

END OF AN ERA

WHY THE EROSION OF PETROLEUM'S MONOPOLY ON FUELING
TRANSPORTATION SHOULD DRIVE SAUDI ARABIA TO RAISE OUTPUT
AND LOWER PRICES

Master of Arts Capstone Project

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28 April 2014

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Summary and recommendations

The long-term goal of the Kingdom's energy policy should be two-fold: maximize the value of its petroleum resources in the face of significant changes underway on the energy supply landscape, and take steps to help diversify the Kingdom's overall economy. High oil prices and profits today make this difficult, but over the long-term, the current drivers of petroleum demand are likely to be undermined by increasingly cheap and viable alternatives for transportation energy, like electricity produced from natural gas and renewable sources. For decades petroleum has effectively been the monopoly supply for transportation energy, but the rise of electric and hybrid vehicles demonstrates this is changing, and in order to reduce the impact of price volatility and the risk of price collapses as these forces accelerate, the Kingdom should pursue a strategy that is optimized for lower prices. This would start by proactively managing world petroleum prices by driving them down through increases in supply.

This counterintuitive approach is possible due to the Kingdom's unique market position, and would help it smoothly reduce its profits over the very long-term (50+ years), rather than risk costly demand shocks as demand from transportation eventually tapers. Lower prices will also provide market-based incentives for the Kingdom's economy to begin the difficult but necessary process of weaning itself from oil dependence. This strategy would likely generate higher near- and medium-term profits that should be invested to diversify the Kingdom's economy and in next-generation energy technologies around the world. The advantages and disadvantages of the tactics to support this strategy are outlined in the following report, and recommendations include:

- Mimic Mexico's de-nationalization strategy in order to attract foreign investment, to expand oil production and to reduce production costs
- Expand domestic gas production and investments in renewables to reduce oil consumed by domestic electricity needs
- Promote domestic energy efficiency
- Expand investment in workforce training and productivity especially in non-oil sectors
- Advocate for carbon taxes, especially in developed countries
- Invest in transitioning oil resources to petrochemical and other higher-value uses

However, this approach is likely to be politically challenging for several reasons due to:

- Need for domestic understanding that maximizing total long-term value of the Kingdom's oil resources necessitates increasing current output in return for lower prices
- Likely pushback from other oil-producing countries
- Possible pushback from environmental advocates, although this may be mitigated by strong support for carbon taxes

If this report's projections are accurate, the risks from not pursuing the proposed strategies are high, since falling petroleum demand and prices will leave the Kingdom with an economy unprepared and perhaps incapable of transitioning from oil dependency. However, if these projections are inaccurate and demand does not ultimately fall, the costs of having unnecessarily pursued them will be relatively low, since taking these steps will reduce the

negative effects of the 'resource curse,' including vulnerability to price volatility, Dutch Disease, and risk of price collapse.

Problem/background

While petroleum has been the Kingdom's great asset during the modern era, it has led to excessive economic reliance on the resource. Currently petroleum represents approximately 80 percent of the Kingdom's government budget and 90 percent of its export revenue,¹ and without doubt it will remain the country's most important industry for the foreseeable future. Worldwide, petroleum consumption is primarily in two areas: transportation and petrochemicals; approximately 62 percent of oil is used for transportation, with passenger transport comprising 60 to 70 percent of this. The balance is used for commercial purposes including other fuels, plastics, and other petrochemicals.²

The Kingdom's economy is almost completely dependent on petroleum and its use in these areas, and it has publicly stated its petroleum reserves total more than 260 billion barrels.³ The ready availability of high profits from oil has permitted the country to develop rapidly, but it has simultaneously stripped the Kingdom of viable alternative sources of economic growth. This has led to many of the classic problems often attributed to the "resource curse." These economic challenges include:

- Crowding out of other areas of economic activity. This stems from 'Dutch Disease': the problem resulting from exchange rate fluctuation which leads to inflation within the country. The country becomes uncompetitive in non-oil related sectors and other

tradable goods, and related talent migrates out of the country. As a result, the country specializes in non-tradable goods like construction and financial services.

- Vulnerability to oil price volatility. Because of the country's reliance on oil revenues, government spending tends to fluctuate with oil prices. The country's national budget becomes a function of worldwide oil prices. This challenges the government's ability to make reliable long-term plans and leads ultimately to inability to execute reliably.
- Risk of price collapse
- Electric vehicles (EVs), the increasing cost competitiveness of liquefied natural gas (LNG), and the diversification of viable energy sources including renewables, are likely to cause oil price volatility to increase, as the cost performance of these sources, relative to oil, vary as they are improved.

Factors necessitating change by the Kingdom

As senior officials know, the dominant role petroleum plays in the Kingdom's economy represents an enormous long-term risk. The biggest risks to the value of the Kingdom's petroleum resources are:

1. Increasing viability of substitutes to petroleum for transport, the largest source of demand.
2. Worldwide efforts to reduce reliance on oil in internal combustion engines, due to concerns about climate change.

As outlined below, competing market forces over the long-term are at work, with some pushing petroleum demand and prices up, and others acting in the opposite direction. With the rise of alternative transportation fuels, especially electricity from LNG and other sources, the Kingdom is in a race against the collapse of the value of petroleum as a transportation fuel, which would dramatically reduce the value of the Kingdom's oil that is still in the ground. The example of the German dynamite cartel formed in the 1880s by Alfred Nobel is illustrative. To control the price of the valuable explosive, fend off competitors and motivate itself to identify profitable new ventures, the group systematically reduced prices by 10 to 20 percent, as demand rose. The approach forced the group to cannibalize its own business and find new profitable opportunities before other forces did; the DuPont Corporation and numerous other valuable companies are modern-day evidence of the success of this strategy.⁴

Oil has effectively commanded monopoly profits in the transportation sector due to the lack of alternatives, but this is changing as new economically viable sources of transportation energy emerge. While petroleum will still have significant value as feedstock for petrochemicals, the decline in demand from transportation is likely to lower overall prices significantly as its monopoly power and rents dissipate.

