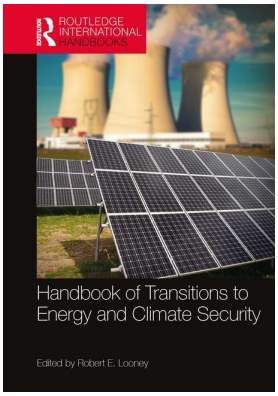

Handbook of Transitions to Energy and Climate Security

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In the furnace

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In the furnace

Saudi Arabia and the dynamics of global climate change

James A. Russell

Saudi Arabia sits the middle of the world's climate furnace – there are few hotter, drier places on the planet. It's only going to get even hotter and drier throughout Saudi Arabia and the Middle East over the rest of the century as the world continues to dump carbon into the atmosphere. Since 1995, the world's atmosphere has seen carbon amounts increase from 360 parts per million to an estimated 400 parts per million by 2015. The world's atmosphere has never had more carbon in it.[1] Some researchers estimate an increase in temperature of 3 degrees Celsius throughout the Middle East by 2050. According to climate change researchers, the Arabian Peninsula eventually will become too hot for people to remain outdoors for more than six hours at one time. Writing in the journal *Nature Climate Change*, Jeremy Pal and Elfatih Elfatir categorically state "… by the end of the century certain population centres in the same region are likely to experience temperature levels that are intolerable to humans owing to the consequences of increasing concentrations of anthropogenic greenhouse gases (GHGs)."[2]

As if on cue, other "canary in the coal mine" indicators have emerged pointing to inexorable climate change trends in Saudi Arabia and the wider Middle East. As noted by *New York Times* columnist Tom Friedman, a heat index temperature of 163 degrees Fahrenheit was reported in the Iranian city of Bandhar Mahshar on July 31, 2015, described by a weatherman at the time as "one of the most extreme readings ever in the world."[3] Meanwhile, in the midst of its war with the Islamic State, Iraqi citizens in Baghdad rose up in spontaneous protest at the inability of its government to deliver enough electricity to keep the city's air conditioning humming to deal with the intolerable heat. As noted in a poignant report describing every-day life in Baghdad during the summer of 2015, "the lucky ones drive around in their cars with the air conditioning on, visit shopping malls, or wait for the air coolers to switch on and huddle around them in a single room. Those without that wherewithal find cool where they can, sometimes swimming in dirty, sewage-tainted pools and canals."[4]

Elsewhere in September 2015, Israel experienced its worst sandstorm since records started being kept – a storm that was almost certainly made worse by abandoned farmland in Syria as a result of an ongoing drought and debilitating civil war.[5] During the storm, air pollution in Jerusalem reached 173 times the national average and power usage in the country broke all national records as Israelis tried to keep cool in the searing heat.[6] The same storm produced

high winds and torrential rains in Mecca, Saudi Arabia and undoubtedly played a role in the collapse of a crane that killed 107 and injured 238.[7] Elsewhere in the region, Iran remained in the grip of a seven-year drought as reservoirs throughout the country sank to new lows.[8]

It would be easy to think of these extreme cases as scenes created for Hollywood movies, but in fact they will become the future norm, regardless of the December 2015 Paris Agreement. These summer 2015 snapshots provide a view into the challenges that await Saudi Arabia and the wider Middle East as the world inevitably gets hotter and its ecosystems become ever more stressed. The tidal wave of looming environmental stresses adds yet another systemic factor to a region already being torn asunder by four civil wars, failed states, dangerous regional balance of power politics, militant Islamic extremism, massive displaced refugee populations, military interventions by outside states, and oppressive governments seeking to rein in their citizens' demands for different forms of governance. All in all, it's a scenario for the perfect storm of a wider and destabilizing long-term regional crisis. Indeed, the world may be seeing only the opening phase of that crisis that promises to get progressively worse as the political and environmental stresses converge and multiply over the rest of the century. The storm will indeed break in Saudi Arabia and the Middle East if it has not already.

