CHAPTER 1: CLIMATE CHANGE

INTRODUCTION

This chapter provides an overview of the impacts on Qatar and the Gulf Cooperation Council (GCC) region from climate change, the economic implications of global action to reduce GHG emissions on fossil fuel consumption, and the economic challenges and opportunities of climate change policies. The chapter concludes with recommendations as to how Qatar can develop a comprehensive approach to climate change that can make a meaningful contribution to reducing its GHG emissions, taking into account its economic interests in a way that leverages Qatar's strengths in focused areas of clean energy technologies to drive climate change solutions for Qatar, the GCC and the world.

CLIMATE CHANGE: ITS IMPACTS AND CHALLENGES

According to the 2013 Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5), "warming of the climate system is unequivocal," and the rate of increase of global carbon emissions in the first decade of the 21st century has been more rapid than predicted.[6] The report also notes that concentrations of greenhouse gases have increased and that each of the last three decades has been successively warmer than any preceding decade since 1850.[7] In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1,400 years. In addition, the report concludes that it is extremely likely that human activities caused more than half of the observed increase in global mean surface temperature from 1951-2010. The report goes on the say that "human influence on the climate system is clear and has been detected in the warming of the atmosphere and the ocean, in changes to the global water cycle, in reductions of snow and ice cover, in global mean sea level rise and in changes to some climate extremes."[8] In terms of future warming, IPCC scenarios show global surface temperature change by the end of the 21st century exceeding 1.5°C in all but one scenario. The report also points out that warming will continue beyond 2100 under all scenarios apart from one.[9]

A June 2013 World Bank report on climate science, *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*, stresses that a global increase of 4°C by the end of the century remains a real risk. The report outlines the latest scientific evidence as indicative that current levels of greenhouse gas emissions and future emissions trends will lead to higher 21st century emission levels than previously projected.[10] The report also reaffirms the International Energy Agency's 2012 assessment that, in the absence of further mitigation action, there is a 40 percent chance of warming exceeding 4°C by 2100 and a 10 percent chance of it exceeding 5°C in the same period.[11] The updated United Nations Environment Program (UNEP) *Emissions Gap Report*, released at the UNFCCC Conference of Parties in Doha in December 2012 (COP18), found that current emission trends and pledges are consistent with pathways that will reach warming of 3.5°C to 5°C by 2100.[12]

According to the IPCC AR5, the effects of this level of temperature increase would likely include extreme weather patterns, a substantial rise in sea levels and desertification of large swaths of land.[13] The effects of temperature increases also include an increase in the annual mean precipitation at high latitudes and the equatorial Pacific Ocean, and a decrease in water resources in the mid-latitudes, tropics and semi-arid areas (e.g., the Mediterranean Basin, western United States, southern Africa and northeastern Brazil).

These impacts are expected to trigger migration accompanied by unforeseeable political tensions and potential conflict over strategic natural resources such as water.[14] A 2010 United States Department of Defense report also concluded that climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation and the further weakening of fragile governments. The report stated that climate change will contribute to food and water scarcity, will increase the spread of disease, may spur or exacerbate mass migration, and may act as an accelerant of instability or conflict.[15] Climate change will also increase the risk of species extinction and reduce marine ecosystem and fishery productivity.[16]

Climate Change Implications for the Gulf Cooperation Council Region

Climate change in the Gulf region will have environmental, economic, political and security implications. The Arabian Peninsula is characterized by great variability in seasonal and annual precipitation, as well as extreme temperatures. Combined with rising population levels,[17] climate change will aggravate existing challenges of water scarcity and food security, and raise new challenges through adverse impacts on human health, economic development and the environment.[18]

For instance, regional average temperature increases of 1.8°C by 2040 and 3.6°C by 2070 combined with decreasing precipitation exacerbate the already high levels of desertification in the region, further reducing the availability of arable land and water resources and leading to a higher incidence of drought.[19] These effects will occur in a region with fast-growing populations, the lowest levels of water supplies per capita globally, and high water-consumption rates.[20]

The impact of climate change on rising sea levels will also affect coastlines and marine life in the region and could threaten coastal desalination plants that are an increasingly important source of water for the GCC region. Rising sea levels in the region will increase the salinity of underground water supplies, degrading the land further and reducing regional biodiversity. The low-lying coastal zones of Bahrain, Kuwait, Qatar and the United Arab Emirates, where much of the countries' populations and industries reside, as well as the various artificial islands in the Persian Gulf, will be particularly vulnerable to sea level rise. The projected rise in temperatures and incidence of drought are also expected to increase the frequency of dust storms and sand dune movements, and increase soil erosion. In addition to further exacerbating existing stresses on water supplies, climate change will contribute to air pollution and have negative health impacts.[21]

Climate Change Implications for Qatar

Climate change will impact Qatar by enhancing ecological and physical vulnerabilities as well as economic vulnerabilities. According to Qatar's 2011 National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), climate change presents a dual threat:

