

Climate Action in the GCC: Current Status and Future Prospects

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Introduction

The UN's Intergovernmental Panel on Climate Change (IPCC) sixth report re-emphasized that we have already caused more than 1°C of heating compared to pre-industrial levels, and likely getting close to the 1.5°C of heating within the next two decades. The report also emphasizes that the warming we've experienced to date is affecting every corner of the planet's land, air and sea already, and extreme weather events - like heatwaves, floods, and droughts - have become more frequent and more intense since the 1950s¹. The Gulf Cooperation Council (GCC) countries—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE)—is no exception from these climate effects. However, given that hydrocarbon resources— with almost 30% of the world's total proven oil reserves and around 20% of its total proven natural gas reserves (BP, 2020)² – have played a crucial role in shaping the GCC economies, the consequences of climate change in the GCC are not restricted to its physical implications. Global efforts to implement climate mitigation measures aiming at reducing greenhouse gas emissions (GHG), especially through policies aiming to reduce fossil fuel consumption could impose direct economic losses on the GCC states (Al-Sarihi and Mason, 2020)³.

Aware of these challenges, the GCC states have progressively joined global forces to addressing climate change. They signed and ratified the Paris Climate Agreement and have submitted nationally determined contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC), in which they set their ambitions to mitigate and adapt to climate change. Importantly, all the GCC have established institutional architectures conducive to climate action and put in place a set of policies and initiatives that help achieving their climate mitigation and adaptation ambitions.

This paper discusses how climate change impacts the GCC states that have special economic condition characterized by heavy reliance on hydrocarbons. It also debates why taking action on climate could have multiple social, economic and environmental co-benefits for the special context of the GCC. The paper also offers an overview of the current climate-related initiatives and programs that support GCC achievement of their climate mitigation and adaptation ambitions.

¹ IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

² BP (2020) Statistical Review of World Energy 2020. Available from: [bp.com/statisticalreview](https://www.bp.com/statisticalreview). [Accessed 27 December 2020].

³ Aisha Al-Sarihi & Michael Mason (2020). Challenges and Opportunities for climate policy integration in oil-producing countries: the case of the UAE and Oman. *Climate Policy*. 20:10, 1226-1241.

Impacts of climate change on hydrocarbon-producing GCC

Given the GCC's special economic conditions characterized by heavy reliance on hydrocarbons, the GCC states are not only exposed to the physical impacts of climate change but also to the consequences of international community implementation of climate mitigation measures especially through policies aiming to reduce fossil fuel consumption.

Physical impacts

The GCC region is expected to warm as twice faster compared to other parts of the world. According to the RICCAR report, all projections indicate that temperatures will rise over the Arab region during this century (Figure 1). The average mean change in temperature for RCP 4.5 shows a projected increase of 1.2 °C–1.9 °C at mid-century and 1.5 °C–2.3 °C by end-century. For RCP 8.5, temperatures increase to 1.7 °C–2.6 °C for mid-century and 3.2 °C–4.8 °C towards end-century. The higher increase at mid-century is shown in inland areas, with the most marked changes projected in the Sahara Desert.

