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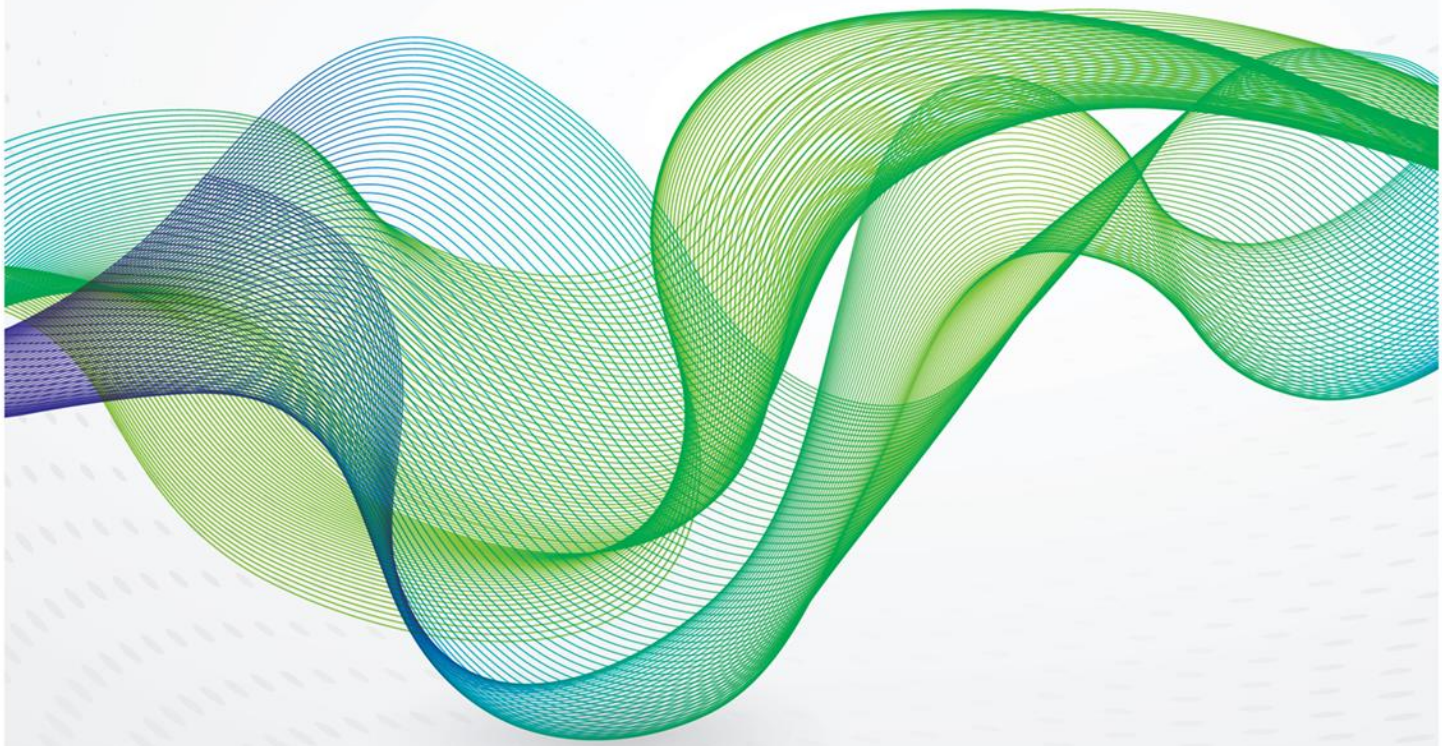
Saudi Oil Policy:

Continuity and Change in the Era of the Energy Transition



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Introduction

The crucial position that Saudi Arabia has in global oil markets cannot be overstated. In 2019 its proven crude oil reserves stood at 297.6 billion barrels, representing 17 per cent of the world's total.[1] In the same year Saudi Arabia produced 11.8 million barrels per day (mb/d) of crude, blended, and unblended condensates, and natural gas liquids (NGLs).[2] The country produces a wide array of crudes, ranging from Arab Super Light (American Petroleum Institute [API] gravity > 40° and sulphur content < 0.5 per cent) all the way to Arabian Heavy (API gravity < 29° and sulphur content > 2.9 per cent). Despite rising domestic demand in the past few decades, Saudi Arabia exports the bulk of its crude production and thus has a dominant position in international trade: exports averaged around 7.2 mb/d in 2019.[3] It is the only country that has an official policy of maintaining spare capacity that can be utilized within a relatively short time at a low cost. Saudi Arabia's reserves are also among the cheapest in the world to find, develop, and produce. In 2019 Saudi Aramco's average upstream lifting cost was estimated at $2.8 per barrel of oil equivalent (boe) produced.[4] The wedge between international oil prices and production costs generates high rents for the kingdom. In 2018 and 2019 Saudi Aramco's income (before taxes) stood at $212.7 billion and $177.8 billion respectively.[5]

In contrast to some neighbouring countries and other members of the Organization of the Petroleum Exporting Countries (OPEC), such as Iran, Iraq, Libya, and Venezuela, Saudi Arabia has not experienced conflict or political instability and has not been subject to international sanctions. It has thus been able to invest heavily in its energy sector and integrate the upstream sector with refining and downstream assets, both in the kingdom and overseas. In 2019 Saudi Aramco's gross refining capacity stood at 6.4 mb/d, while its gross chemical production capacity stood at 46.1 million tonnes[6]. In the same year Saudi Aramco's downstream operations consumed 38 per cent of its crude oil production.[7] The oil and gas sectors are also heavily integrated, given the large volumes of associated gas produced. However, Saudi Aramco has been investing heavily in developing its non-associated and shale gas reserves, thereby increasing the flexibility of its oil policy (Fattouh and Shabaneh 2019).

Saudi Arabia also has a dominant position in OPEC and historically the organization's key decisions have been shaped by the kingdom, either those related to cutting output to balance the market or increasing output to offset output disruption within OPEC and elsewhere. Although Saudi Arabia's output has not been impacted by political or military shocks (notwithstanding the September 2019 attacks on Saudi Aramco facilities, which disrupted output only temporarily), it has nonetheless been highly variable (Nakov and Nuño 2013), reflecting the kingdom's flexibility to increase and decrease output in response to shocks.

Given its size and large margins, the oil sector also plays a key role in the Saudi economy. Despite efforts to diversify its revenue base over the past few decades, oil revenues still accounted for an average of 86 per cent of total government revenues during 2012–15, while non-oil revenues averaged less than 5 per cent of gross domestic product (GDP) (IMF 2019). Recently the government has diversified its sources of income, for instance by introducing a value added tax (VAT), excise taxes, fees on expatriate workers, and other fees and taxes. These helped increase non-oil revenues to around 8 per cent of GDP (IMF 2019) and reduced the share of oil revenues to 64% and 67.5% per cent of total government revenue in 2018 and 2019 (General Authority of Statistics). Despite these new revenue sources, the government remains highly reliant on oil revenues for its current and capital

[1] BP Statistical Review of World Energy 2020, 69th edition. Saudi Arabia's official numbers are slightly lower at 266.7 billion barrels.
[2] BP Statistical Review of World Energy 2020, 69th edition.
[3] BP Statistical Review of World Energy 2020, 69th edition.
[4] Saudi Aramco 2019 Annual Report.
[5] In 2019 Saudi Aramco's net income was more than $88 billion. Saudi Aramco 2019 Annual Report.
[6] Saudi Aramco 2019 Annual Report.
[7] Saudi Aramco 2019 Annual Report.

spending, many components of which – such as public wages – remain rigid (Tamirisa and Duenwald 2018) and therefore difficult to adjust downward during economic downturns. Also, government spending is a key driver of growth in non-oil and private-sector activity through infrastructure investment, public sector wage bills, and social transfers (Fouejieu et al. 2018; Al-Moneef and Hasanov 2020).

All the aforementioned features, from the size of the kingdom's reserve base and production to the high reliance of government finances on oil revenues, have shaped Saudi oil policy choices and its relations with other producers over the years. The main purpose of this paper is to analyse a range of these policy choices and relations, their determinants, and the evolving role of the oil sector in the context of an energy transition, the speed of which remains highly uncertain and its impact uneven across the globe (Fattouh et al. 2019).

How is Saudi Arabia's Oil Policy Characterized in the Literature?