"On one hand, like other developing countries with minimal adaptive capacity, Qatar's ecological and human systems are prone to the adverse impacts of climate change. On the other hand, due to its total dependence on the export of carbon-based resources, Qatar's economic welfare and prosperity depends on the outcome of the climate change negotiations which seeks, as an ultimate objective, complete phase out of fossil fuel energy sources from the world energy market."[22]

In terms of physical vulnerabilities, arid regions with high climatic variability like Qatar will experience major effects from climate change. Qatar's annual mean temperature has increased by 0.3°C over the last 40 years according to Qatar climate records,[23] and decreasing levels of precipitation are predicted for the region.[24] Additional physical vulnerabilities exist in the water and agriculture sectors, energy sector, public health, coastal zones and marine environment.

- **Water and agriculture sectors:** Demand for water in Qatar is rising at a rate of 12 percent annually, stemming mainly from industry and population growth as well as an increase in irrigation for agriculture. Domestic water consumption is estimated at 675 liters per capita per day and is met through desalination plants.[25] The combination of increased temperatures and no increase in rainfall will likely result in further desertification and water scarcity. Increased pressure on the desalination process will contribute to increased energy consumption and further GHG emissions.[26]

- **Energy sector:** As the most important sector of the economy, the energy sector will be adversely affected by temperature increases and sea level rise. The majority of the oil, gas, power and water facilities are located either offshore or along the coast. Increases in air and sea water temperature will influence the design values for power and desalination facilities.[27]

- **Public health:** Climate change will result in thermal stress and air quality impacts in Qatar, causing increases in incidences of heat exhaustion and heatstroke cases. Desertification and increases in the concentration of suspended particulate matter will lead to respiratory problems among children, asthmatics and the elderly. Current levels of ozone and photochemical oxidants in Qatar are already high, raising public health concerns that have the potential of worsening with climate change.[28]

- **Coastal zones:** A large proportion of Qatar's industrial investments are located along the coast and offshore, including upstream and downstream oil and gas facilities, petrochemicals factories, oil and gas export terminals, and power- and water-generating facilities. Even small changes in the sea level pose serious threats in terms of land inundation and coastal erosion, impacting population settlements and aquatic resources.[29] According to the Maplecroft Climate Change Vulnerability Index, Qatar is one of three countries, along with Kuwait and Bahrain, in the Arabian Gulf exhibiting "extreme" vulnerability to sea level rise. They have estimated that Qatar is susceptible to inland flooding with 18.2 percent of its land area and 13.7 percent of its population at less than 5 meters above sea level.[30]

- **Marine environment:** Because the Gulf waters surrounding Qatar are shallow, any small increase in temperature will have a profound influence on coastal and marine life. From a climate change perspective, the most vulnerable marine species in Qatar are mangroves, sea grass and corals.[31] Due to limited water exchange, a characteristic of the Arabian Gulf, the sea water is prone to temperature extremes. As a result of high sea temperatures, coral bleaching events occurred in 1996, 1998, 2002 and 2012,[32] thus reducing living coral to as little as 1 percent in shallow areas. Along with the loss of coral is a significant decrease in fish stocks and species richness.[33]

CLIMATE CHANGE AND ENERGY

The Energy Mix in Qatar and the GCC

The largest share of GHG emissions in the Gulf countries originates in the energy sector from electricity and heat production. Approximately 40 percent of the world's proven oil reserves and 23.6 percent of the world's proven gas reserves are located in the Gulf. Oil and gas exports from GCC countries represent approximately 73 percent of total export earnings, roughly 63 percent of government revenues and 41 percent of GDP.[34]

Qatar has the world's third largest natural gas reserve, and its proven reserves of oil were the 13th largest in the world at the end of 2012. Qatar is also a member of OPEC and is a significant net exporter of oil and gas. Although only producing liquefied natural gas (LNG) since 1997, Qatar is now the world's largest exporter and a member of the Gas Exporting Countries Forum (GECF). In 2011, Qatar exported over 4,200 billion cubic feet (Bcf) of natural gas, of which over 80 percent was LNG primarily to Asia and Europe. According to official OPEC data, Qatar was the 10th largest total liquids exporter among the 12 OPEC members in 2011.[35] The oil and gas sector accounted for 58 percent of Qatar's 2011 GDP.[36]

The economic importance of oil and gas makes Qatar and other GCC countries economically vulnerable to global efforts to reduce greenhouse gas emissions.[37] Modeling by the IPCC and OPEC[38] find that, like other OPEC member countries, Qatar's economy would be adversely impacted by measures adopted by industrial countries to reduce their GHG emissions. Specifically, a shift by large economies toward increased fuel efficiency and the development of electric cars could lead to reduced global demand for oil. For example, tighter fuel economy standards have recently been introduced in the U.S., the EU and China,[39] and countries have recently signaled their support for the development of electric vehicles through production and sales targets, and subsidy policies.[40] In addition, "breakthrough" technologies such as longer battery storage could further reduce demand for fossil fuels.