This chapter examines the case of Saudi Arabia as the world attempts to systemically address the issue of climate change and the associated challenges of environmental stress as it seeks to control the release of carbon into the world's atmosphere. As noted at the outset, while Saudi Arabia sits in one of the hottest pieces of real estate in the world, it similarly sits in the hot seat of the global debate over how to control the release of carbon into the world's atmosphere. There can be no effective global accord to limit carbon emissions without the agreement of Saudi Arabia (and its Gulf State neighbors) – an agreement that the Saudis understandably show little enthusiasm for. The chapter will address the dimensions of the environmental changes unfolding on the Arabian Peninsula and the wider Middle East, Saudi Arabia's strategic dilemma in responding to these environmental stresses, the politics of climate change and energy markets, and the implications of these issues for regional security and stability.

The gathering storm

To state the obvious, Saudi Arabia is located in the Middle East and is subjected to the same environmental stresses that are common to the region. Indeed it is hard to think of many environmental stresses that aren't present there. As poignantly noted by researchers writing in 2009: "the Arab countries are in many ways among the most vulnerable in the world to the potential impacts of climate change, the most significant of which are increased average temperatures, less and more erratic precipitation, and sea level rise (SLR), in a region which already suffers from aridity, recurrent drought and water scarcity."[9] These are systemic, cross-regional problems that will affect life throughout Saudi Arabia and the Middle East.

The region is already getting hotter. The year 2010 was the hottest year since data started being collected in the late 19th century, and five Arab countries set new high temperature readings in 2011.[10] It is not just going to get a lot hotter in the Middle East; it's going to become even drier in a region today that already contains less than 1% of the world's fresh water resources. The summers will get hotter and winters shorter and drier, with annual rainfall forecast to decrease by as much as 20% over the rest of the century. Some estimates suggest that annual rainfall may decline by as much as 50%.[11] All but six of the Arab countries of the Middle East suffer today from water scarcity, defined by the World Bank's minimum requirement of individuals having access to 1,000 cubic meters per year of fresh water. What little fresh water there is above ground will decline significantly by the end of the century. Higher temperatures

will see a reduction of water runoff of 10% by 2050 at the same time that demand for fresh water is forecast to increase by 60% over the same period.[12] Two of the region's major aboveground fresh water sources, the Jordan and Euphrates rivers, are forecast to see dramatically decreased water flows by the end of the century. Those aboveground water sources that remain will be severely stressed by pollution and decrepit public works infrastructures. Researchers estimate that several cities in the Middle East lose as much as 40% of their fresh water due to leaky pipes.[13]

The story of the region's underground sources of fresh water isn't any better. Underground aquifers are being sucked dry by growing, fresh-water hungry societies. In war torn Yemen, for example, the capital of Sanaa and its projected population of over 4 million may exhaust its ground water supplies by 2025. Some sources estimate that as much as 50% of Yemen's population of 24 million already does not have access to safe drinking water.[14] Iran is in the midst of what some describe as an epic water crisis as a result of persistent drought and disastrous water management practices. It has exhausted 70% of its groundwater supplies over the last 50 years.[15] Jordan and Saudi Arabia are sucking an estimated 9 billion cubic meters a year from Disi/Saq aquifers – water that has been underground for tens of thousands of years that has also been found to contain potentially dangerous levels of naturally produced radiation.[16] Today, an estimated 50% of Saudi Arabia's freshwater comes out of the ground. In short, the region's already scarce natural supplies of water through rainfall and aquifers are drying up.

The region is running out of fresh water at the same time as it will have to start coping with the threat of SLR, that will further stress fresh water supplies due to salt water intrusion. According to the Intergovernmental Panel on Climate Change (IPCC), the average rate of sea level increase has doubled since 1993 to an annual rate of 3.2 millimeters a year. Researchers forecast annual increases in sea level of 16 millimeters a year by 2081. By the end of the 21st century, the world's oceans may rise a total of 1 meter as areas in the Arctic and Antarctic inexorably melt.[17] Egypt is the regional state most vulnerable to SLR, although the Gulf States also will not be immune. An estimated 6% of Egypt's GDP is at risk with an SLR of 1 meter. Qatar, Kuwait, and the United Arab Emirates are also particularly vulnerable to SLR over the rest of the century. Qatar's land area could be reduced by anywhere from 2.6–13% depending on the level of SLR.[18] Saudi Arabia is somewhat less vulnerable than its GCC neighbors to this phenomenon, although it too will see its coastlines change dramatically with the rising waters.