Factors driving demand to fall

The modern history of personal transportation has been made possible and dominated by petroleum products, and the coming shift from gasoline to electric propulsion poses a significant transformation in energy use worldwide. With approximately 68 percent of

petroleum demand worldwide coming from light and medium distillates (primarily motor gasoline and diesel),⁵ a significant shift away from internal combustion engines will result in a decline in demand for gasoline, and for the first time, the viability of a significant shift is on the horizon. The increasing viability of electricity as an alternative to fossil fuels is softening demand, specifically from the accelerating switch to EVs and partially-electric vehicles. EVs, while not yet fully cost-competitive with vehicles powered by internal combustion engines, are increasingly viable and desirable, and demand for full and partially-electric vehicles is expected to grow rapidly in the coming years. One researcher forecasts CAGRs of 11.5 percent for hybrid EVs (HEVs), 31.9 percent for plug-in hybrid EVs (PHEVs), and 31.5 percent for full EVs.⁶ All major car manufacturers are pursuing electric vehicle programs and robust growth for EV penetration is widely projected worldwide.

Batteries comprise as much as 50 percent the cost of an EV, so key to these forecasts are recent studies finding that EV battery performance is improving at 7 percent per year, and that battery costs per kilowatt-hour are anticipated to be 50 percent lower in 2020 than present levels.⁷ This, and improvements in battery capacity, recharge speed and other key performance metrics, are expected to double roughly every 10 years for the foreseeable future.⁸ (See Figure 1 in Appendix.) These limitations in battery performance have been a principal obstacle to the commercialization and adoption of EVs, and as adoption of EVs and PHEVs continues, improvements are expected to accelerate, with EV and PHEV battery pack prices expected to decrease 10 percent and 26 percent respectively by 2020.

Combined worldwide sales of HEV and plug-in electric vehicles will reach 6.6 million annual units by 2020, and worldwide plug-in electric vehicle sales to reach 3.8 million annually by 2020, and will comprise almost 7 percent of the total light-duty vehicle market, according to one recent study.⁹ Demand is expected to vary by region, with the number of partial hybrid EVs sold in most regions expected to be lower than battery EVs, except for North America and Latin America. In these regions, the longer driving range of PHEVs is expected to prove more attractive to consumers. In other regions, dense urban areas and the high cost of petroleum fuels are anticipated to contribute to higher sales of BEVs than PHEVs. While sales have lagged optimistic projections for years, the market is now expanding rapidly given persistent gasoline prices, and “sales of plug-in EVs will grow at a compound annual growth rate of nearly 40 percent over the remainder of the decade, while the overall auto market will expand by only two percent a year.”¹⁰ By 2040, ExxonMobil expects hybrid EVs to account for about half of worldwide new car sales, and given the large increases in fuel efficiency that will result, the company predicts that total demand for energy by the worldwide light-duty fleet will peak in 2020, and then fall steadily.¹¹ Significant global growth is expected in heavy-duty transportation energy demand, but efficiency gains will also be increasingly important.

Capitalizing on these improvements, the EV company Tesla has already built a functioning nationwide network of vehicle recharging stations in the US, and it has plans to significantly expand it within the US and other countries by 2015. Tesla says that all of the electricity used by its recharging stations is from solar, and that its recharging station network will ultimately transfer energy back into the electricity grid.¹² While the company sells only

super-premium luxury cars and sold just 22,450 units in 2013,¹³ it has plans to expand production to include lower cost vehicles and to increase production significantly in coming years. And though Tesla can rightly be considered a start-up and does not by itself presage a near-term shift of transportation to full EVs, its success seems to be proving the viability of the battery-only model and has attracted every major car manufacturer to investigate production of similar vehicles; Nissan, Ford, and BMW are already selling them.

Consumer preference for the performance advantages offered by EVs is also becoming a factor as technology improves. Tesla has for the first time demonstrated that a high-priced, luxury EV engineered to the standards of comparable luxury vehicles can have high demand. In addition to its efficiency, the Model S is specifically prized for its impressive acceleration and handling, caused by the low center of gravity from the weight of its battery packs. Wait-lists for the car are common, and it has received numerous industry accolades, including the highest rating ever from the influential US automotive magazine, Consumer Reports.¹⁴

Aside from EVs, carmakers are also successfully responding to increasing governmental pressure worldwide to increase fuel efficiency. This is due to a combination of government regulatory pressure and consumer demand for increased efficiency. Volkswagen recently developed and briefly sold a vehicle that was rated at 270 miles per gallon, and it is expected to commercialize this technology more broadly in the near future.¹⁵ Other car makers have similar technologies under development, and US fleet average fuel standards will rise to 54.5 mpg in 2025.¹⁶ An initiative backed by the UN Environment Program, International Energy Agency,

International Transport Forum, and FIA Foundation, called “50 by 50”, aims to push the world’s automobile fleet to increase fuel efficiency 50 percent by 2050, a move described as achievable and which would save 6 billion barrels of oil annually.¹⁷ Since 2007, the sales-weighted average fuel efficiency of cars sold in the US has increased 22 percent¹⁸, and the combination of continuing pressures to raise efficiency, as well as the increasingly viable alternative to gasoline in the form of electricity, will drive down demand from transportation for petroleum.