Additionally, a successful outcome from the international climate change negotiations that includes global targets for reducing GHG emissions will further reduce consumption of fossil fuels.[41] However, the projected decrease in Qatar's oil exports and revenues is slightly less than the estimates made for the rest of OPEC countries, due to Qatar's large natural gas reserves and related exports, and its' successful diversification away from oil.[42] As countries introduce policies to encourage a shift away from using coal (mainly in electricity production), coal production is likely to be replaced by natural gas-fired electricity production. This replacement is already happening in the U.S. where the low price of natural gas combined with Environmental Protection Agency (EPA) regulations that make it practically impossible to build any new coal-fired electricity plants has already resulted in increased gas-fired electricity generation. This replacement, combined with increased use of natural gas vehicles (NGV)—powering about 112,000 vehicles in the U.S. and roughly 14.8 million vehicles worldwide[43]—has led to consumption of natural gas in the U.S. increasing by 11 percent between 2009 and 2012.[44] And U.S. natural gas consumption is projected to increase by 23 percent between 2012 and 2040.[45] Moreover, in the U.S., growth in global demand for natural gas[46] combined with strong U.S. domestic production and low natural gas prices relative to other global markets[47] have led to an increase in total U.S. natural gas exports by 63 percent between 2008 and 2012.[48] This example of the growth in natural gas points to potential export growth for Qatar and other gas-producing states in the region leading to a shift away from coal.

Greenhouse Gas Emissions in Qatar and the GCC

Although GCC countries are not the world's largest emitters in terms of total GHG emissions and total GHG emissions per GDP, several Gulf countries fall in the top 10 emitters in terms of GHG emissions per capita (see Table 1).[49]

Table 1: GCC country-specific GHG emissions data, excluding land use, land use change and forestry						
	Total GHG emissions (Millions of tons CO_2 equivalent)	**Global rank**	**Total GHG emissions per GDP** (Tons CO_2 equivalent/ million $GDP)	**Global rank**	**Total GHG emissions per capita** (Tons CO_2 equivalent per capita)	**Global rank**
Saudi Arabia	542.1	18	1573.8	26	19.89	21
UAE	256.4	33	1323.0	37	30.37	9
Kuwait	196.5	39	1294.9	38	65.68	1
Oman	90.4	58	961.8	60	32.26	8
Qatar	74.7	66	806.0	76	42.69	5
Bahrain	34.9	95	608.4	104	27.87	12

World Resources Institute (2010) Climate Analysis Indicators Tool.

For instance, Qatar is the world's fifth largest per-capita emitter, with the bulk of emissions generated by the energy sector (96.5 percent, as shown in Table 2). Qatar relies on oil and natural gas for its primary energy consumption. Almost half of energy-related emissions come from electricity and heat production from gas-fired electricity generators. Industrial processes are the second largest source of GHG emissions in Qatar, generated by the production of cement, steel, ammonia and urea, methanol, methyl tertiary butyl ether (MTBE) and plastics.[50] The transportation sector (comprising road transportation at 88 percent and civil aviation at 12 percent)[51] is the key driver of growth in oil demand, though along with waste, generates the smallest share of GHG emissions in Qatar (see Table 3 for a detailed breakdown). Qatar's GHG emissions will continue to increase as a result of increased production and expanded operations in the oil and gas sector.

Table 2: Sources of GHG emissions by sector (expressed as a percentage of total emissions)					
	Energy	**Industrial processes**	**Agriculture**	**Land use change and forestry**	**Waste**
World	71.6	5.5	13.7	5.9	3.3
Saudi Arabia	87.4	5	2.7	N/A	4.9
UAE	92	4.8	1.1	N/A	2
Kuwait	98	1.3	0.2	N/A	0.4
Oman	94.6	3	1.3	N/A	1
Qatar	96.5	3.5	0.2	N/A	0.6
Bahrain	86.6	2.2	N/A	N/A	11.1

World Resources Institute (2010) Climate Analysis Indicators Tool.

Table 3: Sources of GHG emissions from energy sub-sectors in GCC countries (expressed as a percentage of the total emissions from these sectors)					
Energy sub-sectors	**Electricity & heat production**	**Manufacturing & construction**	**Transportation**	**Other fuel combustion**	**Fugitive emissions**
World	42.8	18.6	17.8	12.9	7.9
Saudi Arabia	54.4	18.6	23.9	1.2	1.8
UAE	33.3	36.3	14.3	3.7	12.4
Kuwait	30.4	6.4	6.2	0.3	56.8
Oman	30.1	10.4	7.3	3.7	48.5
Qatar	46.2	24.4	12.6	3.1	13.6
Bahrain	52.1	29	14	1.2	3.7

