging Saudi Arabia to consider raising crude oil production capacity beyond the current ceiling of 12.5 million barrels per day. The kingdom has managed to maintain a constant share of global crude oil markets, even as it copes with growing domestic demand for oil and a spate of investments in refineries, inside and outside the kingdom. Longer term, the threat of peak global oil demand – perhaps in response to climate change – enhances the attractions of a shorter time horizon to depletion. However, an increase in Saudi crude oil production would have consequences for markets and competing forms of energy, as well as for the kingdom's geopolitical stature. The wide range of potential outcomes suggests that a major capacity increase is a risky strategy.

1. Introduction

As recently as 2015, Saudi energy officials dismissed suggestions that the kingdom would seek to raise its crude oil production capacity above its theoretical maximum of 12.5 million barrels per day (m b/d). However, that stance has evolved. Public statements from officials at Saudi Aramco – operating since May 2016 under a new oil minister – indicate that the company expects to increase oil production above recent historic highs. Further ahead, the company is considering investments to increase its capacity beyond the current maximum 12.5 m b/d threshold.[1]

Saudi Arabia finds itself in an energy demand quandary. At home, the kingdom needs oil and natural gas for transportation, industrial production and electricity generation. Each of these sources of domestic demand is increasing, propelled by rising populations, growing incomes and subsidized end-user prices that, despite a recent adjustment, remain among the lowest in the world.[2]

Internationally, Saudi Arabia also faces conflicting priorities for its crude oil. It finds itself oscillating between cutting crude oil production to prop up prices and maintaining high levels of exports to defend its share of the crude market from competing suppliers.[3] Meanwhile, the kingdom's national oil company, Saudi Aramco, is in the midst of doubling a crude oil refining business that could see it compile ownership stakes in as much as 10 m b/d of capacity.[4] That amount is roughly equal to all of Saudi Aramco's current oil production.

As the kingdom endeavors to satisfy these competing demand sources, it increasingly sacrifices one of its most important strategic assets, the spare oil production capacity that it uses to balance markets in times of disrupted supply. Saudi Aramco's spare capacity has most likely slipped below 2 m b/d in recent years.[5]

An increase in Saudi oil production could also be incentivized by expectations that restrictions on burning of fossil fuel will intensify in the future, as importing states impose policies aimed at mitigating greenhouse gas emissions causing climate change. The Saudi government has announced plans to diversify its economy, thereby reducing its exposure to climate risk, by selling a 5% portion of Saudi Aramco, via an initial public offering (IPO) of ownership shares. Climate risk could also weigh into a decision to raise output. If policymakers believed that threats to monetizing oil reserves will grow stronger in the future, they may opt to increase oil output in the present, a phenomenon described as the "green paradox" (Sinn, 2008, 2012). In other words, if the long-term outlook for fossil fuels looks risky, a short-term strategy becomes more attractive. Thus the kingdom's energy policymakers find themselves revisiting a pressing question: Should Saudi Aramco invest in oil production capacity beyond 12.5 m b/d?[6]

2. A change in thinking

During the period of tight oil markets that saw prices reach an all-time high of $147/b in 2008, then-Oil Minister Ali al-Naimi announced the kingdom's intent to raise oil production capacity to 15 m b/d. Al-Naimi reversed course a few months later when prices plummeted

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amid the global financial crisis.[7] Since then, suggestions that the kingdom might move beyond its longtime 12.5 m b/d maximum have been rejected.[8] In 2013, a senior member of the ruling al-Saud family, the former intelligence chief and US ambassador Prince Turki al-Faisal, said that the kingdom planned to increase capacity to 15 m b/d by 2020. He said the increase was needed to raise export levels to 10 m b/d while allowing for rising domestic consumption.[9]

Al-Naimi rejected the notion. He said Saudi Aramco had no need to move beyond the maximum sustainable capacity (MSC) of 12.5 m b/d, a level that the company determines it could sustain after a six-month period of capital and operational investment.[10] Saudi Aramco declared that it had achieved the 12.5 m b/d MSC under the late King Abdullah, who approved investments to raise capacity from about 9 m b/d at the beginning of his tenure.