Another factor likely to reduce vehicular demand for energy overall (either from gasoline or electricity) is the increasing viability of autonomous vehicles. These vehicles are expected to significantly enhance the efficiency of traffic flows, especially in metropolitan areas, and a recent US Treasury Department study found that traffic congestion wastes 1.9 billion gallons of gasoline in the US annually.¹⁹ Both Mercedes-Benz and Nissan have publicly announced plans to have self-driving vehicles for sale by 2020,²⁰ and Volvo, Audi, General Motors, Ford and Toyota are also known to be actively developing the technology.²¹ By 2035, the US is predicted to have nearly 54 million self-driving cars on the road, and by 2050, nearly all cars in the US are expected to be autonomous.²² Adoption rates in other countries will be lower at first, but are expected to rise. Whether adoption occurs as quickly as projected is unknown, but ultimately a significant portion of the worldwide automotive fleet seems likely to move in this direction, which will bring further reductions in fuel demand due to more efficient traffic flows.

Increases in shale and unconventional gas production

The newly exploitable reserves of significant deposits of gas and oil in the US, Canada and other parts of the world promise to put further downward pressure on oil prices, especially as transportation shifts away from gasoline. In addition, with the return of Iraq to large-scale oil production and the stated desire of both Iraq and Iran to drive up production at lower prices, it will become increasingly unlikely to withhold production as a means to raise prices.²³ Over the very long term, these developments will reduce the value of the Kingdom's resources and reduce its ability to avoid price shocks.

Impact of carbon controls

While rising concern over carbon emissions is increasing the likelihood of carbon taxes and other government-mandated carbon control mechanisms around the world, such taxes are not expected to have a significant impact on oil prices. A carbon tax would certainly improve the cost competitiveness of non-carbon alternate energy sources, like renewables. However, as noted by Daniel Schrag, petroleum would be "relatively unaffected by a price on carbon simply because oil is already so expensive per ton of carbon."²⁴ Among fossil fuels, coal is expected to be most negatively affected by the imposition of a carbon tax, and since natural gas contains roughly half the carbon content of coal per unit of energy, it would become more price competitive relative to coal.²⁵ The shift to EVs and hybrids would therefore likely be a net positive for natural gas, with more likely negative consequences for coal than oil because coal is used much more in the production of electricity than petroleum. However, the uncertainty that surrounds the prospect of carbon controls, be they taxes, performance/portfolio standards, or

cap-and-trade or command-and-control mechanisms, can be expected to raise undesirable price volatility for all fossil fuels.

Factors driving demand to rise

While the above factors are expected overall to lower demand for petroleum, increasing economic output of the emerging markets will likely lead to upward energy demand overall, especially from non-OECD countries including China, India, and others.²⁶ (Figure 2.) Notably, China has gone from being an oil exporter in 1993 to surpassing the US as the world's largest oil importer.²⁷ Similarly, India's demand is expected to rise sharply over the next 3 decades, and it is expected to become the world's largest source of petroleum demand growth by 2035.²⁸ Overall, vehicle demand is expected to rise significantly, although as noted above it will increasingly be away from conventional gasoline motors.²⁹ (Figure 3.) Based on these projections, the prices of petroleum-based fuels are expected to rise in the near-term; based on historical rolling averages, one estimate expects global gasoline and diesel prices to increase at 7.2 percent and 8.3 percent compound annual growth rates (CAGRs) between 2013 and 2020.³⁰

However, many developing countries are also attempting to implement energy saving and pollution-reducing technologies as their economies expand. The United Nations group of Least Developed Countries, which comprises the world's 49 poorest nations, recently agreed to binding cuts in their emissions of greenhouse gases, which over the long-term is likely to reduce use of fossil fuels.³¹ China is highly focused on reducing its reliance on emission-producing fossil fuels in order to address pollution problems, which are largely caused by its heavy reliance on

dirty coal-fired electricity plants;³² the country is also seeking to trim its reliance on petroleum and replace it with natural gas and renewable energy sources. Policies aimed at reducing energy consumption, expanding implementation of renewable energy sources and the use of clean-energy vehicles are expected to reduce the growth of the country's use of petroleum.³³

Policy options

To respond to the challenges posed by the uncertainty in world oil demand, the Kingdom has numerous policy options it can pursue. These options are in the areas of changes it can make within the petroleum sector, and those it can pursue outside it.

Petroleum sector changes

Increase oil supply and lower oil prices

While counterintuitive, the Kingdom could work to drive down the long-range price of oil. Due to its role in establishing world oil prices, the Kingdom has the power, unique among oil producing nations, to execute this approach; it can do so by increasing the supply of oil it sells into world markets over time. Although there has been some disagreement about the Kingdom's true reserves, their level and high profitability are likely substantial enough to execute this strategy. US diplomatic cables unintentionally released during the WikiLeaks scandal in 2008 quoted a top Saudi Aramco official suggesting that reserves could be as much as 40 percent lower than official estimates.³⁴ The cables also suggested that the Kingdom may be unable to pressure prices downward in the future if necessary. However, speculation at the time of these cables' release held that if the lower figures were true, oil prices could be likely to

rise in the near term; that this has not happened could indicate less concern about the size of the Kingdom's reserves, in combination with new resource discoveries in the Kingdom, the US and elsewhere.

While oil will clearly remain important for the next several decades, its primary source of demand, as a transport fuel, appears certain to begin softening due to the worldwide focus on efficiency and the increasing viability of EVs. Therefore, the Kingdom should take steps to accelerate a strategic shift away from an oil-centered future, by accelerating investments in non-oil areas of the country's economy and workforce. This can be made possible in two ways:

- by increasing production from fields that Saudi Aramco already has under production
- by inviting foreign partners to share risks and rewards from further exploration and exploitation of the Kingdom's resources.

Benefits of this strategy would include increased near-term revenue and profits that can be invested in sovereign wealth funds (SWFs) for investment in areas as detailed below. In addition, by lowering oil prices, this strategy would also be likely to reduce the adoption rate and technological advancement of alternative energy sources, like battery technology and LNG transport. While it almost certainly cannot stop their development, it can slow down their impact on petroleum demand.