Given its core position in the oil market, many studies have modelled Saudi Arabia as the dominant producer, with the other producers (both OPEC and non-OPEC) acting as a competitive fringe (Mabro 1975; Salant 1976; Nakov and Nuño 2013; Golombek et al. 2018).[8] As the dominant producer, Saudi Arabia sets its output in anticipation of the reaction of the fringe and maximizes its profits based on the residual demand. In particular, Saudi Arabia produces less oil than its capacity given the oil price, allowing it to charge a mark-up over its marginal cost (Nakov and Nuño 2013).

Despite this prevalent view of Saudi Arabia in the literature, the empirical evidence has not been supportive of the 'dominant producer' model. For instance, Smith (2005) finds no evidence in support of a dominant producer and concludes that 'if Saudi Arabia ... has assumed the role of Stackelberg leader, dominant firm, or swing producer, it must not have been pursued with enough vigour and continuity, either before or after the quota system was adopted, to have left a discernible pattern in the data'.

Griffin and Nielson (1994) find evidence that rather than acting as a dominant or a swing producer, Saudi Arabia opted for a tit-for-tat strategy that punishes members for producing above their quotas and rewards those that comply. They identify three strategies used by Saudi Arabia: the Cournot strategy, the swing producer strategy, and the tit-for-tat strategy.[9] As long as Saudi Arabia earns more than Cournot profits, it would be willing to tolerate deviations from the quota and at times it may act as a swing producer to earn profits in excess of the Cournot equilibrium level. However, if cheating becomes flagrant, Saudi Arabia will punish the 'cheaters' by increasing its output until every producer is reduced to Cournot profits.

The above suggests that Saudi Arabia, and more broadly OPEC collusive power, is not constant over time (Geroski et al 1987; Almoguera at al. 2011). Geroski et al. (1987) find that collusion is rarely perfect, and some producers may change their behaviour in response to a rival's previous actions. Their empirical results show that varying-behaviour models tend to outperform constant-conduct models. Almoguera at al. (2011) identify multiple switches between collusive and non-cooperative behaviour during the 1974–2004 period. They find that although there were periods in which oil prices were higher due to collusion among OPEC members, overall OPEC has not been effective in systematically raising

[8] For a more extensive literature review, see Fattouh and Mahadeva (2013).

[9] In the standard Cournot strategy, each producer takes the output of the other producers as given and equates the marginal cost with the marginal revenue. In Griffin and Nelson (1994), the Cournot equilibrium sets the floor for the level of profits that Saudi Arabia can achieve if other strategies fail. In the swing producer regime, Saudi Arabia adjusts its production in response to other OPEC members producing above their quotas (i.e. cheating), and hence one would expect to see stable prices in this regime. In the tit-for-tat strategy, Saudi Arabia punishes other OPEC members for producing above the quota and matches their cheating, barrel by barrel, resulting in greater price variation than in the swing producer regime.

prices above Cournot competition levels. Using quarterly data from 1986 to 2016, Golombek et al. (2018) also find that while OPEC exerts market power, this power tends to vary over time.

More recent studies also show that Saudi Arabia's oil policy should not be analysed in isolation of the evolution of global oil market dynamics, such as the entry of US shale with its short-term investment cycle, low capital intensity, and higher responsiveness to price signals (Fattouh and Sen 2015; Fattouh 2016). Some argue that the entry of US shale has complicated both OPEC's and Saudi Arabia's management of the market, rendering the option to shift to a high-volume strategy more attractive under certain conditions. Using a static game under uncertainty, Fattouh et al. (2016) show that without sufficient knowledge about how elastic US shale is, it was rational for Saudi Arabia to test the resilience of US shale and not cut output in 2014. The large size of the market imbalance in the fourth quarter of 2014, the difficulty of reaching an agreement with OPEC and non-OPEC producers to cut output, its unwillingness to act unilaterally to balance the market, and its belief that it can withstand lower oil prices for longer as a result of its accumulation of large foreign reserves also contributed to Saudi Arabia's decision in 2014. Behar and Ritz (2017) show that pursuing a high-volume strategy becomes the dominant strategy when global oil demand growth is slower, US shale oil production is higher, cohesiveness within OPEC is low, and output in other non-OPEC countries is higher.

Ansari (2017) tests various market setups and finds that all of them fail to explain the price fall in 2014–2016, which declined beyond perfect competition outcomes, concluding that the shift in Saudi policy could have been an attempt to defend market share and test the resilience of US shale. Similarly Berk and Çam (2020) find that although oligopolistic market structures fit the market outcomes before 2014, they fail to explain the low oil prices during 2015 and 2016, which were closer to levels generated by a competitive market, supporting the view that the market has shifted to a more competitive structure.

In addition to these market factors, Saudi oil policy is fundamentally rooted in and shaped by salient features of its political and economic structures. One of the key factors that has a direct influence on oil policy is the kingdom's high dependency on oil revenues. Also, the government continues to play a central role in the country's development path through its capital expenditure and revenue spending, which remain the engine behind the growth of its non-oil economy and the private sector (Al-Moneef and Hasanov 2020). Given the central role the oil sector continues to play in the Saudi economy, the objective of maximizing oil revenues will always rank high in any output decision and acts as a constraint on oil policy choices (Fattouh and Sen 2015).

Early models of OPEC behaviour approached this objective of revenue maximization from the point of view of a 'wealth-maximizing rational monopolist' (Pindyck 1978). However, as noted by Mabro (1991), 'in practice, ... the revenue maximization objective which theory postulates and core producers would dearly like to achieve is not credible. [Instead, producers have to] become content with a second best: to obtain through the pricing policy more revenues than would have accrued under a competitive market structure. This may be much better than nothing but is likely to be very different from the optimum'.

It is in the context of second best, trade-offs, dynamic behaviour, and economic constraints that this chapter analyses Saudi oil policy. In particular, the lack of fiscal diversification or clear fiscal rules acts as a constraint on oil policy, especially in the short term. At the same time, it elevates the role of oil policy to the position of the primary policy to boost revenues and address the fiscal deficit in the face of an adverse shock, as government spending cannot be reduced sharply given its rigidity, while fiscal buffers tend to erode over time. However, using oil policy to boost revenues has become increasingly challenging, involves many trade-offs, and is being shaped by multiple factors, some of which are beyond the kingdom's control.

Saudi Oil Relations and the Expansion from OPEC to OPEC+

In face of a negative shock such as the COVID-19 crisis, Saudi Arabia can coordinate its oil production policy with other producers under the umbrella of OPEC to boost its oil revenues. All OPEC members recognise the fact that in the face of ex-ante excess supply due to overproduction and/or a negative demand shock, reliance on price or market mechanisms to correct the market imbalance and clear the

resulting large build-up in inventories is a lengthy and painful process as revenues fall sharply. Cooperation on the output front to restrict supplies is the most effective way to reverse the price decline and balance the market. There is rarely a disagreement on this general principle. But disagreements usually arise over which countries should shoulder the burden of the cut. It has long been the case that non-OPEC countries leave it to OPEC to implement cuts. In turn, many within OPEC would like to leave it to Saudi Arabia to shoulder the burden (Mabro 1998).

However, following the experience of the price collapse in 1985, nobody should realistically expect Saudi Arabia to unliterally balance the market. At that time, Saudi Arabia's attempts to defend the marker price resulted in a huge loss of market share and revenues: the kingdom reduced its production from 10.2 mb/d in 1980 to 3.6 mb/d in 1985 while prices continued to fall. This episode still shapes Saudi oil policy to this day.

Over the years, through its announcements and actions, Saudi Arabia has insisted on the principle that any cut should be implemented collectively with other producers. Also, with OPEC's market share declining over time, the principle of collective cuts has extended to non-OPEC producers, particularly to big producers such as Russia. In fact, this has been the main motivation behind the creation of OPEC+ and the conclusion of the OPEC+ charter in 2019, which saw two of the world's biggest producers – Saudi Arabia and Russia – join forces in managing the market (Economou and Fattouh 2018).