Two systemic stresses must also be added to the cauldron of environmental problems: population growth and urbanization. For centuries, the Middle East and North Africa population hovered around 30 million, reaching an estimated 60 million early in the 20th century. Since, then the region has experienced one of the most rapid population growth rates in the world. By 1950, the region's population reached 100 million.[19] The region's population today is estimated to total between 340 and 350 million and is projected to increase to 588 million by 2050.[20] The region's population growth rates are slowing from their rates of the mid-20th century, but the bow wave of population growth will break over the region during the next quarter century.

Like the rest of the world, the Middle East is in the midst of a systemic change in the distribution of its population between rural and urban areas. Populations around the planet are leaving the countryside and moving to cities – a process over the last 60 years that has occurred at a dizzying and unprecedented pace.[21] In 2007, more people lived in cities than in the countryside for the first time in history. By 2050, the United Nations estimates that world will see one-third of its population live in rural environments, two-thirds in cities – reversing the disposition of the world's population as recorded in middle of the 20th century.[22] The movement of these populations will introduce a variety of political, economic and social stresses in

societies everywhere, but particularly in the developing world. Historically, the process of urbanization is associated with sweeping political, economic, cultural, and social transformation in the affected societies. These transformations are not always peaceful.[23]

In the Middle East, an estimated 56% of the region's population currently lives in urban centers. That percentage is expected to rise to 75% by the middle of the century. Persistent drought and hotter temperatures will help speed the growth of the region's cities, as agrarian subsistence farming becomes untenable. The emptying of Syria's countryside due to the extreme drought between 2006 and 2009 is a window in the future of what awaits other societies in the region.[24] The move to the cities from the country will also see a decrease in the production of food, making regional societies ever more dependent on food imports. The shift of the region's populations from rural environments to cities will hardly be an orderly process. Indeed, newly arriving urban inhabitants will find themselves in cities with inadequate, dilapidated and aging infrastructures, overcrowded housing, and governments already struggling to provide water, electricity and basic social services. In Cairo, for example, the city's population is expected to double by the middle of the century, reaching 40 million inhabitants.[25] Life promises to be difficult in the region's urban, concrete heat islands where a minority of well off citizens will sit in air conditioned buildings while the less well off will literally bake outside.

According to the United Nations, Saudi Arabia's population is expected to grow from approximately 30 million in 2015 to 40 million by the middle of the century. Over 90% of Saudi Arabia's inhabitants will live in urban areas by 2050.[26] The populations of these urban areas are and will be overwhelmingly youthful. The World Economic Forum estimates that 60% of the Middle East and North Africa population is under the age of 25, with unemployment rates in some states for this group as high as 40%.[27] In Saudi Arabia, 37% of the population is below the age of 14 and 51% is under the age of 25. Youth unemployment is variously estimated at somewhere between 20 and 30%.[28] As a demographic, this group is generally well educated, having passed through the Kingdom's extensive educational system, with as many as 100,000 graduates annually entering the job market. By 2030, Saudi Arabia's labor market will have to accommodate 4 million additional workers. Education received in the Saudi system, however, remains overwhelmingly focused on religion and rote memorization – subject areas of little use in a diversified, private sector driven job market. That job market remains concentrated in the state sector, with what few private sector jobs there are going to foreign nationals. The International Monetary Fund estimates that 60% of Saudi Arabia's labor force totaling 3.3 million people are employed in the public sector.[29] According to the Saudi Arabia Monetary Agency, only 10% of the Saudi labor force works in the private sector.[30]

The Middle East remains systemically vulnerable to the social, political and economic forces unleashed by urbanization. The region's political systems remain controlled by security sector and familial elites with little space for more widespread popular participation and the development of civil societies. To substitute for the lack of private sector development, regional states have created bloated and inefficient government bureaucracies to provide jobs, which, in the petroleum states like Saudi Arabia, are used to distribute wealth to the citizens in exchange for their acquiescence at being ruled by the elites. For example, in Kuwait it is estimated that 90% of the work force is employed by the government. Perhaps most important, the region has not opened up opportunities for women to participate in the economic, social, political, and economic development of their respective states. In a particularly religious and tradition-bound country like Saudi Arabia, it means that the state is receiving almost no economically beneficial contribution from a significant portion of its population – an intolerable and unsustainable situation for a country entering the modern era.