> "I don't know what (Prince Turki) means by 15 million. He may be thinking … that Saudi Arabia is capable of doing it, building capacity to 15 million. Now, based on what we see as projection and call on Saudi oil, we don't see anything like that, even by 2030 or 2040. So the need to build the facilities and drill wells to produce 15 million or have the capability for 15 million is not there," al-Naimi said during a speech in Washington. "Based on all projections that I have seen, including ours, there is no call on us to go past 11 (million), 11.5 (million) by 2030 or 2040."[11]

Three years on, al-Naimi has retired and been replaced by former Aramco CEO Khalid al-Falih, who heads an expanded Ministry of Energy, Industry and Mineral Resources.[12] Shortly after al-Falih's ascension, Aramco's new CEO, Amin Nasser, publicly stated what Aramco officials have long said in private, that the 12.5 m b/d MSC would be maintained "for now," but could be expanded in the future.[13] A month later, al-Falih said much the same thing.[14]

Sources of pressure on Saudi production capacity include the following:

- An increase in global demand in response to the sustained period of low oil prices since late 2014.
- The perception that non-OPEC producers have deferred so much capital investment since late 2014 that, without sufficient Saudi spare capacity, future tightening in oil markets could trigger a damaging price shock.[15]
- The kingdom's limited ability to constrain growth in domestic hydrocarbon consumption. Recent subsidy reforms and an emphasis on substituting natural gas for oil in the domestic economy appear to have slowed, but not eliminated, demand growth.[16]
- The erosion of spare production capacity, in particular via recent downstream investments that, combined with other demand sources, could challenge the kingdom's capability to continue as dominant global supplier of raw crude.
- Longer term, future demand could be undermined by climate-driven disincentives to oil and the emergence of substitute fuels and technologies. Worries about premature peaking of global oil demand could incentivize stepped-up production and shorter-term depletion strategies.

In summary, if Saudi Aramco intends to maintain all of its commitments to its myriad demand sources – while protecting the kingdom's strategic supply role – the company may decide to intensify upstream investment, increasing production capacity to 13, 14 or 15 million barrels per day. Longer-term threats reinforce this logic, implying that accelerated monetizing of reserves may be pragmatic.

3. Discussion: rationales for raising Saudi Arabia's oil production capacity

Why would Saudi Arabia seek to increase oil and gas production capacity? At the time of writing, Saudi Arabia had reaffirmed a 2016 commitment to *cut* oil production by nearly 500,000 b/d, as part of an OPEC-led supply restriction aimed at balancing an oversupplied market and boosting prices. There are also practical financial questions about

[1] Bill Spindle and Summer Said, "Saudi Aramco Likely to Step Up Production." Wall Street Journal, May 10, 2016. [http://www.wsj.com/articles/aramco-aiming-to-double-gas-production-in-10-years-1462864819].

[2] See Jim Krane and Elsie Hung, "Energy Subsidy Reform in the Persian Gulf: The End of the Big Oil Giveaway." Issue Brief, Rice University's Baker Institute, April 28, 2016. http://bakerinstitute.org/files/10489/.

[3] Saudi Arabia agreed to cut roughly 500,000 b/d in November 2016. The cuts were extended by nine months in May 2017.

[4] Deema Almashabi, "Saudi Arabia Plans to Expand Oil Business as Global Demand Rises." Bloomberg, May 10, 2016; https://www.bloomberg.com/news/articles/2016-05-10/saudi-aramco-ceo-sees-significant-growth-in-oil-output-in-2016.

[5] This estimate is obtained by subtracting total crude oil production from the kingdom's theoretical production ceiling of 12.5 m b/d. At times when crude production rises above 10.5 m b/d, such as from June-October 2016, theoretical spare capacity drops below 2 m b/d. Some analysts maintain that Saudi spare capacity is lower. Consultancy Rystad Energy estimated 1.1 m b/d at the end of 2015. (Rystad Energy, 2015).