The cooperation between Russia and Saudi Arabia followed a series of failed attempts (Henderson and Fattouh 2016). In the 1997–1998 oil price crisis, OPEC called for production restraint from non-OPEC producers, and while Russia promised a reduction in output, it increased its exports by 400,000 barrels per day (b/d). In 2001, following the attacks on the World Trade Center in New York and as the global economy took a downturn, oil prices fell sharply. OPEC offered an output cut of 1.5 mb/d if non-OPEC countries implemented a 500,000 b/d cut. Russia promised a 30,000 b/d reduction, increasing its offer to 50,000 b/d, but ultimately delivered no reduction at all. During the financial crisis in 2008–2009, Russia attended three consecutive OPEC meetings as an observer, encouraging production cuts from OPEC but without promising any cuts itself. While Russia claimed it had cut output and exports during 2009, its overseas sales increased by 700,000 b/d (Henderson and Fattouh 2016). The real breakthrough came only in December 2016 with the Declaration of Cooperation (DoC) that constituted an unprecedented milestone in Russia–Saudi oil relations (Economou and Fattouh 2018).[10] The DoC occurred against a background of a sharp and extended period of oil price falls between 2014 and 2016 as oil exporters competed for market share.

But reaching agreements to cut output with a diverse and heterogeneous group of producers has always been challenging, and this has become increasingly so with the larger number of producers under the OPEC+ umbrella. Various studies show that the cost of negotiating a collusive outcome is large when there is asymmetry between parties, as there is no focal point for them to select as an equilibrium (Thomadsen and Rhee 2007). Also, agreements may take a long time to conclude due to bargaining problems (Hyndman 2008). These could be on the timing of the cut, its size, the allocation of the cut among individual members, and the timing of exiting the agreement. This became evident during the breakup of the OPEC+ agreement in March 2020. The negative demand shock due to COVID-19 brought to the fore the differences in perspectives between the biggest OPEC+ producers – Saudi Arabia and Russia – on the size of the cut and its timing. The inability to reach an agreement caused a shift in policy towards maximizing market share and, in the face of demand contraction, put severe pressure on oil prices and the oil market infrastructure, eroding revenues for all producers.[11]

[10] The unprecedented conformity levels achieved by the OPEC+ producers, led by Saudi Arabia and Russia, surprised the market and proved that both producers were committed to bringing the market into balance.

[11] Saudi Arabia recognised the extent of the impact of the virus on demand early on and pushed for implementing a deeper cut in production. Russia, on the other hand, showed strong resistance to deepening the cut and was not willing to implement even a small reduction. This reflects Russia's fundamentally different perspective on the crisis and other players' behaviour. Either Russia did not appreciate the scale of the shock, or did not see any value in deepening the cut given the size of the shock and

But even if producers do agree on the optimal size of the collective cut,[12] how to distribute the burden of the cut across individual members remains a key challenge. The current quota system used by OPEC does not have 'formal' rules for allocation and this may give rise to a sense of unfairness among some of the producers, affecting their incentive to comply with their quotas (Gault et al. 1999). This is especially true when the required cuts are large, as OPEC members with small levels of production find it difficult to reduce their production on a pro-rata basis, the system adopted by OPEC over the years. But setting alternative formal rules to distribute the burden of the collective cut is not feasible as there are many criteria that could be used. For instance, from a pure efficiency point of view, OPEC members with high production costs should cut production first and then be compensated by financial transfers from low cost producers (Bain 1948). OPEC, however, does not have a system to determine the size of transfer or the mechanisms to implement such transfer schemes. Allocating production quotas using other criteria, such as the size of reserves, population size, fiscal buffers, and level of development, all suffer from their own limitations as each country will choose the criterion or set of criteria that suits it best. The bargaining process of selecting relevant criteria itself could constitute an additional source of disagreement, with the outcome depending on the relative negotiating power of the different countries.

However, agreements to distribute output cuts across individual members are often reached, usually following a lengthy and tough bargaining process and a prolonged period of low oil prices. As noted by Mabro (1998), '[OPEC members' ability to] compromise to reach agreement should not be underestimated. It is founded on the belief that all members, including the largest producers, would be worse off without OPEC'. Hyndman (2008) shows that the larger the shock (positive or negative), the more likely it is for OPEC to reach an agreement.

Reaching an agreement does not imply the end of the process. An additional challenge is to verify and ensure that member countries abide by the agreed individual quotas. Since individual member countries have no incentive to reveal the true level of their production, OPEC members and more recently non-OPEC countries participating in the DoC, rely on 'secondary sources' to monitor compliance.[13] This mechanism is imperfect, as secondary sources use different methodologies and definitions and cannot observe domestic refinery runs to reach accurate production numbers. Nevertheless, reliance on sources other than direct reporting by participating countries helps resolve the credibility problem.

But even if OPEC+ is able to verify non-compliance, it has no formal enforcement mechanism to ensure that producers abide by their quotas (Kohl 2002; Libecap and Smith 2004). Since agreements extend over multiple months or even years, ensuring compliance over an extended period of time is challenging. The incentive for each individual country to comply with collusive agreement results from comparing the short-run gain from deviating from the agreement (which is the difference between deviation profit and collusive profit) and the cost or losses resulting from a collapse of the agreement and the resulting fall in oil prices. These trade-offs are not constant over time, especially if some producers believe that deviations from the agreement will not be detected immediately.

The ability of Saudi Arabia to increase its supply at short notice, and its willingness to shift policy if there is no agreement on collective cuts and/or if compliance falls to unacceptable levels, increases the cost of non-compliance for all producers. In effect, these shifts in conduct are needed to enforce discipline in the absence of formal enforcement mechanisms. In contrast to Stigler (1964), who considers a price war to be a signal of the collapse of collusion, insights from game theory suggest that in the absence of a formal disciplinary mechanism, collusion could still work if implicit threats force members to abide by the agreed quotas. In Porter (1983a; 1983b) and Green and Porter (1984), 'price wars' represent

amidst concerns that US shale producers could increase output to compensate for the cut. Russia would also have benefited from free-riding on OPEC's decision, if OPEC went ahead and unilaterally implemented their proposed deeper cut.

[12] Empirical evidence suggests that this may not be the case. Berk and Çam (2020) show that planned OPEC+ cuts in 2017 should have been much larger and that by cutting deeper, OPEC+ would have fully exerted market power.

[13] At the December 2019 meeting, non-OPEC members in OPEC+ were allowed to exclude condensate from the production data they submit, but agreed in return to use secondary sources rather than direct communication to assess compliance with targets.

the equilibrium outcome of a dynamic non-cooperative game and are the solution to the problems of imperfect information that plague OPEC. They are also a credible means of communicating and signalling to other players – hence price wars can be strategic and tactical in nature.

Saudi Arabia's decision not to adjust its output to balance the market in 2014-2016 and its decision in March 2020 to increase output following the breakup of the OPEC+ agreement provide support to this view. The severity of the price fall in April 2020 had the effect of focusing the minds of the world's largest producers. Unlike the 1997–1998 and the 2014–2016 price cycles, when it took several months to reach an agreement to cut output, producers' response was much faster during the COVID-19 shock – within weeks, OPEC+ was able to reach an agreement to implement a historic cut of 9.7 mb/d.[14]

Sustaining cooperation when prices are recovering is also essential for the success of an agreement, as an early or late exit reduces the net gains from cooperation. Since countries participating in OPEC+ have different budgetary requirements, fiscal stabilization schemes, oil industry structures, and perceptions about the resilience of US shale, they have different trigger points for the 'desired exit' and thus there may be disagreement on the optimal timing of easing the cut.

In short, in pursuing collective cuts with other producers, there is always the risk that: (a) no agreement can be reached: (b) and/or an agreement can be reached only after a long period of inaction or shift in conduct, which could result in a dramatic fall in oil prices and rise in inventories; (c) and/or an agreement can be reached with a cut that is lower than the optimal size; (d) and/or there is unequal sharing of the burden of adjustment; (d) and/or producers do not abide by their quotas; (e) and/or the timing of exit from the agreement is suboptimal. All these factors limit the potential net gains that could be achieved from cooperation.

If the net gains associated with cooperation become very small or highly uncertain, Saudi Arabia can choose to adopt a high volume or market share strategy for tactical reasons or as a permanent strategy. The kingdom is in an advantageous position to implement such a strategy: it has the capacity to increase output in a short period of time and it has a very well-developed infrastructure to market its crude and compete in any region. As a long-term strategy, the kingdom can increase its investment and the size of its productive capacity and capture a larger share of the market (see the next section).