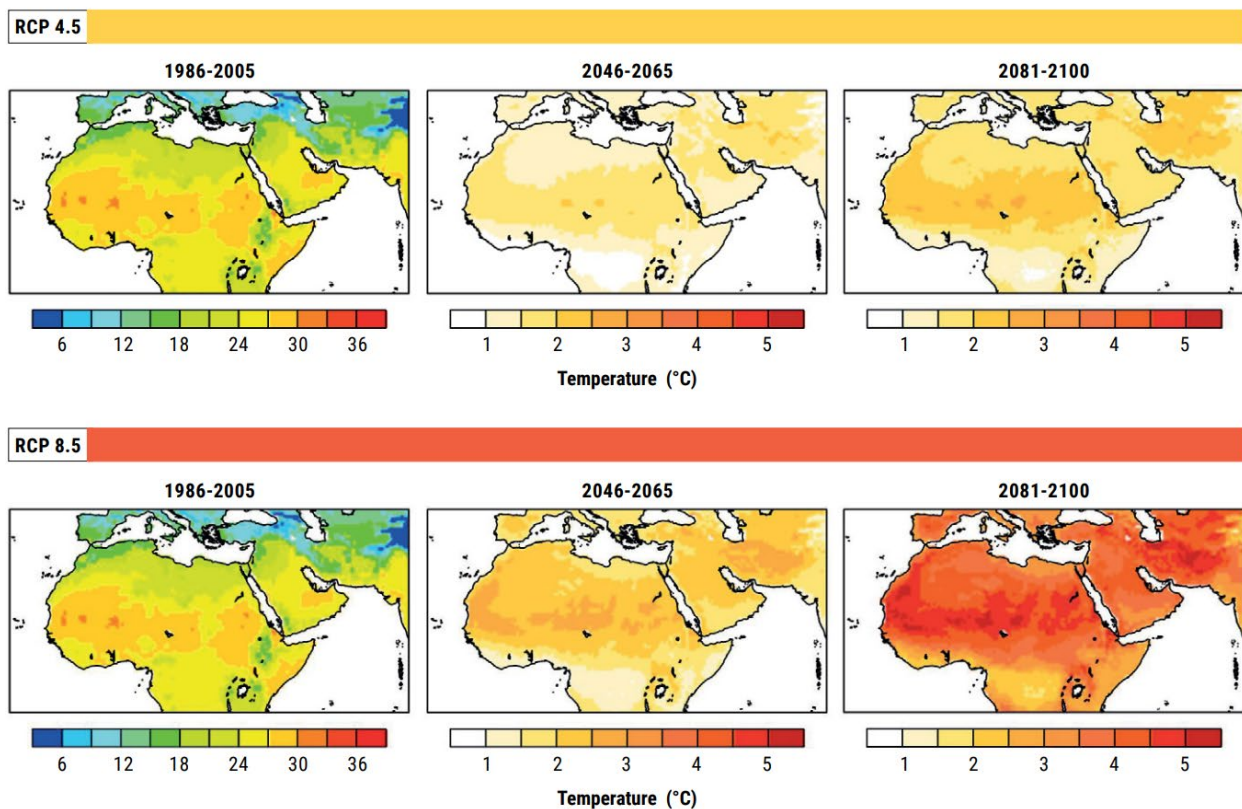


Figure 1 Climate models suggest a rise in temperatures over the Arab region during this century under both RCP 4.5 and RCP 8.5 scenarios. Source: ESCWA et al. 2017⁴

According to the RICCAR report, precipitation trends will be largely decreasing across the Arab region until the end of the century, albeit some limited areas are expected to exhibit an increase in the intensity and volume of precipitation. Projected precipitation changes vary considerably across the Arab Domain with no universal trend for annual or seasonal results. Decreasing precipitation trends can be seen in most of the Arab region towards mid-century (Figure 2). By the end of the century, both scenarios project a reduction of

⁴ United Nations Economic and Social Commission for Western Asia (ESCWA) et al. 2017. Arab Climate Change Assessment Report – Executive Summary. Beirut, E/ESCWA/SDPD/2017/RICCAR/Summary.

the average annual precipitation reaching 90–120 mm/year in coastal areas. This is mainly projected around the Atlas Mountains and in the upper Euphrates and Tigris basins.