[6] Saudi Aramco declared 12.5 m b/d as its "maximum sustainable capacity" after the company reported reaching that level in 2009. However the US Energy Intelligence Administration and the International Energy Agency estimate Saudi Arabia's production ceiling at around 12 m b/d. The kingdom has never produced more than 10.6 m b/d for any sustained period. Actual capacity is understood to fluctuate based on demand conditions and the pace of investment.

[7] Rania el-Gamal and Reem Shamseddine, "Saudi looking beyond oil price slump as rig count spikes." Reuters, March 21, 2015. [http://www.reuters.com/article/saudi-oil-drilling-idUSL6N0WM33S20150321].

[8] See, for example: Rania el-Gamal, "Will Saudi boost oil capacity? Naimi's retort: Show me 10 pct return." Reuters, June 5, 2015. [http://uk.reuters.com/article/opec-meeting-saudi-capacity-idUKL5N0YR0Y820150605] Also: Rania el-Gamal, Reem Shamseddine and Andrew Torchia, "OPEC won't bear burden of propping up oil price: Saudi minister." Reuters, March 22, 2015. [http://www.reuters.com/article/us-saudi-opec-idUSKBN0MI06720150323] Also: Said, Summer and Keith Johnson. "Rift Emerges Over Saudi Oil Policy." *Wall Street Journal*. Apr. 30, 2013. [http://online.wsj.com/news/articles/SB10001424127887323528404578454683761056470].

[9] Prince Turki al-Faisal, "Saudi Arabia's New Foreign Policy Doctrine in the aftermath of the Arab Awakening." Transcript of April 25, 2013 public lecture at Harvard University. [http://belfercenter.hks.harvard.edu/files/PrinceTHKSPublicLecture.pdf].

[10] The ambitious six month timeframe for reaching 12.5 m b/d stems from Saudi Aramco's internal guidelines, according to an employee interviewed on condition of anonymity in 2016.

[11] Ali al-Naimi, "A Conversation with His Excellency Ali al-Naimi, Minister of Petroleum and Mineral Resources, Kingdom of Saudi Arabia." Center for Strategic and International Studies, Washington DC, April 30, 2013. [http://csis.org/files/attachments/133004_TS_Al_Naimi.pdf].

[12] The former Ministry of Petroleum and Mineral Resources was expanded to include domestic energy policy and renamed the Ministry of Energy, Industry and Mineral Resources on May 7, 2016.

[13] Ibid, Spindle and Said, May 10, 2016.

[14] "Interview with Khalid al-Falih," Argus, June 2, 2016. [http://www.argusmedia.com/news/article/?id=1250725].

[15] Wood Mackenzie estimates that upstream investment to 2020, including in exploration, has been cut by as much as $1 trillion. As a result, discoveries of new oil supply have plummeted. See: "Global upstream investment slashed by US$1 trillion," Wood Mackenzie, June 15, 2016. [https://www.woodmac.com/analysis/global-upstream-investment-slashed-by-US1-trillion] Also see: Mikael Holter, "Oil Discoveries at 70-Year Low Signal Supply Shortfall Ahead." Bloomberg, Aug. 29, 2016. [https://www.bloomberg.com/news/articles/2016-08-29/oil-discoveries-at-a-70-year-low-signal-a-supply-shortfall-ahead]

[16] Joint Oil Data Initiative figures for 2016 show Saudi oil demand growth reaching its lowest level since 2010, while demand for refined products dropped nearly 2% in the first half of 2016, with diesel demand down by more than 5%. BP figures show Saudi oil demand grew only 1% in 2016, far lower than average.

investing in infrastructure that may never be fully deployed. However, a convergence of demand and revenue pressures, along with long-term risk factors, point to the possibility that the kingdom's production ceiling is under reconsideration.