However, this strategy risks a fall in total oil revenues as the higher revenue due to the increase in market share may not compensate for the loss of revenues due to the lower oil price as a result of higher production. This is especially true in the short term as low oil prices may not result in the immediate shut-in of oil production in high-cost producers and/or induce a strong recovery in oil demand. Also, for a market share strategy to work, it requires that prices stay lower for long enough to affect expectations and alter the behaviour of high-cost producers and their financial backers. Sustaining such a policy for a prolonged period, beyond achieving some short-term strategic objectives, may not be feasible given Saudi Arabia's high reliance on oil revenues (Mabro 1998). And pursuing a market share strategy results in the accumulation of stocks that may take months or even years to clear.

There may be opportunities in which Saudi Arabia can increase its share without undermining revenues. Such a strategy could succeed in specific contexts, for instance in a world of growing demand, declining or stagnating non-OPEC supply, output being disrupted from other producers, or a combination of these circumstances. Thus, the timing of implementation of such shifts in strategy and the ability to act proactively are key to capturing these opportunities. For instance, the transformation of the supply curve as a result of the COVID-19 shock and the lack of appetite for financing hydrocarbon projects could

[14] Without the US, an agreement would have been eventually reached, but it would have taken several months. Thus, US pressure did accelerate the process of reaching an agreement. Given their strategic alliance, the fact that the kingdom is sensitive to US interests should not come as a surprise. What is new in this relationship is US's dual role: in a low-price environment it acts as a producer and prefers a higher oil price; and in a high-price environment it acts as a consumer and prefers a lower oil price.

present Saudi Arabia with an opportunity to increase production without jeopardising revenues (Fattouh and Economou 2020a). If the demand recovery after the COVID-19 shock proves to be stronger than expected, and if the US supply response turns out to be weaker than in previous cycles due to lack of investment and investors' lack of appetite to finance US shale, then Saudi Arabia may find itself able to increase production and capture market share by substituting for production losses elsewhere. Revenues from higher production and exports may compensate partially or fully for the lost revenue due to lower oil prices, which are needed to keep US shale growth in check.

In short, Saudi Arabia recognises that there are net gains available from pursuing collective cuts with other producers. But the size of these gains is shaped by market conditions, internal cohesion within OPEC, cooperation from non-OPEC producers, and the nature of the shocks, among other factors. If these gains become small or uncertain, Saudi Arabia has shown willingness to shift policy towards market share. Thus, Saudi Arabia's output policy is not constant, and it continues to shift from cutting output to pursuing market share (and vice versa) depending on market conditions and the behaviour of other producers.

Capacity Expansion and Monetization Strategy

Short-term strategies cannot be isolated from medium- and long-term term issues, particularly those of investment in new productive capacity, the size of spare capacity, and monetization of reserves.

Given Saudi Arabia's large oil reserve base, relatively low development costs, stable investment environment, and competent national oil company that has a strong record of executing megaprojects, there are no technical, financial, or geopolitical barriers that would prevent the kingdom from increasing its productive capacity above the stated current level of 12.5 mb/d (including the neutral zone). The investment cycle, however, is longer than for US shale, and plans to expand capacity beyond current levels would take time to implement and require heavy investment, not only in the upstream sector, but also in calibrating the entire system, including increasing the capacity of gas-processing plants and building storage facilities, pipelines, and terminals.[15]

Thus, the decision to expand productive capacity and how fast is primarily a strategic one and will be determined by views on the future demand for Saudi crude, the prospects of which have become highly uncertain. This is not only due to the wide uncertainty regarding the speed of the energy transition and its impact on growth in global oil demand, but also how the energy transition would impact the financing of hydrocarbon projects, the growth in oil supply outside Saudi Arabia, the shift in portfolios of international oil companies, and the fragility of some oil exporters and their ability to increase productive capacity in a more challenging environment. COVID-19 has only amplified these uncertainties[16]. Decisions are also shaped by internal factors, particularly the expected growth in Saudi domestic energy demand, which in turn is closely tied to a wide range of policies including energy pricing reform, energy efficiency measures, and increases in the share of gas and renewables in the power mix.

Many are of the view that large reserve holders should focus on monetizing their reserves as quickly as possible so as not to be left with stranded assets. However, a rapid monetization strategy in the face of slower demand growth due to the transition may result in a sharp decline in oil prices and oil revenues,

[15] For instance, Saudi Arabia decided in 2004 to gradually increase its sustainable productive capacity from 11 mb/d to 12.5 mb/d and completed the expansion by approximately 2010. This involved the development of megaprojects including the Haradah Increment III (0.3 mb/d), the Abu Hadriya, Fadhili, and Khursaniya Project (0.5 mb/d), Khurais (1.2 mb/d), the Shaybah Increment (0.3 mb/d), and Nuayyim (0.1 mb/d). During this period, the gross additions amounted to around 2.35 mb/d, with 0.8 mb/d of this earmarked to make up for declining rates in mature fields. Of the new capacity additions, 1.1 mb/d was Arab Light quality, while the rest consisted of Arab Extra and Arab Super Light crudes.

[16] For a comprehensive discussion on how the energy transition and COVID-19 could accelerate shifts in consumer, government, and investor behaviours, see Oxford Energy Forum (2020), 'COVID-19 and the Energy Transition', Issue 123, Oxford: Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2020/07/OEF123.pdf

and thus could act as a constraint on a high investment–high output policy.[17] As argued by Dale and Fattouh (2018), 'a low-cost oil producer cannot sustainably seek to gain market share by adopting a higher volume, lower price strategy if it requires selling oil at a price below its total cost of production (including social costs). If the oil price doesn't cover an economy's total costs, it implies that some aspect of the economy is unsustainable.' It would also induce a reaction from some OPEC producers who will also have the incentive to monetize reserves by improving the fiscal terms and the investment environment. Under this strategy, there is no room for cooperation among low-cost producers – competitive forces will prevail, and margins will fall.

Were Saudi Arabia's economy highly diversified and its government finances less reliant on oil revenues, adopting a rapid monetization strategy would become more feasible given its status as one of the world's lowest-cost producers. However, this constraint could become less binding over time if Saudi Arabia is successful in implementing deep economic transformations. Also, factors such as the speed of the energy transition and the performance of US shale could result in a more competitive oil market (Dale and Fattouh 2018), reducing the effectiveness of policy responses and the ability to reach collective cuts with other producers. The higher output strategy could result in higher revenues for Saudi Arabia in the long run if some existing producers fail to adjust their economies to a sharp decline in oil revenues, causing them serious economic, social, and political repercussions that prevent these countries from expanding or even maintaining oil productive capacity. In other words, the calculus for Saudi Arabia on shifting to a high volume–market share strategy could change over time, and therefore a gradual shift away from the current strategy represents a strategic choice that should not be dismissed in the medium to long term.[18]

Spare Capacity When Prospects for Demand Remain Highly Uncertain

Investment in upstream is also linked to the optimal size of spare capacity. Decisions on optimal sustainable production capacity and spare capacity involve a trade-off. On the one hand, productive capacity should not be so large that Saudi Arabia ends up with spare capacity that is costly to maintain and could adversely affect the kingdom's long-term revenues by putting downward pressure on prices. Also, as Saudi Arabia increases its productive capacity, cutting production becomes more challenging, as no producer wants to operate well below its maximum sustainable productive capacity.

On the other hand, spare capacity should not be so small that Saudi Arabia loses control of the market on the upside, and risks higher and more volatile prices undermining demand growth. Given the kingdom's large oil reserve base, ensuring a stable oil market has been a key long-term policy objective. Historical evidence shows that OPEC spare capacity (largely concentrated in Saudi Arabia) has had a smoothing effect on global oil price movements, with prices under the counterfactual scenario in which there is no spare capacity exhibiting much sharper cycles both on the upside and the downside and higher volatility relative to the actual observed (Fattouh and Economou 2020b; Pierru, Smith, and Zamrik 2018).[19] On a yearly basis, Fattouh and Economou (2020b) find that price volatility under the counterfactual scenario would have been higher by 15.5 per cent, as in the absence of a buffer, even small shocks could induce higher price volatility. The ability to ramp up production also serves as a mechanism to enforce discipline within OPEC. Finally, spare capacity allows the kingdom to offer additional supplies during disruptions, when prices are usually high, boosting its revenues and its

[17] Also fast monetization of oil reserves that does not take into account demand growth can result in stranded assets if investments in new capacity end up being underutilized.

[18] The picture is much more complex as the decision not only involves whether to increase productive capacity or not, but also, as important, the timing of the implementation of any particular strategy.