Saudi Arabia's strategic dilemmas and opportunities

Saudi Arabia confronts the region's troubled strategic landscape and faces both opportunities and dilemmas as it attempts to transition to a new economic model and reduce its reliance on carbon. The central strategic problem facing the Kingdom is simply this: it depends on pumping ever increasing amounts of oil out of the ground to keep the ship of state afloat now and for the foreseeable future at a time when the world is attempting to implement a system created under the December 2015 Paris Agreement to limit carbon release that comes from burning fossil fuels. There is an inherent contradiction between trying to slow the increase of the world's temperature and Saudi Arabia's requirement to keep on pumping oil to fund its state and feed the world's growing thirst for oil. At stake is the viability of Saudi Arabia's rentier state, which is built on the premise of distributing wealth from energy sales revenues to its citizens in exchange for their acquiescence in being ruled by the House of Saud without meaningful political representation.[31] The ways in which the Kingdom addresses this contradiction will almost certainly determine the survival of the state as currently constituted and its ruling royal family.

The Kingdom is in a race against time as it simultaneously addresses a series of strategic, political, economic, and environmental challenges:

1 Build and pay for an infrastructure to accommodate its burgeoning population that includes the environmental mitigation and adaptation program.
2 Make the necessary investments and political commitment to diversify its economy away from domination by the public sector. Saudi Arabia needs the private sector to become the engine of economic growth that will provide jobs for an estimated 4 million Saudis that will enter the work force over the next 20 years. One recent study estimates the price tag of these investments could total as high as $4 trillion.[32]
3 Transition from a carbon-based economy to one in which the Kingdom's energy needs are increasingly met by renewable and cleaner energy sources to help enable it to meet its carbon reduction commitments under the Paris accord.
4 Continue to manage the politics of energy markets while simultaneously meeting its commitments to reduce carbon output in such a way that the Kingdom will maintain its relative power and influence around the world.
5 Preserve the shape and identity of the state and the ruling family's position as it manages all the above.

It is difficult to understate the magnitude of these simultaneous challenges, bringing potentially wrenching and even revolutionary changes in a society that is arguably only just beginning to enter the modern era.

It's hard to understate where Saudi Arabia would be today without oil sales revenues. Indeed, it's hard to conceive of Saudi Arabia as anything other than the quintessential petro state. Oil sales revenue today accounts for approximately 85–90% of the government budget, 90% of all export revenues, and 45% of GDP. In 2015, some estimates indicate that oil revenues generated $160 billion of government revenue in a total budget of $223 billion, with $38 billion of that total supported by deficit financing.[33] Saudi revenues are distributed to its citizens in many forms, such as government jobs, generous unemployment benefits, subsidized gasoline, water and housing, and free education and healthcare. The Kingdom spent an estimated $36 billion in 2013 on subsidies for gas, water and electricity.[34] Saudi consumers paid 45 cents a gallon for gasoline in 2015 and received electricity at a fraction of the cost paid by consumers around the world.

During 2015, Saudi Arabia's oil production totaled between 9.75 and 10.3 million barrels per day, an increase of 6% over 2014 levels, reaching a 30-year high in production levels.[35] The Kingdom is thought to have a production capacity of approximately 12.3 million barrels, 2.6 million barrels of which constitutes spare production capacity. No other oil producer has this kind of production flexibility. Saudi Arabia has historically used this capacity to smooth supply disruptions on world markets.[36] The world is expected to continue needing more oil – despite the commitments to limit carbon release. Indeed, the world's continued economic growth depends on access to reasonably priced supplies of energy. According to the US Energy Information Administration, if left unchecked, world demand for oil may reach 120 million barrels a day by 2040,[37] an increase from daily production of 95 million barrels per day in 2015.[38] If this scenario is realized, much of the additional oil needed to keep pace with global demand will come from Gulf State producers, including Saudi Arabia, where oil is much cheaper to get out of the ground than in other oil producing states.

The contradictions between the need for more oil and the need to mitigate climate change are addressed with great clarity in the scientific community. In addition to modeling forecasts about increased temperatures and SLR, recent research conclusively demonstrates that much of the world's vast fossil reserves (coal, natural gas and oil) must be kept in the ground indefinitely if the world is to have any chance of limiting the world's temperature increase to 2 degrees Celsius over the rest of the century. Figures published in the journal *Nature* indicate that as much as 260 billion barrels of oil in the Middle East would have to remain in the ground under such a scenario – roughly the size of Saudi Arabia's estimated oil reserves.[39] Such an outcome would certainly reorder the world's geostrategic map that places Gulf State oil producers at the epicenter of global energy markets, to say nothing of the associated political and economic challenges that would be created in each of the producing states if significant parts of their oil reserves remain in the ground. In the past, Saudi Arabia has demanded that it be compensated for any oil left in the ground as part of an agreement to limit global carbon release.