Production decisions in the kingdom are subject to painstaking deliberation over the optimal pace of depleting reserves. Even though costs are among the world's lowest, Saudi Arabia has pursued a long-term depletion strategy that was designed to promote domestic fiscal and political stability. The kingdom limits oilfield depletion to 2–3% per year, which has allowed it to consistently deliver around 13% of global supply since 2000 (Fig. 1). Saudi Aramco calibrates output from individual fields so that recoverable oil is exhausted gradually, over a minimum of 30 years.[17] The market effect of Saudi restraint has been to constrain the kingdom's contribution to global supply and force oil prices up, while allowing higher-cost "fringe" producers to meet remaining demand with more expensive oil. At some future point, when Aramco can no longer enhance recovery or add reserves, Saudi output is supposed to decline at a gradual rate that allows the kingdom time to diversify its economy for the end of oil (Kenny, 2009; Mitchell and Stevens, 2008, 12).

The late King Abdullah gave voice to this strategy in 2008 when he reportedly ordered new reserves left for future generations. "I keep no secret from you that when there were some new finds, I told them, 'No, leave it in the ground. With grace from God, our children need it.'"[18]

At the time, limiting production was not just useful for safeguarding resources, it also fit with Saudi policy of exploiting market power to maximize profit. That calculus could change, however, if Saudi energy policymakers believed in the emergence of threats to the long-term value of crude oil, especially in oil's viability as a transportation fuel.

Global efforts to reduce fossil fuel use in response to climate change are a major worry among oil producers. Expectations of a robust and intensifying anti-fossil fuel campaign could bring about a breakdown of the Hotelling rule, under which storing oil underground is financially preferable to producing and selling it at times when returns in financial markets are low (Hotelling, 1931). The result could be manifested in a green paradox scenario, where producers accelerate extraction so that resources can be monetized before value is lost. Such price war behavior implies an increase in supply and reduced prices, which winds up enhancing the attractiveness to consumers of the restricted product (Sinn, 2008, 2012; Fang et al., 2014).

Climate-focused scholars have sought to quantify the amount of potentially stranded resources by calculating "burnable" fossil fuels as a portion of global reserves, measured by the carbon parameters implied by limiting climate change to 2 °C. McGlade and Ekins (2015) find that some 431 billion barrels of global oil reserves, 33% of the total, must remain unburned[19] – along with even greater proportions of natural gas and coal – for humanity to adhere to the 2° limit. The authors forecast that the Middle East will see a greater-than-average proportion rendered unburnable, 38% or 263 billion barrels, due to the modest pace of Middle Eastern oil extraction relative to reserves (McGlade and Ekins, 2015). From this perspective, Saudi prudence looks risky.

However, few forecasts of climate effects find that oil demand will be displaced without concerted policies that use legal or economic means to constrain consumption. Such policy action is difficult to predict. Without it, oil substitutes in transportation will be held back by

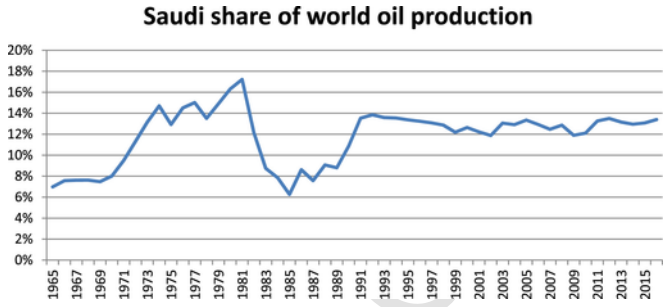

Fig. 1. Saudi Arabia's share of global oil supply has remained roughly constant since 1991. (Source: BP Statistical Review of World Energy 2017)

shortcomings in energy density, cost per mile, range, and even carbon content. While electric vehicles and battery technologies are improving, so are internal combustion engines. Further, new innovations, such as autonomous vehicle technology, could provide a structural increase in demand by reducing the time constraint on driving and allowing vehicles to be used for longer periods.[20] In short, oil is unlikely to lose its primacy in transportation without concerted government policies that impose heavy penalties on emissions or favor alternatives (Covert et al., 2016).

Even without a viable substitute, oil demand is still subject to reduced growth, and, perhaps, decline. A 2016 report from Royal Dutch Shell predicts that the world could see total oil demand reach its zenith as soon as 2021.[21] The IEA forecasts that gasoline demand may already be nearing a plateau, as efficiency gains and electric vehicles compensate for growth in the developing world.[22] Whenever it happens, demand for oil is likely to tail off gradually, requiring production to continue for decades.