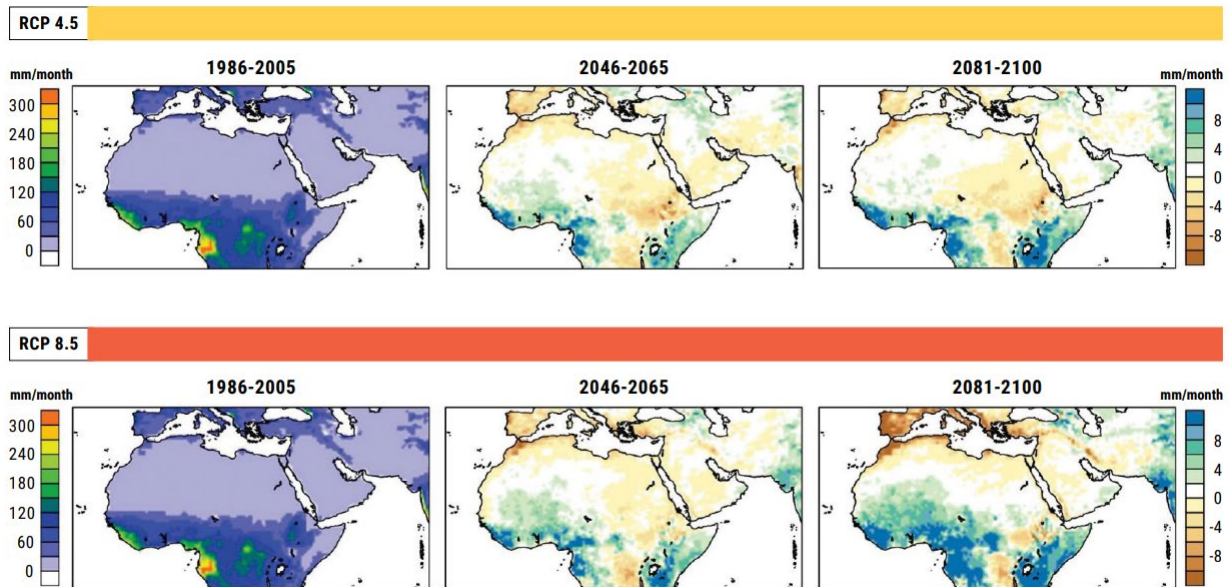


Figure 2 Climate models project a reduction of the average annual precipitation in the Arab region during this century under both RCP 4.5 and RCP 8.5 scenarios. Source: ESCWA et al. 2017⁵

The rise in temperature combined with a reduced in annual rainfall present a challenge to the sustainability and resilience of the GCC non-oil economic sectors such as agriculture, tourism, and infrastructure. Also, the sea level rise and acidification present a challenge to the resilience to coastal areas as well as the fishery sector (ESCWA, 2017; Elsha, 2010). A 2018 study suggests that 3°C warming could cause the GCC large GDP losses of 0.2-0.5% yearly decline after 2027 and 1.5-3% yearly decline from 2067 (Kompas, 2018)⁶.

Like other parts of the world, GCC states are also exposed to extreme weather events such as storms, flooding and wildfires. In Saudi Arabia, examples of extreme rainfall events include the flash floods that hit Jeddah in November 2009 and most recently in October 2018. The 2009 flash flood was described as the worst in the region in 30 years, causing the deaths of more than 150 people and resulting in great economic losses, with damage to more than 7,000 vehicles and 8,000 homes. Over 3.5 inches of rain fell in four hours over an area that normally receives 1.8 inches per year. The flash flood in October caused the deaths of at least 30 people (Mahmoud, 2017)⁷. Oman, with a coast on the Arabian Sea, has been hit by at least four cyclones over the last 12 years alone⁸. Additionally, an unprecedented number of floods have hit the Gulf states, causing severe infrastructure damage, leading to the resignation of Kuwait's minister of public works in 2018 (Al-Sarihi, 2019)⁹.

⁵ United Nations Economic and Social Commission for Western Asia (ESCWA) et al. 2017. Arab Climate Change Assessment Report – Executive Summary. Beirut, E/ESCWA/SDPD/2017/RICCAR/Summary.

⁶ Kompas, T., Pham, V.H. and Che, T.N., 2018. The effects of climate change on GDP by country and the global economic gains from complying with the Paris climate accord. *Earth's Future*, 6(8), pp.1153-1173.

⁷ Mai Mahmoud. 2017. Weathering Climate Change in the Gulf. Arab Gulf States Institute in Washington.