[19] For instance, Fattouh and Economou (2020) find that in a world without OPEC spare capacity, the price would have risen by $110 per barrel (b), from $51.6/b in 2010 to $161.7/b in 2012, compared to $30.7/b in the actual world. In 2012, the Brent price would have been $39/b higher than the actual observed. On the other hand, in weak markets where OPEC had to cut output to balance the market, the oil price would have persisted lower for longer. For instance, following the 2008–2009 oil price collapse, in the absence of OPEC cuts prices would have remained in the $50-60/b range until early 2011, compared to the actual swift price recovery above $80/b by the second half of 2009.

geopolitical standing. By utilizing its spare capacity, Saudi Aramco generated an estimated $35.5 billion of additional revenues from 2013 to 2018 (Saudi Aramco 2018).

Thus, expanding upstream capacity and the size of available spare capacity also shape short-term oil policy. While during downturns Saudi Arabia's response in collaboration with OPEC+ is to cut output and draw down inventories, the response when prices drift upwards is less clear. For instance, despite the strong demand and supply responses in the high oil price environment of 2010-2014, there was no proactive Saudi or OPEC policy to bring prices down (Fattouh and Sen 2015). Instead, the Saudi oil minister at that time, Ali Al-Naimi, validated the $100 oil price environment by signalling the fairness of such a price. This reflects a clear asymmetry in oil policy response: prices need to rise to extremely high levels to generate a strong response.[20]

A key issue is whether Saudi Arabia and OPEC more generally should have a clearer policy to put a cap on the oil price. The advantages of such a cap is that it discourages new supplies from coming into the market and does not dampen demand growth. But this raises another fundamental question as to the price cap and the level of spare capacity needed to exert control on the upside. Choosing the appropriate price cap is very challenging and has to be based on incomplete and imperfect information. A clear example is the current divergence of views about the price level that could trigger a strong response from US shale. Saudi Arabia can err on the downside and assume a low-price threshold that would trigger a strong US shale response, but this will come at a cost, as the kingdom will be obtaining lower revenues than it potentially could. However, an alternative way to look at this problem is that Saudi Arabia will be giving up some of the upside price potential in order to protect itself from oil price falls further down the road.

The issue of maintaining spare capacity has become more complex in the context of the energy transition. If the energy transition has the effect of increasing the probability of supply shocks and their size and/or causes a slowdown in supply growth outside Saudi Arabia, the demand for Saudi crude could still rise and, in the absence of new investments, spare capacity would erode over time. The question is then whether Saudi Arabia should aim to increase its productive capacity and maintain spare capacity even in a world where oil demand is declining. If, by contrast, the demand for Saudi crude does fall over time, then Saudi Arabia may end up with larger spare capacity. In this case, should Saudi Arabia adopt a strategy to reduce its productive capacity or should it instead utilize all its spare capacity and pursue a faster monetization strategy? Thus, the size of spare capacity depends on a number of factors including Saudi Arabia's strategic choices. If market management is the preferred strategy, then availability of spare capacity is essential, especially if supply becomes more inelastic during the transition. If there is a shift in policy towards market share, then spare capacity becomes less important and the available spare capacity could be utilized in advancing such a strategy.

Until recently, Saudi Arabia's stated official policy has been to maintain its productive capacity of 12.5 mb/d. While it continued to develop and expand new fields, they did not represent net additions, but instead changed the quality mix of the kingdom's production. In 2020, Saudi Aramco announced that it had received a directive from the Ministry of Energy to increase maximum sustainable capacity from 12 mb/d to 13 mb/d, although no time frame has been announced. This indicates that Saudi Arabia still expects an increase in demand for its crude as supplies from outside the kingdom fall, or it wishes to retain enough spare capacity for its effective management of the market, or both. However, the relatively modest proposed increase in productive capacity, and the flexibility in the time frame, show that in this environment where prospects for global oil demand have become more uncertain, the option to wait has increased in value. It is most likely Saudi Arabia will continue to exercise this 'wait and see'

[20] This was seen in the first half of 2008 when prices hit close to $150, and then again in early 2012 when oil prices increased sharply as concerns over US-Israeli attacks on Iran intensified. In both these episodes, Saudi Arabia took measures without any coordination with OPEC, reflecting both the difficulty of getting other OPEC members on board in a rising market and the fact that the other OPEC countries are producing at maximum capacity and hence have no power to influence the market.

option until some of the key uncertainties are resolved or subside, especially given that investments in new productive capacity are irreversible.

The Oil Sector, Diversification, and the Energy Transition

The evolution of the oil sector during the energy transition is central to the kingdom's development path given oil's importance to the Saudi economy, its role as the main generator of government revenues, and its status as a key determinant of Saudi Arabia's international relations. From a developmental perspective, however, the country's heavy reliance on the oil sector presents major shortcomings. It does not generate a stable source of income as oil prices fluctuate widely. It also does not deliver on other government objectives such as job creation for the local workforce as the energy industry is capital- rather than labour-intensive (Hvidt 2011; Hvidt 2013). Also, the prospects of oil demand have become increasingly uncertain, with may expecting oil demand growth to slow or even to peak within a decade, causing margins and revenues to decline over time.

There has been considerable discussion about the adaptation strategies that oil-exporting countries should adopt to mitigate the adverse effects and risks of disruptive trends in the energy sector. Most of these strategies focus on economic diversification (Cherif and Hasanov 2014). Diversification reduces the variance of return in an uncertain environment by spreading risk, for instance by creating new sectors other than oil and gas (Poudineh and Fattouh 2020). But oil-exporting countries face real challenges in achieving a meaningful diversification strategy. This is because diversification is only successful if it offers risk reduction by pooling uncorrelated income streams, for instance by creating new sectors or new sources of taxation. If these countries diversify into sectors where inputs rely on energy infrastructure, they may not achieve sufficient risk reduction. Conversely, if they diversify into substantively different areas that have little in common with their current primary industry, they run the risk of failure to establish viable non-resource export sectors (Poudineh and Fattouh 2020). Furthermore, achieving diversification requires building human capital and improving the education system, as well as extensive reforms to improve the business environment, transparency, economic governance, and introducing taxation, which requires developing the administrative capabilities of the state (Luciani forthcoming). It also calls for the streamlining of procedures, reducing excess monopoly rents in non-tradable sectors, and removing barriers to private-sector participation (Hvidt 2013). There is uncertainty about how rapidly such economic and institutional reforms can be implemented, and how effective they will be in diversifying the sources of government income.

Saudi Arabia has introduced various reforms under Vision 2030, including reform of the labour market, fiscal policy and energy pricing, but with mixed outcomes (Grand and Wolf 2020). Also, the reforms required to achieve meaningful diversification and structural transformations are lengthy and could be subject to setbacks. Thus, to expect Saudi Arabia to diversify away from the oil sector, which constitutes its core competitive advantage, and for this strategic sector to play a lesser role in the transition process is not only unrealistic, but it is also suboptimal, as the kingdom will be limiting its risk reduction strategies and abandoning a core strength and an important source of revenues. After all, the oil sector remains very profitable and enjoys higher margins than any new industries/sectors that the government aims to establish. Furthermore, the sector could contribute to the overall diversification strategy (Fattouh and Sen forthcoming). By leveraging the energy sector and its income, the government could also finance the creation of new sectors and ease the pain of reforms, increasing the chances of success by introducing targeted compensatory measures to shield the most-affected households and sectors.

Therefore, *in addition* to diversification, which is needed to enhance fiscal diversification, but the outcome and the associated costs and benefits of which remain highly uncertain, Saudi Arabia should pursue a conservative bet-hedging strategy (Poudineh and Fattouh 2020), the essence of which is reflected in the old saying that 'a bird in the hand is worth two in the bush'. The core of a conservative bet-hedging strategy is to enhance the competitiveness of the energy sector and increase its resilience against potential risks of disruption due to the energy transition. This could be achieved by adopting a set of measures that includes:

- Lowering production costs and increasing oil and gas production efficiency so Saudi Arabia can compete in any price environment and maintain healthy margins.
- Decarbonizing oil and gas production to enhance competitiveness in a world of rising carbon prices.
- Improving the efficiency of domestic energy use and optimizing the energy mix to maximize the country's oil export potential.
- Shifting the portfolio towards petrochemicals and non-combustible uses of oil.
- Decarbonising final petroleum products to sustain long-term demand for the kingdom's core products as the transition towards decarbonized sources of energy accelerates.