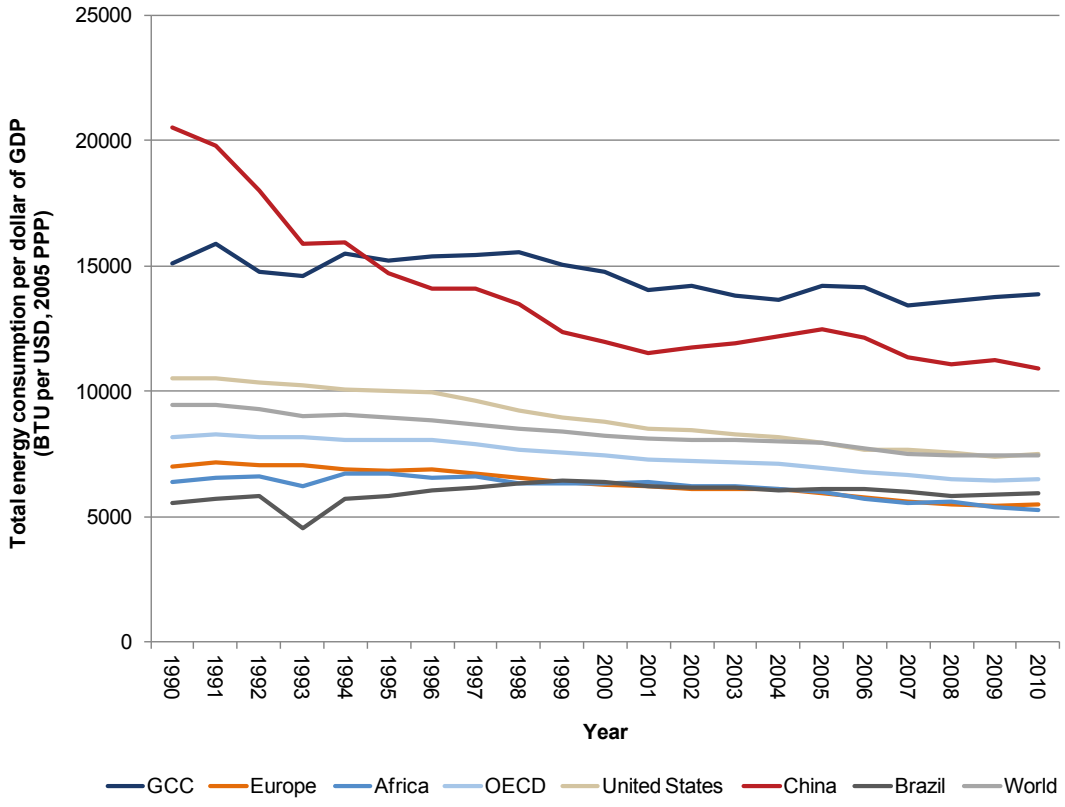
World Resources Institute (2010) Climate Analysis Indicators Tool.

In fact, GCC-wide, the energy sector is the main source of greenhouse gas emissions. Moreover, it is energy used for the production of electricity that drives the majority of emissions. However, in some countries—such as the United Arab Emirates (UAE)—the manufacturing sector is the most significant source of emissions, while most greenhouse gas emissions in Kuwait come from fugitive emissions. The GCC countries' demand for electricity has increased at three times the global average over the last few years due to higher-than-average economic growth rates and huge development projects in the infrastructure sectors, particularly in Saudi Arabia and Kuwait. Consumption of electricity is also high as a result of government energy subsidies, which lead to free electricity in Kuwait and Qatar and very low electricity prices in Saudi Arabia, Bahrain and Oman.[52]

Energy consumption in Qatar and the GCC is also placing increasing pressure on domestic energy supplies. Additionally, the GCC region has the highest energy intensity in the world, and this trend is not expected to change as GCC countries increasingly rely on energy-intensive desalination plants.[53] High levels of consumption combined with robust population and economic growth—30 percent and 56 percent, respectively, from 2000 to 2020—will see energy demand increase over the next decade (Figure 1).[54] And greater domestic consumption of energy will mean that less is available for export. In fact, demand for electricity, which is typically generated by domestic gas, is already outstripping supply in some GCC countries and is expected to rise by 7 to 8 percent per year on average in the coming decade.[55] On current consumption patterns, Saudi Arabia will import about 248 billion liters of gasoline and diesel over the next 10 years, which, at current prices, is worth about $170 billion.[56]

These energy consumptions patterns in the GCC highlight the challenges and opportunities for the region in reducing GHG emissions. As Table 1 shows, Qatar, the UAE, Kuwait and Bahrain have some of the highest per capita CO_2-equivalent emission rates in the world. At the same time, these patterns suggest that there are low-hanging fruit—mitigation options at the low end of the McKinsey Greenhouse Gas Abatement Cost Curve—where measures such as improving waste recycling, building insulation and energy efficiency could have a significant impact on GHG emissions and provide economic benefits.[57]

Figure 1: Trends in energy intensities in different world regions (total energy consumption per dollar of GDP, in BTU per 2005 USD in purchasing power parity)



U.S. EIA (2013) International Energy Statistics.