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<https://www.atheer.om/archives/507313/%D9%82%D8%A8%D9%84-%D9%87%D9%8A%D9%83%D8%A7-%D8%AA%D9%81%D8%A7%D8%B5%D9%8A%D9%84-%D8%B9%D9%86-%D8%A3%D8%B9%D8%A7%D8%B5%D9%8A%D8%B1-%D8%B9%D8%AF%D9%8A%D8%AF%D8%A9-%D9%85%D8%B1%D9%91%D8%AA-%D8%B9%D9%84/>

⁹ Al-Sarihi, Aisha. 2019. The Gulf Arab States' Mixed Record on Climate Action. Arab Gulf States Institute in Washington.

Socio-economic impacts

Oil-based economic sectors, which are already vulnerable to oil price shocks, can also be vulnerable to the outcomes of global climate change mitigation measures aiming to keep climate change at a (relatively) safe level. Different organizations such as BP and International Energy Agency (IEA) have published projections about energy demand outlook that is consistent with the objectives of the Paris Agreement. BP Energy Outlook 2020 released two energy pathways that are consistent to Paris Agreement emission reduction targets: Rapid (70% decline in emissions by 2050 consistent with 2C by 2100) and Net-Zero (15% decline in emissions by 2050 consistent with 1C). In both scenarios, while the primary energy demand is expected to rise by 10%, the share of hydrocarbon will decline from 80% in 2018 to between 70-20% by 2050 (BP, 2020)¹⁰. The IEA in its Net Zero Emissions Scenario, oil demand will have to fall by almost 75% between 2020 and 2050, a decline from 88 million barrels per day (mb/d) in 2020 to 72 mb/d in 2030 and to 24 mb/d in 2050, in order to bring global energy-related carbon emissions to net zero by 2050 and to keep global warming within 1.5C (IEA, 2021)¹¹.

In fact, most GCC top trade partners – including the European Union, with 14.7 percent of the trade balance; Japan, with 11.5 percent; India, with 10.4 percent; and China, with 13 percent – have already set in place GHG emissions reduction targets and have even adopted net-zero targets, all of which might translate into reducing demand for hydrocarbon imports (Table 1).

Table 1 GCC Countries' Top Trade Partners and their Emission Reduction Targets.

Trade partner	NDC emission reduction targets	Net-zero target
EU	40% below 1990 levels by 2030	Yes, by 2050
Japan	26% by fiscal year 2030 from 2013 levels	Yes, by 2050
India	Reduce carbon intensity by 33%-35% from 2005 by 2030 Increase the contribution of non-fossil fuel-based power generation capacity to 40% by 2030	Yes, by 2070
China	Reduce carbon intensity by 60%-65% from 2005 by 2030	Yes, by 2060

Why does it make sense to take action on climate in the GCC?

As explained in the previous section, addressing the potential impacts of climate change in the GCC will help to reducing potential economic losses associated with climate inaction. Furthermore, GCC investments on addressing the impacts of climate change in different economic sectors could create new economic and social co-benefits. These include in areas of:

Economic diversification and job creation

The GCC economies have been heavily reliant on oil and gas export revenues, with a narrow export profile dominated by oil and gas: accounted for 53% of total exports in Bahrain, 91% in Kuwait, 75% in Oman, 94% in

¹⁰ BP. 2020. Energy Outlook 2020. London, United Kingdom.

¹¹ IEA (2021), Net Zero by 2050, IEA, Paris <https://www.iea.org/reports/net-zero-by-2050>