The strategic dilemma confronting Saudi Arabia is significant, but, importantly, it is better positioned than many of its poorer regional neighbors to withstand the previously outlined systemic pressures. Therein lies the potential for opportunity to sensibly manage the Kingdom's transition from a carbon-based economy to one with reduced fossil fuel income and output. Over the decade of 2003–2013, oil prices skyrocketed from $36 a barrel to $110 a barrel by 2011. The decade saw an unprecedented period of oil-fueled economic growth in Saudi Arabia during which time the Kingdom doubled its GDP to an estimated $750 billion (somewhat larger than Sweden and Switzerland) and became the world's 19th largest economy. GDP grew at an annual rate of 6% over the decade – one of the most rapid rates of growth in the world. Monthly household income increased by 75% from $2,100 to $3,600 and 1.7 million jobs were created (1 million of which were in the public sector) as money poured into the Kingdom's coffers. Moreover, women started to enter the Saudi work force in numbers over the period, reaching an estimated 1.8 million or 18% of the working age female population. Saudi Arabia is today regarded as a high income country with an estimated 2014 per capita GDP of $24,000.[40]

While the House of Saud has a deserved reputation for corruption and lavish lifestyles within its extended family, it must also be pointed out that the family responsibly invested oil sales revenues in the Kingdom's infrastructure during the period. Just as important, the regime also bought down the national debt and put money in the bank. It did not gamble with its money. Unlike much of the rest of the world, Saudi investments remained in conservative instruments during the boom in equities markets in the first half of the decade. As a result, during the world's 2008–2009 financial meltdown, Saudi Arabia remained in a strong financial position, buying down its debt at a time when many other countries underwent grave macroeconomic

crises and had to borrow money to avert economic meltdowns. Over the decade it virtually eliminated its public debt and compiled financial reserves totaling nearly 100% of GDP. A staggering $1.6 trillion was invested in the Saudi economy during the decade, including $300 billion in foreign direct investment (mostly in the petroleum sector). McKinsey & Co. estimated that by 2015 the state had compiled $1.4 trillion in financial and other assets. Approximately $450 billion was spent in national development projects over the decade on transportation infrastructure, healthcare, the education system, and social welfare support. Electrical generation capacity was increased by 32%. Eighty-one new hospitals and 20 new universities were created during the period.[41] Mega construction projects like the Kingdom Tower in Jeddah were also launched, which, when completed, will reach 3,300 feet into the sky, making it the tallest building in the world.

In addition to infrastructure investment, the flexibility provided to the House of Saud by the stockpile of cash was dramatically illustrated during the uprisings around the region during the Arab Spring in 2011. To forestall potential unrest, the regime pumped another $130 billion into the country's economy virtually overnight in the form of higher salaries and bonuses for government workers, increased unemployment benefits, additional housing, and more mosques for the country's powerful religious establishment. An estimated $70 billion alone was spent on 500,000 low-income housing units.[42] The windfall has also provided the Al-Saud with political leverage over its neighbors. In a reversal of fortune from the bitter disputes of the 1960s Nasser era, Saudi Arabia has pumped an estimated $6.5 billion into the teetering Egyptian economy following the toppling of the Muslim Brotherhood government by the security services in 2013.

Environmental mitigation and adaptation investments figured prominently in the spending spree over the decade. Indeed, it is no exaggeration that the oil boom is funding one of the longest running and largest environmental mitigation programs ever attempted in history. At the top of the list is Saudi Arabia's investment in desalinated water production. The Kingdom consumes nearly 7 billion cubic meters a day, 50–60% of which is desalinated. Annual demand for water is growing at 8% a year. The Saline Water Conversion Corporation operates 36 plants that produce an estimated 3 trillion cubic meters of water a day, which provides 50% of the Kingdom's water and 70% of all water consumed in cities.[43] In 2014, the Kingdom brought the $7.2 billion Ras al-Khair plant into production – the world's largest desalinization plant. When completed, the plant, located northwest of Jubail, will produce 264 million gallons of fresh water per day (1.025 million cubic meters) as well as 2,600 megawatts of electricity. In 2014, the Kingdom invested an estimated $4.4 billion in desalinization projects.[44] Saudi Arabia will need an additional $53 billion in investment and an additional 20–30 new desalination plants over the next 15 years to meet projected demand for water.[45]