Increasing capacity and competing for market share is just one of a number of possible peak demand response options for Saudi Aramco. Van de Graaf and Verbruggen (2015) argue that producer countries facing declines in global consumption might also agree to coordinate and share the market through agreed-upon output quotas, or seek compensation from importing countries for stranded reserves and lost income, or simply diversify their economies (Van de Graaf and Verbruggen, 2015).

4. Adjusting timelines to depletion

If a price war or market share strategy gained favor in Riyadh, a decision to increase production tempo could be a rational one, albeit with negative consequences for the climate. A shorter time horizon to depletion would, all else constant, reduce global oil prices and increase demand, while also reducing Riyadh's risk of carrying stranded assets that could not be marketed. Stepped-up Saudi oil production might actually *transfer* stranded-asset risk to higher-cost producers. Potential losers could include deepwater offshore, Canadian oil sands, Venezuelan extra heavy, and other higher-cost petroleum resources.

If climate policies encouraged competition based on carbon intensity, Saudi crudes would gain further advantage, due to lower carbon content than competing crudes. Saudi crudes typically lie at the low end of the lifecycle carbon scale, with 460–500 kg of CO2 per barrel

[17] This material is based on an author discussion with a former Saudi Aramco official on condition of anonymity, March 24, 2016. For a similar depiction of Saudi depletion strategy, see: Mitchell and Stevens (2008, 12).

[18] "Saudi King says keeping some oil finds for future." Reuters, April 13, 2008. [http://uk.reuters.com/article/saudi-oil-idUKL139687720080413].

[19] But not necessarily unproduced because some uses of crude oil do not require combustion. Lubricants and petrochemicals are two examples.

[20] Saudi Arabia may gain useful insights on future roles of autonomous vehicles via its 2016 investment of $3.5 billion in ride-sharing firm Uber, an AV proponent.

[21] Rakteem Katakey, "Energy Giant Shell Says Oil Demand Could Peak in Just Five Years." Bloomberg, Nov. 2, 2016; https://www.bloomberg.com/news/articles/2016-11-02/europe-s-biggest-oil-company-thinks-demand-may-peak-in-5-years.

[22] Javier Blas and Laura Blewitt, "Tesla Shock Means Global Gasoline Demand Has All But Peaked." Bloomberg, Nov. 21, 2016; https://www.bloomberg.com/news/articles/2016-11-22/the-tesla-shock-global-gasoline-consumption-has-all-but-peaked.

produced and combusted. Other crudes exhibit carbon intensities as much as 50% higher, particularly the synthetic crudes produced in Canada's oil sands, where emissions per barrel can extend beyond 700 kg.[23]

Al-Naimi and associates have voiced fears for at least a decade about the long-term resilience of oil demand amid pressure from climate action, substitute technologies and fuels, as well as US political rhetoric around "energy independence." US diplomatic cables released by WikiLeaks[24] document some of these concerns, as do al-Naimi's public statements[25] describing climate action as an "existential challenge" to Saudi Arabia[26] and those of an adviser who predicted that global demand would peak by 2025.[27] Al-Falih reiterated these concerns in June 2016, saying that "we as human beings cannot be complacent and assume that oil will continue to fuel the world forever."[28]

Saudi Arabia has taken steps to insulate its economy from stranded assets and falling oil demand. Aside from the planned selloff of a 5% stake in the kingdom's paramount national asset, Saudi Aramco, Riyadh has invested in nonoil industries as well as lower-emission uses of oil, petrochemicals in particular.

Saudi fears of plateauing demand would provide an alternate rationale for recent – and future – increases in output. By forcing prices lower, Saudi Aramco might actually *delay* the onset of peak demand, prolonging oil's dominance in transportation while capturing market share from higher-cost producers. Low prices might also enhance oil dependence among emerging economies, leading states into path-dependent investment in oil-intensive transportation systems and settlement patterns that lock in long-term demand (Fouquet, 2016).