Qatar, 77% in Saudi Arabia, and 74% in the UAE in 2018 (World Bank, 2020)¹². Oil and gas export revenues have been contributing significantly in the GCC's total governmental revenues accounted for 82.4% in Bahrain's total revenues in 2018; 89.6% in Kuwait, 78.2% in Oman, 83.3% in Qatar and 67.5% in Saudi Arabia, and 36.1% in the UAE. They have also accounted for 42.1% of Kuwait's Gross Domestic Product (GDP) in 2019, 24.2% in Saudi Arabia, 24.9% in Oman, 16.9% in Qatar and in the UAE (World Bank, 2020)¹³. This heavy economic reliance on hydrocarbons export revenues and the region's high vulnerability to oil prices have triggered the GCC states to pursue ambitious economic diversification plans and expanding their productive base away from depending on hydrocarbons. Most of the GCC economic diversification plans intend to increase the participation of the private sector, create jobs, human capacity building, and expand trade, business services, logistics, tourism and manufacturing. We argue that expanding investments in renewables could support the GCC countries' in their efforts to diversify their economies and creating jobs through encouraging the investments and involvement of small and medium enterprises along the value chain (IRENA, 2020)¹⁴. Some studies suggest that government spending on renewables creates five more jobs per million dollars invested than spending on hydrocarbons (Garrett-Peltier, 2017)¹⁵ and can create four times additional jobs by 2050 compared to their current level (IRENA, 2020)¹⁶. For the Gulf Arab states, one study suggests that supporting 100% transition to renewable energy could unlock many social, economic and environmental benefits in the long-term including job creation, improve energy security, reduction of air pollution and health cost savings. Examples include creating around 50,000-500,000 jobs, improve energy security by reducing energy demand by up to 60%, reduction of air pollution and maintain health cost savings of 1-3% of GDP by 2050 (Jacobson, et al. 2019)¹⁷.

Environmental co-benefits

Investing in renewable energy technologies, for instance, could play an important role in addressing two environmental issues in the GCC: carbon emissions and air pollution. While not a major contributor to global total greenhouse gas (GHG) emissions - accounted for nearly 2.5% of total global emissions in 2018-, climate-related emissions are increasing in the Arab Gulf States by 6% annually on average (WRI, 2020)¹⁸. In fact, the Arab Gulf States are by far the world's biggest emitters of climate changing greenhouse gas emissions (GHG) on a per capita basis. That is because almost all energy needs for, for example, water, electricity, industries and transport are almost fully met by oil and gas, and because the region has experienced a 5% surge in energy demand per year. Additionally, a 2019 World Air Quality Index found that three Gulf countries, Bahrain, Kuwait and the UAE, ranked in the top 10 list of most air polluted countries in the world, exceeding the World Health

¹² World Bank (2020). Fuel exports (% of merchandise exports). Available from:

<https://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN> [Accessed 8 December 2020].

¹³ World Bank (2020). Oil rents (% of GDP). Available from: <https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS> [Accessed 8 December 2020].

¹⁴ IRENA (2020). Global Renewables Outlook: Energy transformation 2050. International Renewable Energy Agency, Abu Dhabi, UAE.

¹⁵ Garrett-Peltier, H., 2017. Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, 61, pp.439-447. <https://doi.org/10.1016/j.econmod.2016.11.012>

¹⁶ IRENA. 2020. Global Renewables Outlook: Energy Transformation 2050. International Renewable Energy Agency, Abu Dhabi, UAE.

¹⁷ Jacobson, Mark Z, Mark A Delucchi, Mary A Cameron, Stephen J Coughlin, Catherine A Hay, Indu Priya Manogaran, Yanbo Shu, and Anna-Katharina von Krauland. 2019. Impacts of Green New Deal energy plans on grid stability, costs, jobs, health, and climate in 143 countries. *One Earth* 1 (4):449- 463.

¹⁸ WRI (2020). World Resource Institute. Washington DC, USA. <https://www.climatewatchdata.org/data-explorer/historical-emissions?historical-emissions-data-sources=cait&historical-emissions-gases=All%20Selected&historical-emissions-regions=All%20Selected%20CSAU&historical-emissions-sectors=total-including-lucf&page=1#data>. [Accessed 27 December 2020].

Organization's annual exposure guideline for fine particulate matter¹⁹. These results are highly concerning from a climate perspective and public health point of view, highlighting the need to develop alternative energy resources to reduce these emissions.