Unsurprisingly, Saudi Arabia will need more electricity in the years ahead. According to the Energy Information Administration, the Kingdom in 2013 began bumping up against its power generation capacity, estimated at 58.4 gigawatts. Air conditioning accounts for 70% of electricity demand, which is forecast to steadily increase, as the region gets hotter.[46] Saudi Arabia's inhabitants consume an estimated nine times more electricity per capita than their surrounding neighbors.[47] Saudi Arabia will need to generate an additional 35 gigawatts in electricity capacity over the next 15 years, requiring an investment up to $120 billion both to add to and modernize inefficient and aging turbine systems. Some estimates suggest that the Kingdom will have to double its power generating capacity over the next 20 years to 120 GW.[48] Up until now, Saudi Arabia has used oil and natural gas to power its electricity generating system, helping to fuel a steep increase in domestic energy consumption. Saudi Arabia today has one of the highest per capita energy consumption rates in the world. It currently consumes 25% of all the oil it

produces, with internal consumption projected to grow at 7% annually. Saudi Arabia is expected to triple its domestic oil consumption over the next 15 years. If current trends continue, one study estimates that the Kingdom could become a net oil importer by the middle of the century. Depriving the Kingdom of its principal source of income could have potentially cataclysmic consequences.[49]

Diversification of energy sources figures into the Saudi approach. To help lead the effort, the Kingdom established the King Abdullah University of Science and Technology located on the Red Sea North of Jeddah. In May 2012, the Kingdom announced an ambitious 20-year $109 billion plan to generate 41 gigawatts of electricity through a new solar program, which would meet between 25 and 30% of its needs. In parallel, it sought to generate another 21 gigawatts in geothermal and wind power. There is virtually no human or industrial infrastructure in the Kingdom to execute and/or support a program of such magnitude. Perhaps unsurprisingly, the projects have been delayed. In January 2015, Hashim Yamani, president of the King Abdullah City for Atomic and Renewable Energy, the royal agency established to oversee renewable energy policy, delayed the projects by 8 years, stating: "We have revised the outlook to focus on 2040 as the major milestone for long-term energy planning in Saudi Arabia."[50] Under even the most optimistic of scenarios, renewable energy sources will provide no immediate relief from the Kingdom's overwhelming dependence on oil and natural gas as sources for power.

The Kingdom also has taken steps to increase energy efficiency. In December 2014, it announced the imposition of minimum fuel/mileage standards for new and used vehicles and light trucks and automobiles imported into the Kingdom. The standards, based on US Corporate Average Fuel, are to be phased in between 2016 and 2020. As part of the National Energy Phase II program launched in partnership with the UN Development Programme, the Kingdom launched a campaign to have energy efficiency ratings on all new air conditioners and replace aging and inefficient units still in use.[51] As many as 50,000 non-compliant air conditioning units have been seized and destroyed by the government under the joint government-United Nations program.[52] Last but not least, Saudi Arabia has adopted international building codes standards that make thermal insulation mandatory in all new building construction across the Kingdom's 23 cities.[53]

The politics of energy and climate change

Saudi Arabia has been seen around the world as one of the biggest impediments to a global deal to limit carbon output. During negotiations in Copenhagen in November 2014, one observer estimated that the Saudis were responsible for 40% of all the objections in the sessions.[54] Most recently, the Kingdom led a group of 22 nations that successfully lobbied nations to prevent the adoption of more aggressive climate change objectives. According to many observers, Saudi Arabia worked hard to water down the text throughout the final COP 21 negotiations in Paris in December 2015. It has also resisted pressures to contribute to a fund to help poorer developing countries shoulder the costs for climate mitigation efforts. Nonetheless, Saudi Arabia has signed on to the December 2015 Paris agreement of 195 nations.