Compete in a low oil price environment

As the energy transition advances, it could result in a shift to a more competitive market structure and lower margins (Dale and Fattouh 2018). Saudi Arabia already has some of the lowest costs of oil production in the world: the average upstream lifting cost is estimated at $2.8/boe produced, enabling the kingdom to compete in a low-price environment. In a more competitive environment, Saudi Arabia must maintain and enhance its ability to compete by improving the efficiency of its operations, reducing production costs, and maintaining its status as a reliable supplier so it can compete in any region. The well-developed infrastructure of pipelines, storage, and refining facilities both inside and outside the kingdom, and marketing departments in key consuming centres, are all additional sources of comparative advantage. The breakup of the OPEC+ agreement in March 2020 showed Saudi Arabia's ability to sharply increase its production and market it to consumers in an oversupplied market, and hence its ability to compete on volume once the decision to shift policy towards market share has been made.

Decarbonize oil and gas production

But cost is not the only area in which the kingdom can compete. Saudi Arabia has one of the lowest carbon intensities of oil and gas production (Masnadi et al. 2018) and in world of potentially rising carbon prices and carbon border taxes, this could provide a key additional source of competitive advantage. Its lower carbon intensity is in part due to the nature of its reserve base, but is also due to the country's heavy investment in infrastructure over the years such as the establishment of the Master Gas System, which resulted in a massive reduction in the routine flaring of gas over the years (Masnadi et al. 2018; Al-Suwailem 2020). Due to its small number of extremely large and productive fields, the kingdom has very low gas flaring rates per barrel and low water volume per unit of oil produced, and less energy is used for separation, treatment, and reinjection. All these factors contribute to the lower carbon intensity of its production. This is in contrast, for instance, to the extraction and processing of heavy oils in Venezuela and oil sands in Canada, which are characterized as very energy and carbon intensive.

One area in which Saudi Arabia performs particularly well is gas flaring, where Saudi Aramco has been implementing major projects to mitigate routine gas flaring across its oil and gas value chain. These include revisions to its standards and the use of innovative technologies and flare gas recovery systems in its gas oil separator plants and crude and gas processing complexes (Al-Suwailem 2020). According to Saudi Aramco, flaring intensity remains at less than 1 per cent of total gas production. According to World Bank data, Saudi Arabia has one of the lowest gas flaring rates per barrel of oil produced. In 2019, Saudi Arabia joined the World Bank initiative to reduce gas flaring to zero by 2030.[21] Also, Saudi Aramco's methane emissions are among the lowest in the industry, with a 2018 methane intensity of 0.06 per cent.

[21] Non-routine flaring is an important safety feature of oil- and gas-producing and processing facilities. It provides a safe and effective means of burning gas during a plant emergency, such as a valve leak, a purge, or a terrorist attack.

Optimize the domestic energy mix

One of the notable features seen in Saudi Arabia over the last few decades has been the rapid increase in electricity demand driven by multiple factors, including high population growth, robust economic performance, improvements in standards of living, and harsh weather conditions. Limited gas supplies, gas infrastructure constraints, and long lead times to develop alternative substitutes such as renewables and nuclear mean that Saudi Arabia continues to burn large volume of liquids, primarily heavy fuel oil and crude oil, to meet electricity demand. Optimizing the energy mix would increase the kingdom's core competitive advantage by freeing crude and products for export in the most cost-effective way (for instance, as compared to increasing exports by increasing productive capacity through investment). This could be achieved through multiple routes, such as enhancing efficiency, reforming domestic energy prices, increasing the domestic use of gas and renewables in the power sector to displace liquids (Blazquez et al. 2020) and investing in the necessary infrastructure such as expanding the Master Gas System (MGS) and improving the robustness of the grid to enable the entry of these new sources. Saudi Arabia has made progress in all these areas.

In terms of efficiency, the government has been introducing tougher energy efficiency standards (Fattouh and Shabaneh 2019). Efforts to promote a nationwide energy efficiency programme in the kingdom started as early as 2003 with the launch of the National Energy Efficiency Program. In 2010, following a Royal Decree, the Council of Ministers transformed the program into a permanent and broader energy efficiency programme, renaming it the Saudi Energy Efficiency Center. It was mandated to develop the country's energy efficiency policies, regulations, and rules, and to support their implementation. An inter-agency cooperation called the Saudi Energy Efficiency Program was created to improve energy efficiency primarily in three major sectors: industry, buildings (residential, commercial, and government), and transport, which account for 90 per cent of energy consumption in Saudi Arabia. In the industrial sector the program has focused its efforts on enforcing energy efficiency targets in three of its largest subsectors: petrochemicals, cement, and steel. Improving the efficiency of the Saudi power sector has also been a priority. Saudi Arabia's power generation capacity is largely dominated by steam and gas turbines. Subsidized fuel for power plants and low electricity tariffs discouraged investment in the past, but recent price reforms and policies started a push for a more efficient power system. There has been a gradual progression toward combined-cycle power plants. In addition, some of the steam power plants have been retrofitted with supercritical boilers to improve efficiency (Fattouh and Shabaneh 2019).

Saudi Arabia has also been reforming its energy prices, particularly transport fules. Following decades of very low gasoline prices, the government introduced two waves of major price increases, the first in December 2015 and the second in January 2018, which saw prices of Premium 95-octane gasoline increase from 0.60 Saudi riyals (SAR) per litre to SAR 2.04 per litre, more than a threefold increase albeit from a low base. Also, since the start of 2019, the government has been adjusting gasoline prices on a quarterly basis depending on changes in international oil prices (Al Dubyan and Gasim 2019). The impact on gasoline demand is already visible. After growing by an average of 6.3 per cent annually between 2002 and 2015, gasoline consumption has slowed markedly, contracting by 6.4 per cent between 2017 and 2018 (Al Dubyan and Gasim 2019). Although this decline cannot be attributed solely to gasoline price increases, energy price reform played the most important role by far (Al Dubyan and Gasim 2020a).[22]

But reform has not been limited to transport fuels. Historically the government has provided electricity at highly subsidized prices. Low tariff rates encouraged the inefficient use of electricity and did not cover the costs of electricity production, despite the government providing fuels for the power sector at subsidized prices. In 2015, the government raised prices for fuels used in the power sector – diesel, crude oil, heavy fuel oil, and methane. The increases ranged from 67 per cent for methane to 225 per cent for diesel. Even before these feedstock price hikes the Saudi Electricity Company was making

[22] Al Dubyan and Gasim (2020a) find that price reform accounts for 1.9 billion litres of the 2.2 billion litre annual decrease, while for residential electricity, higher prices contributed 9.1 terawatt hours (TWh) of the 13.0 TWh annual decline in 2018.

losses. To offset part of these increased costs and rationalize electricity demand, the government raised electricity tariffs. The government's ultimate objective is to increase tariffs to levels that reflect 'the production cost based on fuel prices, assuming ideal efficiency'.

These new electricity prices, although low by international standards, are expected to rationalize growth in electricity demand.[23] Between 2015 and 2018, residential electricity consumption in Saudi Arabia started to flatten and eventually fell from a peak of 144 TWh in 2015 to 130 TWh in 2018, with factors such as energy price reform and improved energy efficiency accounting for the decline (Al Dubyan and Gasim 2020b). In 2019, for the first time since data have been collected, electricity consumption dropped by 3.5 per cent year-on-year (Soummane 2020).

The Saudi government also revised its natural gas prices in 2016, raising the price of ethane (the main feedstock used in the petrochemical industry) to $1.75 per million British thermal units (mmBtu), an increase of 133 per cent, and the price of methane (used mainly in the power sector) to $1.25/mmBtu, an increase of 67 per cent. The Fiscal Balance Programme 2017–20, launched in December 2016, aims for 'a targeted and gradual transition' of the gas price to 'a linked reference price with an applied price ceiling' by 2020/21. The 'gradual transition' and 'ceiling' reflect the government's effort to try to strike a balance between reforming gas prices and keeping energy and petrochemical industries competitive, as they remain at the heart of the kingdom's industrialization strategy (Fattouh and Shabaneh 2019).