Energy security

Despite being home to nearly a third of world oil and more than a fifth of global gas reserves –most of which are concentrated between Saudi Arabia, the UAE, Kuwait, and Qatar – the countries of the Gulf Cooperation Council (GCC) are also faced with a looming challenge of energy security. The GCC states' economic growth and industrial expansion, together with their rapidly rising living standards, have increased the regional energy consumption by nearly six times since the 1980s– faster than in any other part of the world. For instance, Gulf countries' electricity consumption has exceeded the world average (3 MWh per capita) but also surpassed the level of some major industrial countries such as the UK (4.9 MWh per capita), and that of other developing countries such as India (1.0 MWh per capita) and China (4.9 MWh per capita). In 2018, the per capita electricity consumption exceeded 10 MWh per capita in five GCC (Bahrain with 18.6 MWh per capita, Kuwait 15.4 MWh per capita, Qatar with 16.6 MWh per capita, Saudi Arabia with 10.2 MWh per capita, and the UAE 13.2 MWh per capita). While Oman showed lower levels of energy consumption compared to their neighbors, it still exceeded the world's average, accounting for 7.1 MWh per capita (IEA, 2018)²⁰. The increasing domestic consumption of oil and gas resources have led some Gulf countries like Oman, UAE and Kuwait to import natural gas in order to meet the growing domestic demands. In 2014, natural gas imports in the UAE accounted for 19.2% of natural gas consumption, 37.7% in Kuwait, and 10.8% in Oman (El-Katiri, 2013)²¹. Deploying renewable energy technologies in the GCC will not only help in meeting the increasing domestic needs of energy but will help to free up fuel needed for downstream economic diversification projects while also increasing exports.

GCC has abundance of untapped resources like renewables

Renewable energy potential, particularly solar, seems to be remarkable, and more so given the geographic location of Arabian Peninsula within the sunbelt. While the GCC states are a home for abundant renewable resources (Jalilvand, 2012)²², hydrocarbons continue to meet most of the Gulf Arab states' primary energy needs, accounting for nearly 99% of primary energy consumption in the region (bp, 2021), and the current role of renewables in meeting the region's growing energy demand remains relatively negligible. Aware of the changing energy dynamics, the GCC investments in renewable energy has been in rise, albeit slowly. That is, the total renewable energy installed capacity has increased from 17 megawatt in 2011 to 3271 megawatt in 2020 (IRENA, 2021)²³.

Current state of climate action in the GCC

¹⁹ IQAir (2019). World's most polluted countries 2019 (PM2.5). World Air Quality Index. Available from: <https://www.iqair.com/world-most-polluted-countries>. [Accessed 27 December 2020].

²⁰ IEA (2018). IEA Atlas of Energy: Electricity Consumption per Capita (MWh/capita).

²¹ El-Katiri, L. (2013) Energy Sustainability in the Gulf States – The Why and the How. Oxford Institute for Energy Studies. Oxford, UK.

²² Jalilvand, D.R. (2012), Renewable Energy for the Middle East and North Africa. Policies for a Successful Transition, Friedrich Ebert Stiftung, Bonn, February.

²³ IRENA (2021). Renewable capacity statistics 2021 International Renewable Energy Agency (IRENA), Abu Dhabi, UAE.

All the GCC states ratified the Paris Climate Agreement and submitted nationally determined contributions (NDCs) listing how the country will address climate change at the national level both in terms of mitigation and adaptation. Ahead of the 26th session of the conference of the parties (COP 26), two countries submitted second NDC (Oman and the UAE) and the rest submitted updated versions of their NDCs (Table 2). Four GCC states have set new or enhanced their GHG emissions reduction targets. Submitted its second NDC in December 2020, the UAE sets a 23.5% GHG emissions reduction by 2030. Oman's second NDC, submitted in July 2021, also contained a 7% GHG emissions reduction target relative to a business-as-usual (BAU) scenario by 2030. Oman's first NDC, from 2015, had contained a 2% greenhouse gas (GHG) emissions reduction target, based on a different BAU scenario. Similarly, Qatar's updated NDC, submitted in August 2021, contained a 25% GHG emissions reduction by 2030. Saudi Arabia's updated NDC, submitted in October 2021, contains an enhanced GHG emissions reduction target that aims to reduce emissions by 278 million tons of carbon dioxide equivalent (MtCO_{2e}) annually by 2030.²⁴ This new emissions reduction target is more than double the target of 130 MtCO_{2e}, mentioned in Saudi Arabia's first NDC, submitted in 2015 (UNFCCC, 2021)²⁵.