Costs of this strategy include the more rapid depletion of known reserves, and potential political fallout from fellow oil producers that may have difficulty competing with the new

market equilibrium prices. Depending on the level of the Kingdom's additional profits, transfer payments or foreign direct investment could be made to those nations most affected in order to reduce political friction.

De-nationalize some aspects of Saudi Aramco to increase output and reduce costs

In order to maximize the value of the Kingdom's resources, it could consider de-nationalizing some aspects of Saudi Aramco and its oil industry overall. Following the experience of Mexico and Brazil, the Kingdom could create a system of regulatory bodies which would establish a program of market-based auctions to better monetize external demand for its resources. Under such a scheme, Saudi Aramco would be permitted to maintain control of a set of fields it chooses, and beyond these, foreign oil companies would be permitted to bid on extraction rights through a combination of profit-sharing and production-sharing arrangements. This would allow the Kingdom to better capture the market value of its resources and further increase production. Under a profit-sharing system, private international oil companies (IOCs) would be encouraged to develop new technology that could help the Kingdom further reduce its extraction costs and raise profitability. Since IOCs often have greater experience in managing risky fields than national oil companies (NOCs), such an arrangement would also allow the Kingdom to boost output, although at somewhat lower average profit margins.

The rise in short- and medium-term profits that would likely be seen by the Kingdom by pursuing this strategy could be invested in SWFs to manage their proceeds, and to fund these and other investments detailed below. Careful, transparent management of these SWFs would

be important to reduce possible backlash and to give the public confidence that the Kingdom is making prudent, non-self-interested investments. As in Mexico, a new set of government agencies could be warranted to manage the proceeds, separate from Aramco or the Oil Ministry.

Expand gas fields to reduce domestic consumption of oil

Increasing the Kingdom's production of natural gas would help it to reduce its reliance on oil for production of electricity.³⁵ While the country is estimated to have the fifth largest natural gas reserves in the world, very little is now under production.³⁶ Especially with the involvement of foreign partners, the Kingdom could also expand exploration for shale and unconventional oil and gas. Current domestic electricity use costs the Kingdom roughly \$7 billion (USD),³⁷ based on the market value of the energy less the price at which it is sold, and this demand could be more cheaply satisfied by developing more efficient sources like these, as well as renewables which are discussed below.

Push Saudi Aramco to pursue contracts outside the Kingdom

With its significant experience and well-respected skills in project management, Aramco could yield the Kingdom additional profits by pursuing worthwhile opportunities outside the Kingdom, especially in conventional oil production. Some reports have suggested the company is already possibly looking at this possibility in Mexico, based on its technology and other resources.³⁸

Increase investments in petrochemicals to speed transition from fueling transport to use of petroleum in advanced plastics

By value, petrochemicals are a far more profitable use of petroleum than as fuel, especially from downstream refining. This is what led the Kingdom to increase its participation in this sector through the acquisition of GE Plastics and the expansion of SABIC. As demand for oil as a transportation fuel increasingly shifts away from petroleum, the Kingdom should focus more of its resources on this high-value added source of demand. While already actively pursuing many projects in petrochemicals and other high-value segments, the Kingdom should accelerate the pace of these activities. Bringing in foreign capital and expertise would help the Kingdom to more quickly capitalize on the current value of its resources. The Kingdom could also expand investment in research to identify new uses and lower cost production methods for advanced plastics, carbon fiber, and other petrochemicals. For example, research into further displacing steel and aluminum for new structural uses in car bodies, airframes, and others contexts could be worthwhile.³⁹

The principal cost of these production-expansion approaches is the potential for lost revenue and profits over the long-term if EV uptake projections do not develop as expected. In addition, there is a likely environmental impact that could be the single biggest downside to this strategy. By ramping up production of petroleum, significant amounts of carbon would likely be released into the atmosphere. It is likely that this would induce quicker adoption of carbon taxes by governments committed to curtailing such emissions. But the pace of the

production increases could be timed to assume such taxes, which are likely to be inevitable in any case.

Also, some IOCs might not be willing to participate in the Kingdom's new de-nationalization strategy if they don't see it in their interest to support the Kingdom's low-price/high-volume strategy, or if they fear the Kingdom is likely to re-nationalize and expropriate their holdings. This is a small risk, since an auction arrangement would likely result in bids from at least a small number of partners. Also, given the reliability and profitability of the Kingdom's existing fields, a large number of bidders is likely. The Kingdom has been a reliable partner in the past, and even during the Kingdom's previous expropriation, foreign operators were handsomely compensated for their assets.

Increasing demand from China and other developing countries will temper the overall impact of this strategy, however, this will benefit the Kingdom overall by acting to shore up prices. These new sources of demand raise the opportunity costs of pursuing this strategy while making it somewhat less urgent and profitable, but it remains worthwhile for the variety of benefits presented, especially its likely impact on motivating economic diversification.

Non-petroleum sector changes

Make investments in non-oil sectors and reduce reliance of economy on oil

Significant investments outside the oil sector could be made to grow other areas of the economy and begin to reverse the underlying causes of the Kingdom's 'resource curse.' There

are a variety of fields that could warrant investment to benefit the Kingdom, including a massive increase in education, especially in engineering and R&D. While the Kingdom has doubled its number of universities in the past decade from 16 to 33, more investments could be made to educate young people both at home and abroad.⁴⁰ Most importantly, technical areas that could directly benefit the Kingdom's transition to a low-price oil future could be pursued.