ACTION TO ADDRESS CLIMATE CHANGE

International Climate Change Initiatives

International efforts to address climate change have been underway for the past few decades under the UNFCCC, as well as in other bilateral and multilateral arrangements. These negotiations have resulted in agreement on a political goal of limiting temperature increases to 2°C above preindustrial levels.

UNFCCC discussions in Copenhagen in 2009 resulted in a non-binding, political declaration of intent for future emission reduction targets, known as the Copenhagen Accord. Significantly, the accord represented a new paradigm where countries agreed to pledge targets (for developed countries) and nationally appropriate mitigation actions (for developing countries) on a bottom-up and voluntary basis. Over 140 countries indicated their support and more than 80 countries provided national mitigation targets

or actions. In terms of financial contributions, countries agreed on short-term financing of $30 billion to 2012 and $100 billion in long-term financing by 2020. Subsequent negotiations have resulted in the launch of a second commitment period to the Kyoto Protocol, from 2013 to 2020, and the agreement to negotiate a global agreement with "legal force under the Convention applicable to all parties"[58]—the Durban Platform for Enhanced Action (ADP). This would replace the Kyoto Protocol, cover all countries, be agreed upon by 2015 and implemented in 2020.

However, these negotiations have so far met with only limited success in reaching agreement on commitments by countries to reduce their greenhouse gas emissions consistent with this goal. Recent analysis from the United Nations Environment Programme (UNEP) showed that even if nations meet their current climate pledges, greenhouse gas emissions in 2020 are likely to be 8 to 12 gigatons of CO_2-equivalent ($GtCO_2e$) above the level needed to have a good chance of remaining below 2°C by 2020 on the lowest cost pathway.[59] Similarly, the IPCC's AR5 outlined a carbon budget based on how much CO_2 the world could emit in the future without temperatures rising more than 2°C. The analysis underscored that the amount of carbon the world can burn without heading for dangerous levels of warming is far less than the amount of fossil fuels left in the ground, and at current rates, this "budget" would be exhausted within 30 years.[60]

Parallel to the UNFCCC, climate change issues are being discussed in other groups. The main ones include the Major Economies Forum (MEF), the Group of Twenty (G-20) and the Clean Energy Ministerial (CEM). The Major Economies Forum is a meeting of the largest greenhouse gas emitting countries[61] that seek to address some of the challenging issues of reducing greenhouse gas emissions. The G-20 comprises the world's 20 largest economies[62] and has provided leadership on issues such as climate financing and fossil fuel subsidies. The Clean Energy Ministerial[63] is a global forum for sharing best practices and promoting policies and programs that encourage and facilitate the transition to a global clean energy economy.

While there have been some concerns that these forums might undermine the UNFCCC negotiations, an alternate view is that these forums complement the negotiations by enabling the countries most responsible for greenhouse gas emissions and for financing its mitigation to engage in candid dialogue free of UNFCCC politics, to align parallel domestic initiatives and regulatory approaches, and monitor each other's progress. Progress on climate change issues has been made in these forums.[64] For example, the G-20 agreed to phase out fossil fuel subsidies, which according to the International Monetary Fund (IMF) could reduce global GHG emissions by 13 percent, or 4.2 billion tons.[65] The MEF has developed a Global Partnership on Clean Energy Technologies, which resulted in the creation of 10 "technology action plans" by different countries, outlining the mitigation potential of high priority technologies, highlighting best practices, and suggesting actions countries can take to advance development and deployment of low-carbon technologies.[66]

Climate change issues are also being addressed by a range of other international actors whose primary mandates do not explicitly include climate change. For instance, within the United Nations system alone, some 20 agencies work on climate change-related issues. The implementation of climate change projects is also spread across institutions such as the United Nations Environment Programme (UNEP), the Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and the World Bank.[67]

National Climate Change Actions

Progress globally in addressing climate change also needs to take into account national-level (or even sub-national-level) climate change action. Such action is being driven by concern about the environmental costs of climate change and a goal of developing low-carbon alternatives to fossil fuel energy sources that, in addition, to reducing greenhouse gas emissions, create jobs, develop potentially significant new industries and increase energy security.