With exception of Oman and Kuwait, the GCC countries have framed their Nationally Determined Contributions (NDCs) to be in line with their economic diversification efforts (Luomi, 2020)²⁶. In fact, GCC countries have made environmental sustainability an integral part of GCC economic development plans. In their long-term economic development visions of the twenty-first century, the GCC countries have set out ambitious targets and objectives for diversifying their economies, making environmental sustainability an integral part of their economic development visions, including in areas of: air quality, sanitation and drinking water and waste management, biodiversity, fisheries, climate change and pollution. For instance, Bahrain Economic Vision 2030 states that 'economic growth must never come at the expense of the environment and the long-term well-being of our people'; Kuwait Vision 2035 promises to 'ensure environmental regulations and efficient sustainability within the state'; Qatar National Vision 2030 states that 'economic development and protection of the environment are two demands neither of which should be sacrificed for the sake of the other'; and Oman's Tanfeedh program, promises to advance three environment-related national goals: environmental protection, crisis risk management and science, technology and innovation (Al-Sarihi, 2018)²⁷.

Table 2 Dates of signature, ratification of Paris Agreement and state of NDCs as per 2021.

Country	Signature	Ratification, Acceptance(A), Approval(AA), Accession(a)	Submission of Nationally Determined Contributions (NDCs)	GHG emissions reduction targets
Bahrain	22-Apr-16	23-Dec-16	Yes (Updated, 2021)	-
Kuwait	22-Apr-16	23-Apr-18	Yes (Updated, 2021)	-

²⁴ Kingdom of Saudi Arabia, "Updated First Nationally Determined Contribution: 2021 Submission to UNFCCC (Riyadh: Government of the Kingdom of Saudi Arabia), <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Saudi%20Arabia%20First/KSA%20NDC%202021%20FINAL%20v24%20Submitted%20to%20UNFCCC.pdf>.

²⁵ UNFCCC. 2021. NDC Registry Interim. <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>

²⁶ Luomi, M. 2020. Gulf States' Climate Change Policies Amid a Global Pandemic. Issue paper No. 6. The Arab Gulf States Institute in Washington. Washington, DC. USA.

²⁷ Al-Sarihi, A. (2018). Prospects for climate change integration in GCC economic diversification strategies (LSE Middle East Centre Working Paper 20). LSE Middle East Centre, Kuwait Programme.

Oman	22-Apr-16	22-May-19	Yes (Second, 2021)	7% GHG emissions reduction target by 2030
Qatar	22-Apr-16	23-Jun-17	Yes (Updated, 2021)	25% GHG emissions reduction by 2030
Saudi Arabia	3 Nov -16	3 Nov 2016	Yes (Updated, 2021)	Remove GHG emissions by 278 million tons of carbon dioxide equivalent (MtCO _{2e}) annually by 2030
UAE	22-Apr-16	21 Sep 2016 A	Yes (Second, 2021)	23.5% GHG emissions reduction by 2030

GCC climate mitigation and adaptation strategies

Along with the having in place institutional architecture conducive to climate action (both mitigation and adaptation), all the GCC states have developed initiatives, regulations and programs that serve addressing climate change and achieving the goals set in their NDCs. These include in areas of energy efficiency, renewable energy, and, in 2021, three GCC countries announced commitments to achieving net zero target by mid-century. As per 2021, only three GCC states have announced holistic national climate strategies: the UAE, Oman and Saudi Arabia (Table 3).