At the same time, an increased supply of crude oil would allow Saudi Aramco to continue increasing its stake in refining capacity toward 10 m b/d. The refining strategy appears to be aimed at capturing and retaining markets for Saudi crude, especially heavier grades that are incompatible with common refining configurations built around lighter, sweeter crudes. By designating refining capacity for Saudi crudes, Aramco's strategy could provide some insulation from competing supply in the event of a decline in demand. Ownership of refineries in the United States, China, Japan and South Korea already allows Aramco to protect market share in those countries (Krane, 2015a), while the company has begun negotiating additional refining joint ventures in Indonesia, India and Malaysia,[29] large developing countries in which expectations for future petroleum demand are strong. Inside the kingdom, refining and other downstream industries support job creation through petrochemicals and industries based around plastics, all of which require crude oil, refined products such as naphtha, or associated natural gas and liquids that are produced alongside crude.

Increased crude oil production implies increased supplies of associated natural gas, which could provide some relief to the kingdom's intensifying gas shortage. Simultaneous growth in Saudi Arabia's power generation and industrial sectors has triggered competition for gas, which the kingdom neither imports nor exports. An increased supply would also allow Saudi power generation to shift away from expensive liquid fuels like crude oil and diesel fuel, which still comprise roughly half of power generation feedstocks. Forthcoming investments in wind and solar power may provide additional relief.[30]

Saudi Arabia would also accrue geo-strategic advantages from taking a more dominant role in global crude and products markets. The kingdom sees itself fending off a challenge for regional hegemony by Iran, a longtime strategic competitor. Raising its profile in global energy supply would increase Saudi power and autonomy within OPEC and help revitalize its strategic relationship with the United States, perhaps helping renew US commitments to its external security. Otherwise, as mentioned by Krane (2015a), a declining role in crude markets implies a diminishing of the kingdom's strategic importance.

5. Signs that point to an increase

Several academics and financial analysts have written about creeping domestic oil demand in Saudi Arabia. Articles have extrapolated current growth into the future, suggesting that Saudi Arabia could forfeit its spare production capacity and then divert oil from export into the domestic market before midcentury (Bourland and Gamble, 2011; Gately et al., 2012; Krane, 2015a, 2015b, 2014; Lahn and Stevens, 2011; Lewis and Hsueh, 2012; Rehman, 2012).

Reduced exports can be avoided by either halting growth in domestic demand, or by increasing production capacity. If further progress in reining in domestic demand proves difficult, boosting capacity may be necessary. By doing so, Saudi Aramco could replenish its spare capacity regardless of continued increases in domestic consumption, even as the company maintains export commitments.

Raising output would take years and require immense investment into oil processing capacity, including pipelines and storage. At the time of writing, policymakers in Saudi Arabia and other major exporters were *curtailing* capital spending, cutting subsidies and announcing plans to cut state employment. At the same time, the Saudi government has issued debt to fund budget deficits. Nevertheless, a number of signs suggest that the kingdom may consider a capacity-enhancing program of capital spending.

Consider that Saudi crude oil production is already near historic highs. Output has risen by 7% since 2014, from an average of 9.7 m b/d in 2014–10.4 m b/d in 2016 (Fig. 2). The effects of the production cut have reduced Saudi oil output since January 2017 to around 10 m b/d.

In 2015, Saudi Aramco released plans to spend $33 billion a year to 2025, a total of $334 billion, on upstream investment.(Saudi Aramco, 2015) The program represents a significant increase on typical yearly investment of $17 billion and appears to have survived the difficult fiscal environment and changeover in national and company leadership.[31]

[23] Oil-Climate Index, Carnegie Endowment for International Peace, 2015. http://oci.carnegieendowment.org/#total-emissions.

[24] See, for example: (Kenny, 2009; Smith, 2009).

[25] For instance, al-Naimi said in March 2016 that the world would not be able to stop extracting fossil fuels in the next 50 years. Grant Smith, "Saudi Arabia's Oil Chief Prepares for a World After Fossil Fuels." Bloomberg, March 17, 2016. [http://www.bloomberg.com/news/articles/2016-03-17/saudi-arabia-s-oil-chief-prepares-for-a-world-after-fossil-fuels].