This approach could lead the Kingdom to accelerate the construction of gas-fired electricity plants and enable Saudis to take on the technical and management roles in these projects. In addition, construction of more efficient desalination plants would enable the country to move away from using petroleum to meet its water needs and instead sell this oil on world markets.

The Kingdom has started to pursue these types of investments, such as a recently unveiled fund targeted to specifically invest in manufacturing,⁴¹ but these efforts could be expanded. However, this new company, the Saudi Arabian Company for Industrial Investment will only have initial capital of roughly \$530 million. While not an insignificant amount, it is likely to not be enough to make significant progress. This approach would reflect Oil Minister Ali Al-Naimi's widely-known belief that while the Kingdom already does significant business in raw materials and petrochemicals, it does not invest enough in manufacturing finished products to generate jobs for its young people. In addition, the Kingdom could invest more heavily in education to enable young people to develop businesses in other areas.

While the Kingdom already has developed partnerships with interested foreign companies, these could be expanded. General Electric is today developing manufacturing and other facilities in the Kingdom; these investments are designed to supply key local customers like Saudi Aramco and are also intended “to offer training programs for young Nationals to further build their technical skills.”⁴² These and similar programs already work through the Saudi Aramco Entrepreneurship Center to identify and build local SMEs in manufacturing and service sectors⁴³, and the Kingdom could designate further investment to attract additional foreign companies to help expand programs like these.

Promote energy efficiency and reduce domestic consumption

The Kingdom could make investments in improving its energy efficiency. Improved energy efficient building codes could be observed for new construction, and other steps could be taken to enable the Kingdom to maximize the amount available to be sold on the world market. Today, domestic oil consumption is approximately 3 million barrels per day and is growing at a rate of 7 percent per year. Significant improvements in efficiency would require billions in infrastructure investment, but these would help the Kingdom boost its oil export revenue.⁴⁴

The Kingdom could also expand its already significant investments in PV, which have thus far totaled more than \$100 billion to generate 41 gigawatts (GW) of capacity. This amount is expected to comprise 30 percent of the Kingdom’s electricity requirements by 2030, and will enable this oil to be sold rather than burned domestically.⁴⁵ The Kingdom would not be alone

among petroleum exporters in recognizing the wisdom of this strategy of conserving domestic use of oil for export. Despite its strong economic reliance on petroleum, Norway is aggressively pursuing electrification of its auto fleet. The country already has 10,000 EVs on the road,⁴⁶ and is expected to grow this number significantly. Due to government incentives and a network of recharging stations, EVs in Norway are routinely the most popular cars sold. In March 2014, the Tesla Model S broke the monthly sales record for any car (gas or electric) ever sold in the country.⁴⁷

China is also working to reduce its reliance on fossil fuels, and it is making significant investments in clean technology that the Kingdom could emulate. An example of the many investments by public and private organizations to reduce its reliance on petroleum is one led by the International Finance Corporation. Along with General Electric and ConocoPhillips, this investment was made in early April 2014 in capacitor technology to enhance the efficiency and use of hybrid buses.⁴⁸ Due to its high growth, China continues to be a leading target for innovation and investment to develop cleaner and more efficient alternatives to fossil fuels. The Kingdom could work to attract this type of investment both to reduce its oil consumption and encourage economic development.

Advocate for higher carbon taxes

The Kingdom could take a leadership role in the debate on fossil fuels' role in climate change, and could advocate for the value of higher carbon taxes while simultaneously increasing its own production and efforts to drive down production costs. While also somewhat

counterintuitive, the approach would likely have a desirable effect on the public perception of the Kingdom, and could help mollify environmental concerns about the increased environmental risks from higher fuel production and consumption. It would also fit with an overall strategy to lower domestic use of petroleum, as in cleaner vehicles (natural gas and electric), and to increase use of the Kingdom's petroleum for high value petrochemicals. While controversial, IOCs including ExxonMobil are on record supporting carbon taxes as a sensible mechanism to reduce emissions.⁴⁹ If phased in over an extended period, higher carbon taxes worldwide would also have the effect of smoothing the decreased demand for petroleum with steadier prices. Although mostly affecting coal as noted above, carbon taxes would reduce the profitability of the proposed price reduction strategy, since governments enacting them would capture some of the difference between the new, lower market price for oil established by the Kingdom and the residual high prices resulting from the tax.

Invest in improving economic viability of renewables

While worldwide baseload power for many decades is expected to be from gas, coal, nuclear and other current sources, the increased economic viability of renewables is fueling its adoption, as has been noted. The Kingdom could increase investments substantially in laboratories and companies around the world to increase the efficiency and viability of these technologies, especially in the areas of battery storage technology, carbon sequestration, transmission and smart-grid.

In tandem with a plan to increase output and lower prices of petroleum, this strategy could be especially profitable for the Kingdom. In addition, lower oil prices would depress the value of alternative energy sources and renewables, and would thus allow the Kingdom to invest in developing these technologies earlier in their development lifecycles and at lower valuations.

Eliminate or decrease energy subsidies

The Kingdom could also address the significant subsidies that it provides to support domestic energy consumption. Energy prices in the Kingdom are among the lowest in the world, at \$0.78 per gallon,⁵⁰ which encourages excess consumption and discourages efforts to motivate efficiency. As noted above, the Kingdom spent over \$13 billion on energy subsidies in 2011. The Kingdom could follow the example of fellow oil exporting nation Norway, which has done much to encourage domestic efficiency. As noted above, the country offers generous subsidies which have made it a leading market for Teslas, combined with gasoline taxes that give it the highest gasoline prices in the world: \$10.76 per gallon.⁵¹ While many stakeholders would be likely to oppose reduction in these subsidies, gradual efforts, backed by strong government incentives, could gradually transition the Kingdom from its high reliance on domestic petroleum. For example, as natural gas production expands, government subsidies could be provided for the purchase of natural gas powered vehicles. This could help the government export more of its petroleum where it could be more profitably sold.