Under terms of commitments made to the treaty as its Intended Nationally Determined Contribution, or INDC, submitted in November 2015, Saudi Arabia seeks to reduce carbon emissions by 130 tons annually by 2030. The plan offered no specifics on how its carbon reduction commitments will be met and offered no numeric benchmarks through which to judge its progress or lack thereof in meeting its targets. In 2012, Saudi Arabia was rated as the 14th largest emitter of greenhouse gases in the world, totaling an annual release of 572 metric tons, or 1.2% of the world's total.[55] The Saudi INDC submission stated: "The Kingdom will

engage in actions and plans in pursuit of economic diversification that have co-benefits in the form of greenhouse gas (GHG) emission avoidances and adaptation to the impacts of climate change, as well as reducing the impacts of response measures."[56] The Saudi submission also vaguely warned that its emission targets would be adjusted between 2016 and 2020 if the Paris agreement creates an "abnormal" burden on the Saudi economy.[57] The plan acknowledges the link between climate mitigation and adaptation efforts and high levels of oil exports. In addition to pursuing economic efficiencies and diversified economic growth, the plan calls for Saudi Arabia to develop carbon capture and utilization technology. The plan calls for the Kingdom to build the world's largest capture and use plant, capable of purifying 1,500 tons of carbon per day that will be recycled back into the country's growing petro-chemical industry. Another initiative calls for the insertion of carbon into underground oil reservoirs. Using a technology called Carbon Dioxide-Enhanced Oil Recovery in a demonstration/pilot project, 40 million cubic feet of carbon dioxide will be captured, processed and injected into the Othmaniya oil reservoir as part of pilot project to determine the feasibility of the idea.

By recent standards, the Saudi submission to the Paris accord is significant, since it has been seen as one of the major roadblocks to any attempt to limit carbon release. It was accused by some observers of trying to wreck the whole deal, staunchly refusing to support more stringent actions to limit temperature increase targets to 1.5 degrees Celsius, baulking at the idea of trying to decarbonize the world's economy by the middle of the century, and demanding compensation for potential lost revenues from oil income.[58] The German organization Climate Action Tracker remained unimpressed by the Kingdom's INDC submission, referring to it as "inadequate," and among the worst plans in the world. The organization caustically stated that: "If all countries adopted this level of ambition, global warming would be likely to exceed 3–4 degrees Celsius this century."[59] The organization particularly criticized Saudi Arabia for refusing to establish any baseline levels for carbon emissions through which to measure progress and/or the lack thereof.

The politics of Saudi Arabia's approach to the Paris negotiations remain inextricably intertwined with the politics of international energy markets. As negotiators gathered in Paris to negotiate limits on carbon release, Saudi Arabia's oil production and exports reached an all-time high. In the arena of energy markets, Saudi Arabia has been playing a different sort of politics. After lining its coffers with oil averaging $110 a barrel between 2011 and 2014, prices tumbled to $50 in 2015, cutting Saudi oil revenues and those of other producing states by more than half. Breaking with its past practice of cutting production to restore price stability, the House of Saud instead opened the oil spigots, repeatedly ignoring the entreaties of its OPEC oil-producing partners. While on the one hand tumbling oil prices hurt the Kingdom's short-term revenues, lower prices serve a number of broader strategic interests. Conventional wisdom suggests that Saudi Arabia's refusal to moderate supply is a way to politically pressure oil dependent geopolitical rivals in Tehran and Moscow and to drive more expensive producers from the market to preserve Saudi market share.

Oil prices north of $100 a barrel helped stimulate a glut in world oil production in places like Canada and the United States, where it became economical to produce shale oil in ever increasing quantities. These additional oil supplies also importantly threatened Saudi Arabia's share of world oil markets, particularly in the world's fastest growing markets in Asia. By March 2015, for example, the US production of shale oil reached 5.3 million barrels per day, helping the dramatic overall increase in US oil production that reached a 40-year high of 9.4 million barrels per day in May 2015. There is some evidence that US shale oil producers are feeling the pinch, with production slated to decline in early 2016. Some analysis suggests that the Saudis

are successfully preserving their market share around the world with their refusal to cut production.[60]

Pressuring high cost producers, however, represented only one objective, according to some analysts. Various analysts argued that a deeper and more profound fear drove Saudi actions – a leveling off of the global demand for oil.[61] According to this point of view, higher oil prices not only brought the more expensive oil onto the market, they also reduced demand for oil and further encouraged the move to renewable sources of energy. The slowing demand for imported oil in China was particularly concerning to Saudi officials, some of whom believe that depressing oil prices actually buys Saudi Arabia and its OPEC partners more time in averting what would be a disastrous leveling off of global demand in a higher priced market.[62]

Another line of analysis suggests that Saudi Arabia is attempting to maximize income from a commodity that will gradually recede in importance as the world transitions to a non-carbon based future. This argument suggests that the Saudis recognize that the inexorable move towards limits on carbon emissions will mean that some portion of their most valuable commodity – oil – will have to remain in the ground.[63] The essential logic of the argument is that any barrel of oil sold at a profit, however small, is more valuable than one that is not. Oil that remains in the ground eventually will cease to have value – a disastrous outcome for the Kingdom. Preserving the primacy of their market share would thus allow the Saudis to maximize the value of their commodity.