For instance, the United States is undertaking state-level action that includes California's emissions trading scheme introduced in 2012 as well as regional efforts to promote emissions trading such as the Western Climate Initiative and the Regional Greenhouse Gas Initiative. Twenty-nine of 50 U.S. states have also adopted renewable portfolio standards (RPS)—accounting for more than 42 percent of electricity sales in the United States. For example, the California RPS has a mandate to expand its renewable portfolio by 33 percent by 2020, and the Colorado RPS was recently updated to a renewable portfolio of 30 percent by 2020 from 20 percent and is anticipated to create an additional $4.3 billion in state revenue.[68] Additionally, Congress established the Advanced Research Projects Agency-Energy (ARPA-E) in 2009 with a focus on transformational energy projects with the potential for advancement with a modest investment. Projects are chosen for their potential to radically improve U.S. economic prosperity, national security and environmental well-being.[69]

China's 12th Five-Year Plan, adopted in 2011, includes policies to reduce the country's energy intensity and CO_2 intensity by 16 percent and 17 percent, respectively, by 2015, and seven regional carbon trading pilot projects are being developed with the goal of gradually establishing a national trading system. The plan also includes renewable energy targets and incentives as well as energy efficiency standards. China's other incentive policies, including the Golden Sun program, which provides financial subsidies, technology support and market incentives to facilitate the development of the solar power industry; and the Suggestions on Promoting Wind Electricity Industry in 2006, which offers preferential policies for wind power development.[70]

South Korea is another country focused on developing a clean technology sector. South Korea's 2009 Framework Act of Low Carbon Green Growth includes provisions for renewable energy incentives and tax shifts to encourage low-carbon economic development. In 2012, the government announced an emissions trading scheme (ETS), which will be implemented in 2015, and has committed to reducing its GHG emissions by 30 percent compared to business as usual by 2020. Energy efficiency policies have been developed to complement the emissions reduction target, and the government is pursuing several strategies in the transport and building sectors, for example, fuel efficiency standards and building design codes. In July 2009, Korea announced a new fuel economy standard for car manufacturers and importers of 17 km per liter, or CO_2 emissions of 140 g per km, by 2015, and a performance-based energy code, which limits total energy use per unit area and was applied to all commercial buildings over 10,000 square meters in July 2011.[71] This is a sample of how countries are using climate change policies to reduce GHG emissions and develop clean technology sectors.

Qatar's Climate Change Initiatives

Qatar is taking a range of actions to reduce its greenhouse gas emissions and to position itself as a leader in the development of climate change and clean energy technologies. Qatar ratified the Kyoto Protocol in 2005 and submitted an initial National

Communication to the UNFCCC in 2011.[72] In 2012, Qatar demonstrated its leadership role and support for global action on climate change action by hosting the 18th Conference of Parties (COP18) to the UNFCCC.

Qatar has also taken a leadership role on climate change in the region and twice hosted the Doha Carbon & Energy Forum (DCEF), a workshop-style conference hosted by the Qatar Foundation, Qatar Petroleum and ExxonMobil and featuring regional, Qatari and international experts from the GCC region's industries, academia and governments. The forum focuses on generating policy recommendations for industry and government on climate change, alternative energy, energy efficiency, and carbon capture and storage.

Domestically, Qatar has a renewable energy goal of sourcing 20 percent of the country's total energy from renewable sources by 2024. The mitigation measures described in the National Communication are also outlined in Qatar National Vision 2030 and include the following initiatives: Qatar Petroleum's corporate objective of achieving zero gas flaring; the state of Qatar's membership in the World Bank greenhouse gas reduction program through its Global Gas Flaring Reduction Partnership;[73] the establishment of formal institutions to manage climate change issues (e.g., the National Committee for Climate Change, a national body tasked with formulating climate policy); the development of public transport systems, including the investigation of electric taxis and compressed natural gas buses, and plans for a mass transport network; and the initiation of a national team on "environmental policies for renewable energy." Qatar also has a national plan for energy efficiency, optimization and resource utilization (QPEERU), which will serve as a driver for the GHG mitigation initiatives under the UNFCCC.[74]

Qatar is also undertaking a range of measures to address environmental challenges that will strengthen its resilience and capacity to adapt to climate change. This includes initiatives by Kahramaa, the national water authority, to reduce the loss of desalinated water and to encourage water recycling and reuse.

Climate Change Technology Development

As noted, developing clean technology should be a focus for Qatar given its resources and opportunity to develop technologies that address specific climate change challenges for Qatar and the GCC, and which could be commercialized globally.

In terms of research and development, Qatar launched the Center for Climate Research during COP18, in partnership with the Potsdam Institute for Climate Impact Research (PIK), with the purpose of studying global climate change and its impacts on ecological, economic and social systems. The institute will work to address remaining knowledge gaps by focusing, in particular, on arid regions—where 2.5 billion people live—and the subtropics. A second key effort of this partnership will be the launch of a Global Climate Change Forum to provide a platform for like-minded countries to work together and create innovative climate change strategies. Stakeholders such as non-governmental organizations with international reach and expertise in the field will also be involved.

Other GCC countries are also providing leadership in the areas of climate change and clean energy, with the creation of a number of research institutions. For example, the UAE has established the Dubai Carbon Center of Excellence and the Masdar Institute of Technology, which focus on alternative energy and environmental engineering. Saudi Arabia has its Center of Research Excellence in Renewable Energy.