The government has ambitious plans to reduce liquid burn in the power sector by increasing the share of natural gas and renewables in the power generation mix. Saudi Aramco has been investing heavily in developing its domestic gas reserves, and the new increments of gas supplies have reduced the volume and share of crude burn in power generation and moderated the sharp swings in crude burn (EIA 2019). The kingdom's oil and gas policies are highly integrated. A key objective of gas policy has been to develop domestic gas reserves to replace crude oil in the power mix and develop non-associated gas reserves. This in large part explains the recent focus on developing uncoventional gas such as the Jafurah field[24] and offshore non-associated gas reserves, which are not only needed to meet the current ambitious targets, but will also increase the kingdom's flexibility in conducting its oil policy (Fattouh and Shabaneh 2019).

In addition to natural gas, the kingdom has ambitious plans to increase the share of renewables in the power mix, with the aim of renewables accounting for up to 50 per cent of power generation capacity by 2030 depending on economic growth. Also, in locations where it is uneconomical to deliver gas because of lack of infrastructure, renewables can fill the gap though this requires building energy storage system (ESS) and battery storage to overcome intermittency issues. Despite the great potential of renewable resources in Saudi Arabia, especially for solar energy, only 92 megawatts (MW) of renewable capacity were recorded in 2017, equating to 0.1 per cent of existing capacity (IRENA 2018). But since then, there has been a rise in activity with more than 3.3 GW of projects being tendered and some projects already under construction. Initially Saudi Arabia targeted 9.5 gigawatts (GW) of renewable energy capacity by 2023. The current targets have almost reverted back to the original plan drawn out by the King Abdullah City for Atomic and Renewable Energy, the lead organization at the time that was established to oversee development of alternative energy in 2013, which called for 54 GW of renewable capacity by 2032. The new plan drafted under the National Renewable Energy Program, however, includes more detail and clarity in terms of technology, locations, and a roadmap for

[23] While the cash handouts disbursed through the newly established cash transfer scheme (the Citizen's Account) will help alleviate some of the pain on lower-income households, the allowances have not been large enough to cover increases in the cost of other fuels such as gasoline, the indirect costs of energy price increases, and the introduction of valued added tax. The impact of higher electricity prices on demand is already being felt.

[24] Gas reserves in Jafurah are estimated at 200 trillion cubic feet of raw gas with output estimated to reach around 2.2 billion cubic feet per day of sales gas by 2036, with an associated 425 million cubic feet per day of ethane. The field would also produce some 550,000 barrels per day of gas liquids and condensates. See Reuters, 'Saudi Aramco launches largest shale gas development outside U.S.', February 24, 2020. https://www.reuters.com/article/us-saudi-shale-gas/saudi-aramco-launches-largest-shale-gas-development-outside-u-s-idUKKCN20I29A?edition-redirect=uk

development. The lead organization of energy mix is the Ministry of Energy (in collaboration with other concerned entities in the eco-system). Also, a Supreme Committee for Energy Mix Affairs and Enabling Renewable Energy Sector was established to endorse renewables plans and provide support to achieve them.

All these measures would contribute towards Saudi Arabia meeting its nationally determined contribution (NDC) under the Paris Agreement (Wogan et al. 2019).[25] Saudi Arabia communicated its intended nationally determined contribution in November 2015, which subsequently became the kingdom's first NDC after ratifying the agreement on 3 November 2016. The kingdom aims to achieve mitigation co-benefits by avoiding up to 130 million tonnes of CO_2 equivalent per annum by 2030 through economic diversification policies and adaptation measures.

Extend the value chain

A core strategy in Saudi Arabia's efforts to diversify its economy has been to capture more value added across the hydrocarbon value chain. It has done this through vertical integration into refining and petrochemicals and finished products manufactured in industrial parks that attract private-sector and foreign direct investment. Also, Saudi Aramco has developed a non-metallic program to create new innovative materials from hydrocarbon and polymers, to replace conventional material like cement, steel, aluminum and glass in key sectors such as oil and gas, automotive, building and construction, packaging and renewables.[26] The move towards non-combustible uses of oil such as petrochemicals is expected to offer a degree of hedging against the possibility of a drop in oil demand, and create new industries and jobs (IEA 2018). The Saudi petrochemical sector has established itself as one of the main pillars of the economy, in large part through heavy government investment in new industrial cities and the Master Gas System, encouraging investor participation, supporting Saudi–foreign joint ventures for new petrochemical projects, and providing cheap feedstock. But the traditional model based on cheap ethane and producing basic petrochemicals seems to have reached its limits in terms of development goals and offering a hedge for the kingdom. Instead, Saudi Arabia needs to move towards more speciality products, accelerate the shift of its feedstocks towards liquids such as crude and naphtha, and invest in new technologies of production and recycling. Part of this strategy is to invest in technologies that could convert crude to chemicals allowing 70 to 80 percent of crude intake to be converted into chemicals.[27]

Decarbonize final products

A key part of a conservative bet-hedging strategy is to decarbonize products and sustain the continued use of fossil fuels by replacing oil exports with new energy carriers that are clean and can be produced using existing oil and gas infrastructure. There is wide recognition in the kingdom that this is essential to ensure the long-term viability of its oil industry. A key concept advanced by the kingdom has been that of the Circular Carbon Economy (CCE), in which emissions of carbon from all sectors are managed in a way that allows the carbon to move in a closed-loop system (Al-Khuwaiter and Al-Mufti 2020). Under the Saudi Group of 20 (G20) presidency, the G20 Energy Ministers endorsed the CCE approach and its '4Rs' framework (reduce, reuse, recycle, and remove) as a 'holistic, integrated, inclusive, and pragmatic approach to managing emissions that can be applied reflecting country's priorities and

[25] Wogan et al. (2019) find that by rationalizing costs of fuel inputs, Saudi Arabia could achieve large CO_2 emission reductions while providing a net economic benefit to its economy. Specifically, their results show that fully deregulating fuel prices achieve CO_2 emissions reductions of 1.2 billion tonnes cumulative through to 2030. In such a scenario, electricity demand would be met by natural gas-fired combined-cycle gas turbines (64 per cent) and solar photovoltaic generation (20 per cent).

[26] See Saudi Aramco website, Non Metallic Solutions: https://www.aramco.com/en/creating-value/technology-development/in-house-developed-technologies/nonmetallic-solutions#

[27] Reuters (2018), 'Saudi Aramco signs crude-to-chemicals technology agreement', January 18. https://mobile.reuters.com/article/amp/idUSKBN1F727B. Saudi Aramco and Saudi Basic Industries Corporation (SABIC) have recently announced that they would re-evaluate their crude-oil-to-chemicals project in Yanbu.

circumstances' (G20 2020).[28] The CCE approach requires enabling policies that incentivize investment and continuous improvement in technologies such as carbon capture, utilization, and storage (CCUS) and direct carbon capture, products and human capital, engineering and design, patenting laws, and expertise in trade laws. It remains to be seen how successful the kingdom will be in its decarbonization efforts through the CCE approach, but recent initiatives indicate that Saudi Arabia is accelerating its work to decarbonize its products. One such initiative is the world's first shipment of 40 tonnes of blue ammonia from Saudi Aramco to Japan (Ingram 2020).[29] This remains a one-off shipment to test the concept and additional investment will be needed to make the project economically viable. But it shows that for Saudi Arabia, hydrogen and CCUS represent key opportunities for decarbonization and constitute the cornerstones of the CCE.[30]

Conservative Bet Hedging Strategy: Costs and Limitations

The return on a conservative bet-hedging strategy is lower than the current default strategy of exporting oil and gas, given the costs involved in decarbonization and the potentially lower margins in the new low-carbon businesses. But such a strategy lowers the risk profile and improves the resilience of a key sector of the economy (Poudineh and Fattouh 2020). Policymakers need to realize that while decarbonization polices such as the CCE approach come at a cost, and thus lower the overall return from existing assets, they also reduce the risk of disruption to their energy sectors and economies in the long term. The availability of cheap-to-extract oil enables Saudi Arabia to absorb the added cost of decarbonization as a form of internal carbon tax. Also, this strategy is less complex to implement given its close relationship with the existing hydrocarbon business, and it enables countries to build on their core strengths. Currently many of the decarbonization technologies such as CCUS remain costly, but this means there is significant room for cost efficiency gains that could be exploited. During the transition era, which is highly uneven across the globe and the speed of which is highly uncertain, Saudi Arabia can still export oil and benefit from the generated rents, while at the same time improve the return on decarbonized products.