Strategic and policy implications

As noted at the outset of this chapter, Saudi Arabia sits in the middle of an already unstable region. Political and environmental challenges promise to continue multiplying throughout the Middle East over the rest of the century. Saudi Arabia will not be immune from the troubles of its neighbors whose societies are already fractured by sectarian politics and civil war. The Saudis will feel the political and strategic heat as the region's climate continues its inexorable climb up the temperature scale.

Whatever the Saudi motivations in their strategies to simultaneously manage the politics of energy markets and climate change, it is indeed a delicate balancing act with profoundly important strategic implications for the future of the Kingdom and the future of the planet. As noted at the outset of this chapter, the survival of the Saudi rentier state and the future of the house of Saud may depend on their ability to successfully perform this balancing act. The Kingdom is in a race against time in its attempt to preserve an economically and politically viable state that can survive the transition to a post-carbon future. The assessment in this chapter is that the rentier model cannot be indefinitely sustained as limits on carbon emissions become a global reality, although it is uncertain whether and/or how fast the House of Saud will take steps in this direction.

The economic pressures on the Kingdom are clear. It needs to continue pumping oil for at least the next couple of decades to generate the revenue needed for investment in infrastructure to accommodate its growing population. There is no substitute for oil income over the near term. The Kingdom needs more of everything and must figure out how to pay for it: electricity generating capacity, freshwater desalination plants, housing, public transportation and road systems, health care, and education – to name but a few of the claimants on Saudi resources. As previously noted, the Kingdom's strong financial position is a good start to meet the daunting economic challenges over the next quarter century.

Perhaps more difficult is the parallel political challenge that must also be addressed if the state is to move from the rentier model to one in which the private sector drives economic growth.

The domestic political challenges are complex and varied. If the political leadership attempts to develop a viable and vibrant private sector, it will be asking more of its citizens in a state where subsidies for energy, education, healthcare and public sector jobs are slowly but surely reduced. The work force will no longer be able to live off handouts from the regime and rely on public sector jobs, and receive religiously focused education.

A new and better-educated Saudi work force comprised of men and women will be needed if a viable private sector is to be developed to drive the Kingdom's economic growth. Restrictions on the participation of women in the political, economic, and cultural life of the Kingdom will have to be relaxed in this future. Opening up opportunities for women and changing the country's education system to give Saudi workers the skills they need will require the House of al-Saud to take on domestic political stakeholders like the religious establishment, which has been empowered and funded in the oil era.

Managing this transition as the world slowly but surely clamps down on carbon production and consumption adds another layer of complexity to an already difficult situation. Saudi Arabia has done a good job in slowing down the world's progress towards a climate accord, but the commitments made in Paris represent the opening attempt to limit emissions in the world's carbon producing countries. Saudi Arabia can survive for a time through oil revenues, but its days as a profligate welfare-spending state are slowly but surely coming to an end.

For much of the 20th century, Saudi Arabia and the Middle East served as a strategic epicenter for the West's own economic and strategic security. Cheap and readily available Saudi and Gulf State oil helped support a century of relative political stability and sustained economic growth. Saudi Arabia was the "prize" in the regional constellation, a role embraced by the House of Saud as it fashioned its security partnership with the United States to protect it from its outside enemies.[64] Outsourcing its external protection to the US suited the al-Saud as it focused on building a peaceful and stable internal political order. In some senses, the al-Saud always correctly foresaw that the most significant challenges to the state came not from external enemies but from internal ones. It remains unclear just how relevant that security system will be in the future as the challenges to the internal stability of states throughout the Middle East multiply in the years ahead. The wisdom of the House of Saud's prescient choices all those many decades ago will certainly be on trial over the next quarter century as the state confronts nothing less than a transformation of the Kingdom's society if it is to survive into the next, and hotter, century.

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