[26] Ali al-Naimi, Saudi minister of petroleum and natural resources, speech at CERAWeek 2016 conference in Houston, Feb. 23, 2016. [transcript: http://fingfx.thomsonreuters.com/gfx/ce/1/482/482/NAIMI%20at%20CERA%20WEEK.pdf].

[27] Peter Waldman, "Saudi Arabia's Plan to Extend the Age of Oil." Bloomberg, April 12, 2015. [http://www.bloomberg.com/news/articles/2015-04-12/saudi-arabia-s-plan-to-extend-the-age-of-oil].

[28] Stanley Reed, "Saudi Oil Chief Khalid al-Falih Tells OPEC Changes Are Coming." New York Times, June 2, 2016. [http://www.nytimes.com/2016/06/03/business/energy-environment/opec-meeting-oil-production-saudi-arabia.html].

[29] Wael Mahdi, "Aramco Mulls Indian Refinery in Plan to Boost Asia Footprint." Bloomberg, March 9, 2016. [https://www.bloomberg.com/news/articles/2016-03-08/aramco-mulls-indian-refinery-in-drive-to-increase-asia-footprint].

[30] Wael Mahdi and Vivian Nereim, "Saudis Target 30 Solar, Wind Projects in $50 Billion Pledge." Bloomberg, April 17, 2017. [https://www.bloomberg.com/news/articles/2017-04-17/saudis-seek-30-solar-wind-projects-in-50-billion-pledge] The long-discussed launch of a civil nuclear energy sector in the kingdom could act as a further intervening factor toward mid-century, displacing Saudi oil demand and freeing up greater capacity for export.

[31] The capital spending plans have been described in various places. See: Saudi Aramco (2015); also see "Saudi Aramco plans to spend $334 billion by 2025." Reuters, Sept. 26, 2016. [http://www.reuters.com/article/us-saudi-aramco-spending-idUSKCN11W0U2] Also: Takeshi Kumon, "Saudi Aramco plans massive oil investment." Nikkei Asian Review, Oct. 8, 2016. [http://asia.nikkei.com/Politics-Economy/Economy/Saudi-Aramco-plans-massive-oil-investment].

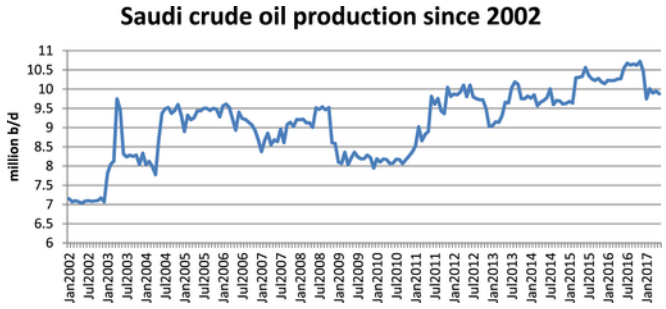

Fig. 2. Saudi crude oil production was at historic highs prior to the Nov. 2016 production cut (Joint Oil Data Initiative, 2017).

The largest segment, 42%, is earmarked for drilling. The number of oil-directed wells would increase nearly 50% from 850 in 2015 to 1250 in 2025. Some 280,000 workers will be needed (Saudi Aramco, 2015). Aramco, with 62,000 direct employees, would require large-scale hiring or contracts with services firms.[32]

Finally, an increase in production capacity fits the risk-inclined policy approach of Crown Prince Muhammad bin Salman, who has emerged as the kingdom's key day-to-day decision maker. Prince Muhammad bin Salman has launched several initiatives – from the aforementioned fiscal reforms to a major military intervention in Yemen – that deviate from the kingdom's traditional caution in regional and domestic affairs.

6. Risks, outlook and conclusion

An increase in Saudi production capacity also carries serious downside risks. Perhaps the biggest is that additional Saudi capacity will not be needed and the investment will be unproductive. Overcapacity could also undercut oil prices and perhaps encourage a long-term equilibrium of lower prices based on higher market exposure to low Saudi production costs. In theory, higher oil production also shortens the time horizon to full depletion. BP estimates that, at current rates of production, the kingdom's reported reserves base will last 59 years. An increase in production would push forward that figure, which could reduce rent allocation for future generations of Saudi citizens.