Increase tourism promotion efforts

In order to promote the development of non-oil related businesses, the kingdom could increase its efforts to promote foreign tourism from non-Saudi citizens. Today, the Kingdom offers no official tourist visas⁵² and generally restricts foreign visits to Muslims making pilgrimages and performing other religious rituals, which are seen as necessary due to the Kingdom's role as custodian of many of Islam's most important shrines. However, the Kingdom has many other notable cultural and natural sites that, properly developed, could be of great interest to foreign tourists generally. In addition to the direct economic benefits of such an effort on promoting non-oil business development, this strategy could also lead to greater innovation among Saudi citizens as they are exposed to contemporary ideas through foreign travelers, and integrate further into the global economy. Doing so would require a shift in cultural attitudes to be more permissive of foreign norms, although other states with somewhat restrictive cultures have managed this influx of foreigners without significant damage to their cultural heritage. For example, Bhutan did not officially permit tourism until 1974, in order to protect its distinctive natural and cultural heritage. Today the country's tourism strategy emphasizes "high value, low impact" visits in order to maximize the benefits and minimize the costs from tourism.⁵³ Over time and with a similar approach, the Kingdom could likely do the same.

Increase women's participation in the workforce

In its effort to diversify and strengthen its economy, the Kingdom could take steps to increase women's participation in the workforce, which has been shown to be positively

correlated with economic competitiveness and workforce productivity.⁵⁴ Today less than 22 percent of women work in the Kingdom, compared to 40 percent in the rest of the Middle East and 43 percent globally.⁵⁵ This would likely also require efforts to change public religious attitudes regarding women's role in society generally, since mingling between unrelated men and women is not permissible under the Kingdom's interpretation of Islam.⁵⁶

Political economy context

Making dramatic changes to the Kingdom's long-standing economic policies will not be easy, and the feasibility of the possible solutions outlined above vary widely. Key considerations in the Kingdom include its centralized decision-making, underlying conservatism, the strong power of religious leaders, and its hesitance to deeply integrate into the global economy. The existing economic interests of the ruling elite may also make instituting many of these changes difficult.

Perhaps the defining characteristic of the Kingdom's political decision-making is its highly-centralized politics and history of deep conservatism. As noted in the recent work *Why Nations Fail*, nations without a history of political checks on authority tend to develop "extractive" political institutions which make innovation and economic development difficult. In the Islamic context, the Ottoman Empire is seen as a system in which the unchecked power of the Sultan prevented meaningful steps toward inclusive political, economic, and civil society institutions, which can support innovation.⁵⁷ The Kingdom's political evolution may have been affected by this factor as well, which could be rooted in the royal family's perception that

maintaining its power necessitates deferring to the powerful religious forces in the country, which have kept ideas of participatory democracy at bay for decades.

The Kingdom's highly modern consumer economy masks the extent of this conservatism in many respects, but in many malls, stores and restaurants have separate entrances and areas for single men and families, to preclude mingling between unmarried men and women.⁵⁸ In addition, religious police enforce compliance with these norms in many areas of the country. This state may be somewhat ironic since its key economic resource is central to the functioning of the world economy and its oil and non-oil economy requires thousands of foreigners to function. However, the Kingdom's deeply religious culture has led it to create separate compounds where foreigners often live and non-Saudi ways are tolerated.

Similarly, civil society institutions that can build inclusion and foment entrepreneurialism have been challenging to build in societies where permission to form businesses and other organizations often requires numerous authorizations and sometimes, official connections. Like many nations with histories of authoritarianism, entrepreneurs in the Kingdom frequently face this challenge.⁵⁹

The significant changes to the framework of subsidies proposed here may challenge the existing businesses of the Kingdom's economic elite. While the King and his advisors have ultimate authority for many decisions, they are believed to be strongly influenced by the long-standing business and family relationships which are the context for much of the Kingdom's economy. Reducing electricity and fuel subsidies may be rational, but it could have negative

consequences for powerful business leaders. It is also likely that reducing popular subsidies will generate a negative backlash from many in society generally.

In addition, the large number of guest workers currently in the country, as well as additional ones that would likely be needed to implement these recommendations, could also be a political challenge. Due to their limited economic and political rights, these workers could over time pose challenges to the current political institutions in the Kingdom. Depending on how their interests were addressed, they could become an unsettling political force in the Kingdom.

Feasible elements

Expanding its political inclusiveness could be pursued as a very long-term goal to be addressed obliquely; rather than attempting to build politically-difficult civil society institutions directly, additional emphasis could be placed on economic empowerment, and beginning to lower the obstacles necessary for business formation and other barriers to innovation. Over time, this may encourage individuals to advocate for other inclusive civil society institutions.

In the near-term, making changes to the social and cultural fabric of the Kingdom is probably not feasible. This includes changing the power structures that flow from the religious leaders and the role of women in society. However, these issues could receive attention and over time, changes could be made to expand the economic options and productivity of citizens, as outlined above.

The major elements of the strategy, including expanding production of both oil and gas, emphasizing efficiency, and opening the oil sector to more private and foreign involvement are believed to be feasible.

Strategic outlook

Based on the Kingdom's current apparent strategy, a forecast of tactics, responses, and risks is presented in the Appendix.