Nevertheless, this strategy of investing to increase the resilience of the energy sector suffers from a few drawbacks. First, the cost of decarbonizing final products remains highly uncertain and although decarbonization costs are expected to decline, it depends on the large-scale of deployment of certain technologies such as CCUS and hydrogen. This deployment in turn depends on the policy framework, the ability to develop business models that ensure that costs are shared between producers and consumers and various parts of the supply chain, and well-designed policies that allow supply-side technologies to be part of the solution (Zakkour and Heidug 2020). This requires a proactive approach and international coordination and cooperation.

Second, the energy industry is capital-intensive in nature and does not generate enough jobs for the hundreds of thousands entering the Saudi labour market each year. It is not sufficient for the energy sector to generate return and improve its resilience; the oil sector has to contribute to economic diversification by creating new sectors and jobs. By extending the value chain and moving away from basic products, Saudi Arabia can create new industries that not only generate more jobs, but different types of jobs, including those in the service sector such as trading, marketing and sales, and procurement and logistics, as well as supporting services such as accounting, finance, and human resource management (Hvidt, Forthcoming).

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[28] Saudi Arabia's role in climate change negotiations has often been described as 'obstructionist' (Depledge 2008). Promoting CCE represents a different strategy that emphasizes 'managing emissions', but taking into account a 'country's priorities and circumstances' and encourages all possible climate mitigation options.

[29] The ammonia was produced from hydrogen from hydrocarbons with the associated CO_2 captured and utilized by Saudi Aramco.

[30] In a recent interview, CEO of Saudi Aramco Mr Amin Nasser said that 'hydrogen is among the long-term business opportunities that we are expending a lot of R&D money on… crude-to-hydrogen and gas-to-hydrogen are definitely opportunities that we are interested in'.

In this respect, the Local Content Requirements that give priority to nationals in employment opportunities, domestic companies in contract opportunities, and locally produced goods and services will only increase in importance. The objectives of such policies are to create a level playing field for local industries, create jobs for locals, and enhance the transfer of technology and technical expertise and skills (Olawuyi 2017). Saudi Aramco has one of the most ambitious localization plans in the region with its In-Kingdom Total Value Add programme, launched in 2015. The main objective of the programme is to maximize the impact of the company's capital expenditure on the local economy, generating growth, new industries, and employment.[31]

The extent to which the energy sector can play a role in diversification also depends on the wider structural reforms. The inefficient economic structures and policies surrounding the energy sector have not only constituted barriers to meaningful diversification, but have also limited the energy sector's contribution to broader and deeper diversification. The recent energy pricing, labour market, and fiscal reforms act as additional enablers to the transition of the Saudi energy system, enhance its diversification role and provide greater flexibility in terms of oil policy.

Conclusion

Oil will continue to be the cornerstone of Saudi Arabia's political economy and its international relations. Over the years, Saudi Arabia's oil policy has been shaped by a number of structural features and trade-offs, and looking ahead these will continue to influence Saudi oil policy. Low fiscal diversification and rigidity of government spending imply that maximizing oil revenues will remain the main guiding principle. But in the case of Saudi Arabia, this has multiple dimensions. In the short term, factors such as producers' cohesion and the nature of the shock will determine the size of gains from pursuing cooperation. During the past few decades, through its actions, Saudi Arabia has reinforced core principles that will continue to shape its policy: unwillingness to act alone, extending agreements to a larger pool of producers, and its low tolerance for non-compliance. Another key feature is Saudi Arabia's willingness to shift policy towards high volumes if the net gains from cooperation become uncertain, or to reach agreement to cut output if producers show willingness to cooperate. Thus, Saudi oil policy is not constant, and it should come as no surprise that past attempts to fit Saudi Arabia's behaviour in non-dynamic models have failed (Fattouh and Mahedeva 2013).

But there is also a long-run dimension. Given the size of its reserves, Saudi Arabia must ensure that it maintains long-term demand for its oil, and this has important implications for both its short-term and long-term policy. While in the face of a negative shock Saudi Arabia's policy is to cut output, the country's oil policy has been less proactive on the upside. One of the key lessons from the 2014–2016 cycle is that high oil prices generate a strong demand and supply response and create the genesis for the next cycle. With the energy transition accelerating, some of these responses could be long-lasting and irreversible.[32]

The ability to control the market on the upside is linked to the issue of investment and how much spare capacity Saudi Arabia should hold. Notably the issue of investment goes deeper than short-term management of the market. Factors such as the speed of the energy transition and increased uncertainty about demand prospects could lead to a more competitive world where collusive outcomes could increasingly become challenging and the trade-off could eventually tilt in favour of a high output-market share strategy. This especially holds if Saudi Arabia is able to accelerate its economic and fiscal

[31] So far, the In-Kingdom Total Value Add programme has attracted 468 investments from 25 countries with an estimated capital expenditure of $6.5 billion, resulting in 44 industrial facilities completed to date and another 64 facilities under construction. In terms of localization, Saudi Aramco's procurement spent in the kingdom rose from 35 per cent in 2015 to 56 per cent in 2019.

[32] See the Oxford Energy Forum (2020), 'COVID-19 and the Energy Transition', Issue 123, Oxford: Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2020/07/OEF123.pdf

diversification. But this strategy has its challenges as it could result in lower margins and revenues if supply outside Saudi Arabia shows strong resilience to low prices and/or if demand for Saudi crude falls due to the acceleration of oil substitution policies.

In the era of the energy transition, and as Saudi Arabia aspires to implement its Vision 2030, many are of the view that the oil sector's contribution to the kingdom's future development path and international relations will become less important over time, with some having already moved to analysing Saudi Arabia beyond oil (McKinsey Global Institute 2015). This view is premature: the role of oil in shaping Saudi's political and economic future will become more important as the transformations in the Saudi economy and global oil market continue, although its contribution to the future trajectory of the kingdom will take different forms from the past.

Thus, in addition to economic and fiscal diversification, Saudi Arabia should adopt policies to increase the resilience of its oil sector. Diversifying away from oil and reducing the role of the oil sector in the kingdom's future development path is not only unrealistic, but from a strategic and policy level, it is suboptimal. Saudi Arabia should continue to leverage its core sector both by enhancing its competitiveness through improving efficiency, promoting greater integration, and decarbonizing oil production and products. It should equally use the generated rents to ease the pain of structural reforms needed to place the economy on a more sustainable path, and leverage the scale of the oil sector to create meaningful backward and forward linkages to the rest of the economy.

Saudi Arabia is very well positioned to implement such strategies and mitigate the potentially disruptive impacts on its energy sector and economy. This strength reflects the level of development of its energy sector, its high degree of integration, its core comparative advantage as the lowest-cost and least carbon-intensive producer, its highly capable national oil company, and years of stable environment which has ensured continued investment into the sector. The government has also introduced some very ambitious reforms, including reforming energy prices.

This is not to say that Saudi Arabia is immune from the current transformations in the global energy markets. As argued in this paper, there is no escape from Saudi Arabia:

- Adjusting its economy and government spending to a lower oil price and potentially declining margins.
- Implementing deep macro and micro reform to diversify its income revenue base and foreign export receipts.
- Leveraging its energy sector both to maximize the income from its core assets and using the generated income to ease the pain of structural reforms.
- Investing in its oil sector to increase its resilience in the face of disruption.

These are all serious challenges. Doom and gloom predictions infer that Saudi Arabia would emerge as a definite loser in the transition, with increasing risk of economic collapse and an inability to navigate through the transformations in global energy markets, and that its geopolitical importance and role in energy markets would only decline. These predictions are rather simplistic to say the least. They ignore the kingdom's core strengths and strategic choices and tend to assume a fast, uniform, and smooth energy transition across the globe.

Finally, this is a two-way street. Transformations in global energy markets are already shaping Saudi choices, but the choices that the kingdom takes will also influence the energy landscape. For instance, if Saudi Arabia succeeds in its diversification objectives, this would allow a more flexible and proactive oil policy and long-term strategies that could influence the speed of global energy transition and the role of oil demand in the energy mix. Also, if Saudi Arabia succeeds in pushing forward the Circular Carbon Economy approach and decarbonising its core exports, this would not only increase the oil sector's resilience and enhance kingdom's strategic position, but it would also contribute (and not on a small scale) to the world's decarbonization efforts.

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