An output increase would also affect the ultimate tally of cumulative oil revenue collected by the Saudi government. If a glut caused oil prices to drop past the point offset by higher export volumes, the kingdom would be worse off. In short, policymakers must weigh whether the risk of a loss in revenue is outweighed by the risk of stranded assets. Post-IPO, future shareholders may also balk at a huge capital investment program, particularly if the outlays interfered with short-term returns or dividend payments.

Perhaps most worrying, a rise in Saudi crude oil output could trigger a damaging period of global oversupply. A glut could be exacerbated by future carbon taxes and other policy restrictions on fossil fuels. This could play out in a number of ways. It might deter Saudi competitors from investing in higher-cost resources, pushing more expensive oil out of the market. It could also signal to other producers that the risk of stranded assets is serious enough to warrant accelerated monetization of in-ground resources. A glut of cheap crude oil would undercut conservation initiatives as well as competing technologies and energy sources, including those associated with lower carbon emissions. Thus a decision to raise Saudi production capacity could generate consequences that trigger the green paradox: enhancing the attractiveness of oil, delaying the peaking of crude oil demand, and intensifying damage to the climate.

An alternate possibility is that by raising production, Saudi Aramco could publicize its fears the world is readying to move beyond oil, inadvertently encouraging investment in alternate technology such as electric vehicles.

Finally, one must address lingering questions about the size of Saudi Arabia's remaining oil reserves, a key determinant of any plan to sustain raised levels of production for a period sufficient to warrant the investment. The kingdom has reported its proven reserves in the range of 260 billion barrels since 1990, when it abruptly raised its official reserves figure from 1989 levels of 173 billion barrels. Since 1990, Saudi Arabia has depleted roughly 100 billion barrels without affecting reserves figures.[33] Most independent reports of Saudi reserves repeat opaque government estimates. But another estimate places proven reserves at just 88 billion barrels, with “probable” and “possible” reserves – including yet-undiscovered resources – adding a further 188 billion barrels (Rystad Energy, 2017).

Since most of the kingdom's major fields were discovered at least 40 years ago, the enduring consistency in reserve estimates suggests that new oil discoveries are probably not the only source of growth. Other factors for reserve growth probably also include “field appreciation,” based on improved recovery and understanding of field capacity, and a relaxed criteria for estimating “proven” reserves, perhaps by including formations normally considered “probable” and “possible.”

Worldwide, some 80% of "proven" oil reserves do not comply with financial reporting requirements of securities exchanges (Mitchell, 2004). Reporting and classifications requirements grow more strident when a firm offers shares on a financial exchange. Thus the promised Aramco IPO could prompt a detailed accounting of reserves, depending on jurisdictional requirements of listing locations.

In the long term, the oil business appears to be moving toward a period of increasing risk. Oil producers understand that the imperative of reducing emissions of climate-warming greenhouse gases endangers the leading position of fossil fuels in the global energy balance. An array of policy obstacles and investment disincentives is creating hurdles for the fossil fuel sector (Krane, 2016). While a compatible replacement for oil-fueled transportation does not yet exist, the threat of climate change compels individuals and governments to work toward oil substitutes, irrespective of prices. This understanding ought to prompt some holders of large reserves to try to monetize those resources on an accelerated pace, lest they lose value or become stranded. Recent statements and actions within the Saudi oil sector suggest that these threats are being taken seriously. Regardless, the costs and risks inherent in raising production capacity render the outcomes uncertain.

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[32] Aramco forecasts spending $57 billion on drilling materials including 11 million units of well casing (equivalent to 33,000–100,000 miles of steel pipe), along with valve trees, drilling mud, cement and other products; as well as a further $119 billion on drilling rigs and well services.

[33] From 1990 through 2016, Saudi Arabia has produced 98.4 billion barrels. BP Statistical Review of World Energy 2017.

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