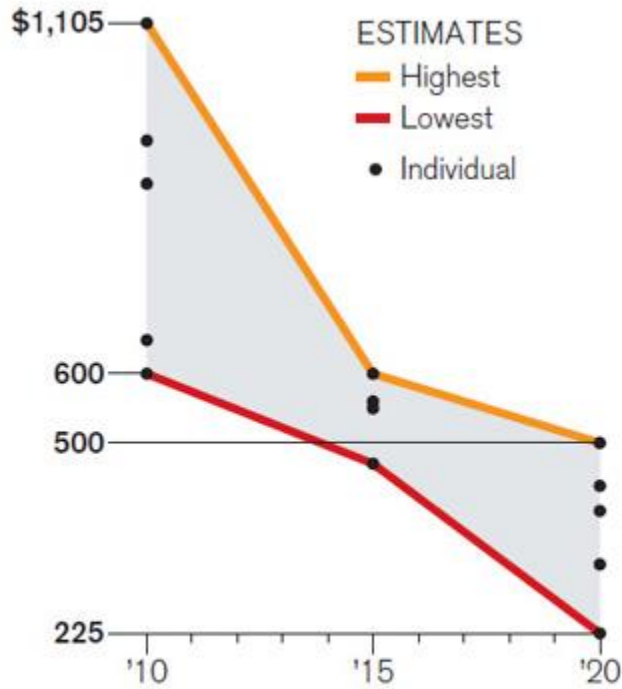
Recommendation and Conclusion

It is recommended that the country begin a long-term program to wean itself from oil as its primary source of economic activity. With high oil prices making this difficult, it is believed that the Kingdom's long-term interest lies in proactively pushing oil prices down, in order to prolong its viability as a fuel source, maximize long-term profits, and provide increasing incentives to government and private decision-makers to diversify the Kingdom's economy.

Unlike other oil producing countries, the Kingdom has the ability to unilaterally act to eliminate many of the risks it faces. If the projected falling petroleum demand from transportation occurs, the Kingdom will have diversified its economy in order to become more sustainable. Even if electrification of transportation does not become commonplace over the next 50 years, this strategy will be beneficial, as the Kingdom will continue to earn significant petroleum profits, and these policy changes would cause its economy to become significantly more productive, create more jobs, and be subject to lower price volatility risks.

Appendix

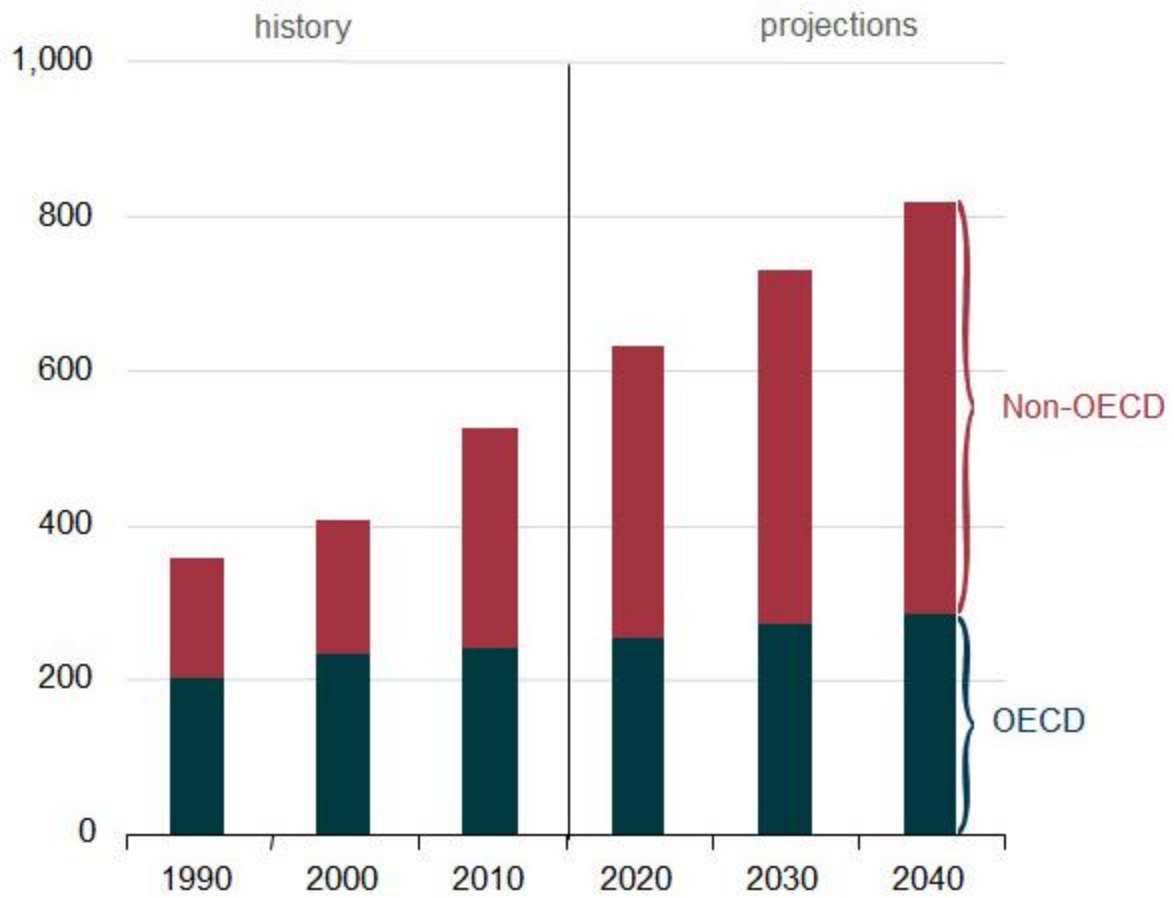
Figure 1. Estimates of electric-vehicle battery costs (in \$ per kilowatt-hour)



Sources: *Advanced Automotive Batteries, Boston Consulting Group, Deutsche Bank, Electrification Coalition, National Research Council, and Pike Research*