Additionally, in 2007, Gulf countries in OPEC pledged $750 million (including $150 million from Qatar) to a new fund to tackle global warming through research for a clean environment, and find technological solutions to climate change, notably carbon capture and storage.[75] The following chapters provide more detailed information on the range of research activities that can contribute to Qatar's climate change and energy goals.

RECOMMENDATIONS

Qatar's climate change action is a combination of firm targets, the most significant being the renewable energy goal and aim for zero gas flaring, which accounts for about 12 percent of Qatar's emissions.[76] Qatar plans on generating 20 percent of its energy from renewables by 2024, and have 1,800 MW of installed green capacity by 2020.[77] Other action is future orientated, such as reducing the energy intensity of electricity consumption, establishing mandatory sustainable building criteria and measures on transportation, and creating legislation under the National Committee for Climate Change (NCCC). Taken together, these actions constitute a blueprint for a comprehensive climate change policy. The following outlines the steps Qatar should take to position itself as a leader in the region on action to reduce GHG emissions and that will underpin the development of clean energy technologies.

Get the Policy Framework Right

It would be beneficial for Qatar to develop a more comprehensive climate change policy under a strengthened National Committee for Climate Change, taking care to consult with stakeholders from government, industry and academia. Experience developing climate change policy in other countries has demonstrated the need for comprehensive understanding of the reasons for these actions to ensure their sustainability and support over time. This is particularly important as the growing impacts of climate change and the failure so far of global efforts to respond will likely require even more stringent and costly mitigation action in the future.[78]

A comprehensive climate change policy framework should include mitigation and adaptation action, and a strategy for engaging with international fora on climate change in ways that strengthen and support Qatar's domestic climate change framework.

Creating a single government agency or an effective interagency process with overall responsibility for climate change issues resting with an identified body would be an important institutional development for Qatar. It would ensure that the impact of climate change action on all economic sectors is fully taken into account. And by providing the decision makers with information on economy-wide impacts and opportunities should ensure an optimal set of climate change policies.

Several countries and regions have already established climate change ministries, including Belgium, Denmark, the EU, Greece, New Zealand, Niue, Romania, Pakistan, Scotland and the United Kingdom. These climate change ministries have been established because the economy-wide implications of climate change policy requires coordination and input across ministries. For example, the U.K. created the Department of Energy and Climate Change (DECC) in 2008 to take over some of the functions related to energy from the Department for Business, Enterprise and Regulatory Reform and those relating to climate change from the Department for Environment, Food and Rural Affairs.[79] Similarly, the Directorate-General for Climate Action (DG-CLIMA) was established by the European Commission in 2010, shifting climate change policy responsibility from the Directorate-

General for Environment. Its mandate is to lead international climate change negotiations, develop and implement legislation to help the EU deal with climate impacts and meet targets for 2020, and implement the EU Emissions Trading Scheme (EU-ETS).[80]

Appropriate Targets and Actions

Qatar has already adopted an economy-wide renewable energy target. The next step will be identifying the suite of renewable energy most suitable for Qatar—more information on Qatar's alternative energy activities is available in Chapter 4 of this report.

Qatar could also enhance these efforts by exploring the scope for both an energy efficiency target and carbon intensity target as other advanced developing countries have done, such as China and India. For instance, an economy-wide energy efficiency target would underpin specific efforts to improve energy efficiency and incentivize investment in developing energy efficient technologies (see Chapter 3 on energy efficiency).

All of these actions should be designed to put Qatar's GHG emissions on an optimal pathway. Such a pathway will need to take into account what other countries of comparable economic development are doing, consider global expectations for mitigation action from Qatar and how this will change over time, and think over how Qatar can use climate change policy to incentivize developments in the energy sector in particular that can produce economic benefits (additional to avoiding the cost of climate change). For instance, reduced domestic energy consumption as a result of energy efficiency improvements will free up gas for export.

The challenge for Qatar will be to reconcile its climate change and environmental sustainability goals with its further development of the energy sector consistent with developing clean energy technologies. For Qatar and the GCC, climate change issues are very much energy issues. And, as discussed, reducing global GHG emissions consistent with achieving the goal of limiting temperature increases to 2°C above preindustrial levels will require reduced consumption of fossil fuels. This creates economic challenges for Qatar and the GCC given their economic dependence on the extraction and export of fossil fuels. However, given Qatar's natural gas resources, the country can play a leadership role in demonstrating the climate change benefits of switching to gas over more carbon-intensive fossil fuels such as coal. Leadership in this area could include developing methodologies comparing greenhouse gas emissions from natural gas and those from coal in electricity generation. In this context, Qatar's goal of zero flaring can help demonstrate the clean energy potential of natural gas, and could lead to developing technologies and know-how that Qatar can export to other gas-producing regions.