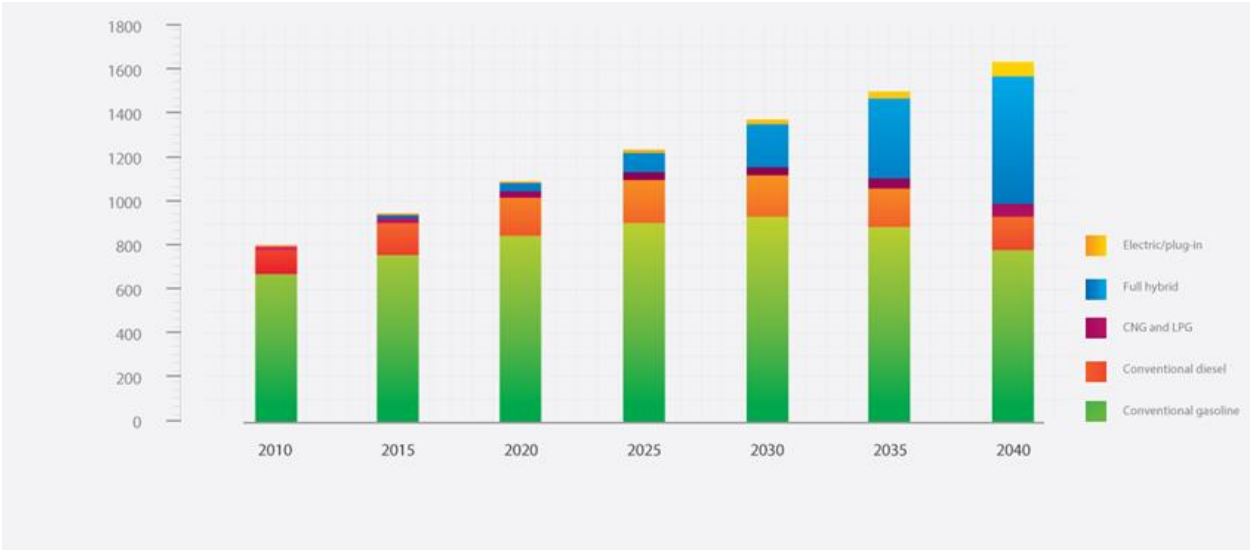
Source: "How Much And How Fast Will Electric-Car Battery Costs Fall?" *Green Car Reports*, John Voelcker, Mar 16, 2012. http://www.greencarreports.com/news/1074183_how-much-and-how-fast-will-electric-car-battery-costs-fall

Figure 2. World energy Consumption 1990-2040 (in quadrillion BTUs)



Source: "International Energy Outlook 2013," *US Energy Information Administration*, July 25, 2013. <http://www.eia.gov/forecasts/ieo/>

Figure 3: Light-duty fleet by type (in million cars)



Source: “2014 Outlook for Energy,” ExxonMobil Corporation.
<http://corporate.exxonmobil.com/en/energy/energy-outlook/energy-demand/transportation>

Strategic outlook

Continue current strategy	10 years	30 years	50 years	Notes
Tactic				
Oil production	Maintain	Maintain	Increase	As demand drops from transportation, pressure will build to increase supply to sustain gov't revenue.
Investment in alternate energy sources	Low	Moderate	Moderate	As domestic energy consumption continues rising, alternate energy sources will become more important.
Invest in the Kingdom's productivity/ education/ infrastructure	Moderate	Moderate	High	Continue investing moderate amount. In long-term, pressure will rise to make investments as oil revenue declines.
Carbon taxes (domestic level and foreign support)	Low	Low	Low	No intention to take public position on carbon taxes.
Invest in foreign oil projects	Low	Low	Low	No intention to pursue operations to foreign locations.
Foreign operations in the Kingdom	Low	Low	Low	No intention to open operations to foreign operators.
Result/impact (vs. current)				
Global				
Global oil prices	Mild growth	Mild decline	Decline	Demand for oil as transport fuel is declining significantly in 30-50 year timeframe
EV/hybrid penetration	Low	Moderate	High	As EV technology improves, adoption rates in the medium and long term are likely to increase.
Viable substitute energy supplies for oil	Low	Moderate	High	Rising LNG production and transportation, renewables and use of smart grids likely to make electricity increasingly viable substitute for oil.
Global carbon taxes	Low	Moderate	High	Implementation of carbon taxes around the world is increasingly likely in the long term.

Political pushback from other oil countries	Low	Low	Low	Steady production unlikely to upset fellow OPEC and other oil producers.
Oil as share of transport fuel	Steady	Mild decline	Decline	Despite rise in demand from developing world, efforts to switch to cleaner fuels will slow growth in petroleum demand.
Domestic				
Saudi GDP	Moderate growth	Steady	Decline	With shift away from oil for transportation, GDP will be under increasing pressure.
Domestic oil prices	Steady	Mild growth	Growth	Pressure will build to export more oil to maintain government revenue.
Gov't revenue from oil	High	Moderate	Moderate	Govt revenue will start to be outpaced by demands from population growth and domestic spending
Govt revenue from non-oil sources	Low	Low	Moderate	Without increasing investment, economy will remain attached to oil.
Social spending	Moderate	Rising	High	Population growth will increase need for social spending and domestic energy subsidies
Saudi economic diversity	Low	Moderate	Moderate	Pressure will build to diversify.
Domestic employment	Mild increase	Mild increase	Decline	As govt profit from oil declines, ability to subsidize employment in other sectors will fall.
Share of oil in petrochemicals	Low	Low	Moderate	In long-term, petrochemicals will increase as share of total oil consumed, as transportation demand falls.
Risks				
Price collapse	High	High	High	As demand drops from transportation, risk of price shocks will grow.
Price volatility	High	High	High	As demand drops from transportation, risk of price shocks will grow.
Domestic social unrest	Low	Moderate	High	Stagnant employment and falling social spending increase likelihood of instability.

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