Even though current estimates are that natural gas produces approximately 50 percent fewer GHG emissions than coal,[81] achieving a global goal of keeping global warming at 2°C above pre-industrial levels will require, over time, transitioning electricity sectors away from natural gas to renewable energy.[82] Qatar can respond to the 2°C goal now by contributing to the development of both CCS—which can allow for the burning of fossil fuels in a carbon constrained world—and the development of renewable energy technologies (see Chapter 2 on CCS).

Financing Climate Change Action and Clean Energy Technology Development

As part of a broad response to climate change, Qatar should develop a fund to finance mitigation and adaptation projects as part of its comprehensive climate change policy framework. Such an initiative could support domestic climate change and energy goals such as the development of renewable energy projects and climate change technologies. A national climate change fund could follow the model of Brazil, which has established the Brazilian Climate Fund, capitalized by revenues from a special tax on oil production.[83] This model could play an important demonstrative role in the region and, in this regard, any such fund could be expanded into a GCC-wide initiative. By setting up its own national climate fund, Qatar could attract international finance for domestic investments in clean technology and generate revenues through the taxation of existing resources such as in the oil and gas sector.

Further, such a fund should be linked with international climate financing efforts. International climate change finance is channeled through multilateral funds such as the Global Environment Facility (GEF), Climate Investment Funds (CIFs) and Adaptation Fund, as well as through bilateral channels.[84] By either contributing funds to CIF initiatives in other countries or regions or receiving CIF funding for domestic projects, Qatar could guarantee its membership on the CIF's Trust Fund Committee, the body that oversees the operations of the fund, provides strategic direction, and approves and oversees programming and projects.[85] Although it is currently restricted from supporting CCS projects, the Clean Technology Fund (CTF) under the CIFs is relevant to Qatar as it finances projects and programs that contribute to demonstration, deployment and transfer of low-carbon technologies with a significant potential for long-term greenhouse gas emissions savings.[86] Involvement in such international financing initiatives could potentially advance Qatar's ambitions to be a leader in low-carbon technology development.

Developing Climate Change Technologies

Qatar and the GCC region have substantial resources and R&D capabilities that can be used to address climate change. The country's capacity to develop climate change technologies is a key strength and could create new markets for Qatar both regionally and at the international level as a leader in low-carbon technologies.

- **Create a domestic enabling environment:** An important driver of the development of climate change technologies will be Qatar's domestic climate change policy. In this regard, climate change policy should provide the right incentives for the development and deployment of low-carbon technologies.[87] For example, clear targets for renewable energy, CCS and energy efficiency goals will signal to investors an opportunity to develop climate change and energy technologies. Policy certainty is another key factor affecting the investment climate. One need look no further than Australia, where, as a result of the anticipated repeal of the Carbon Pricing Mechanism, "businesses are delaying strategic decisions or investments because they are uncertain about the future existence of a carbon price or the structure of any alternative carbon policy, particularly in the short-term", and "the [...] Government must provide longer-term regulatory certainty in the pricing of carbon [to] incentivize business to reduce carbon emissions in the most efficient way and support the transition to a low carbon economy."[88] And in a 2011 survey of U.S. businesses, most respondents cited ambiguity in government support as the key risk associated with low-carbon investments.[89]

Qatar should consider ways to develop greater policy certainty such as locking in its climate change and clean energy commitments by making a political pledge for a post-2020 emission reduction target under the UNFCCC.

- **Develop bilateral cooperation:** Qatar should develop further bilateral cooperation on clean technology, similar to the initiative mentioned above by the Potsdam Institute for Climate Impact Research, and involve both government ministries and research institutions. This could be modeled on bilateral partnerships such as the U.S.-China clean energy partnership, which comprises clean technology energy projects between U.S. Department of Energy laboratories and the Chinese Academy of Sciences on enhanced oil recovery (EOR) for CCS, biomass gasification, and syngas;[90] and the U.S.-China Clean Energy Research Center (CERC), that facilitates joint clean energy R&D on topics such as building energy efficiency, clean coal (including CCS) and clean vehicles.[91]

  Financial contributions by Qatar (discussed below in more detail) could help underpin these partnerships while providing Qatar with access to cutting edge R&D capacity in the U.S. and elsewhere. For instance, the pledge in 2007 by Gulf countries in OPEC of $750 million (including $150 million from Qatar) to a new fund to tackle global warming through research for a clean environment could be a model for developing international climate change and clean energy research partnerships at a government-to-government level.

  GCC-wide cooperation such as the EU-GCC Clean Energy Network—an instrument for the development of cooperation activities on clean energy policy and technology in the areas of renewable energy sources, energy efficiency, clean natural gas, and carbon capture and storage—provides another avenue through which to pursue international cooperation on clean technologies.[92]

- **Engage internationally:** Qatar also has a stake in discussions at the international level and should therefore ensure that international policy efforts maximize the potential for sharing of knowledge and technologies of mutual benefit, for example, through international research-sharing agreements. Supporting international technology-oriented agreements is crucial and an important complement to other international efforts such as emissions-based agreements.[93]