The UAE was the first Gulf states to announce a national climate strategy in 2017, National Climate Change Plan of the UAE 2017–2050. The UAE climate strategy was designed around three objectives: manage GHG emissions while sustaining economic growth; minimise risks and improve capacity of adaptation to climate change; and enhance the UAE’s economic diversification agenda through innovative solutions²⁸. Regarding the latter objective, the UAE has been a first Gulf state to link its climate strategy with its economic development plans, for which the UAE Green Agenda 2015–2030 was established as an overarching implementation framework. The UAE Council on Climate Change and Environment – established in 2016 – is the committee responsible for both overseeing the implementation of the Green Agenda and advancing partnerships across ministries and local authorities with the private sector and academia.

Oman established a national strategy in 2019 to mitigate and adapt to climate change; National Strategy for Adaptation and Mitigation to Climate Change 2020-2040. While the strategy is still not made publicly available, Oman has also adopted other climate-related regulations including its 2016 ministerial decision regarding regulations for the management of climate affairs, which requires “greenhouse gas emitting projects” to obtain a climate affairs permit. The decision requires projects to report their greenhouse gas emissions annually, use energy efficient technologies, and implement climate adaptation measures, among other requirements.

Saudi Arabia developed a holistic approach for climate mitigation at the national level—the so-called circular carbon economy (CCE) approach. The CCE was proposed during Saudi Arabia’s G20 presidency in 2020 and was endorsed by all G20 countries. It calls for managing GHG emissions using all available climate mitigation options rather than advocating for one option over another. Specifically, CCE promotes the “three Rs” of the

²⁸ UAE.AE. 2021. National Climate Change Plan of the UAE 2017–2050. Available at: <https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/national-climate-change-plan-of-the-uae>

circular economy concept: reduce, reuse and recycle (carbon) and adds a novel fourth R, remove. This results in the 4Rs of CCE: Reduce, Reuse, Recycle and Remove. **Reducing** calls for managing emissions in the first place (through energy efficiency, renewables and nuclear). **Reusing** encourages carbon to be used as an input to create feedstocks and fuels (including mobile carbon capture technology for transportation that captures and stores carbon onboard the vehicle using a redesigned exhaust system, and CO₂-enhanced oil recovery [CO₂-EOR], which uses injected CO₂ to extract oil that is otherwise not recoverable). **Recycling** carbon is achieved through the natural carbon cycle with bioenergy and, unique to the CCE, through natural sinks such as forests and oceans and the use of hydrogen-based synthetic fuels to recycle CO₂. Finally, **Removing** deals with excess carbon by storing it through carbon capture utilization and storage (CCUS).²⁹

Furthermore, the GCC countries have shown a progressive interest in developing emission reduction initiatives, which in many cases are backed by renewable energy targets, energy efficiency and net-zero targets (Table 3). For example, Saudi Arabia and the UAE have mandatory efficiency labelling and star ratings for domestic appliances and mandatory building codes (e.g. the Estidama program) and Bahrain and Qatar also have implemented strong energy-efficiency regulations. The GCC countries have also set renewable energy targets for 2025 and 2030, as well as aspirational long-term objectives for 2050. That is, the total renewable energy installed capacity has increased from 17 megawatt in 2011 to 3271 megawatt in 2020 (IRENA, 2021)³⁰.

Table 3 National climate strategies and energy policies that back emissions reduction in the GCC states.

Country	Renewable Energy targets	Net-zero target	Energy Efficiency Targets	National Climate Strategy	Other climate initiatives/governance entities
Bahrain	5% by 2025 10% by 2035	Yes, by 2060	6% reduction in electricity consumption by 2025 compared to average final consumption in 2009-13 consumption by 2025	No	Joint National Committee on Climate Change (2007)
Kuwait	15% by 2030		15% improvement in generation efficiency and 30% reduction in consumption by 2030	No	Kuwait National Committee on Climate Change
Oman	10% by 2025 30% by 2030	No	No target, but established a National Energy Efficiency Centre (Prabhu, 2021)	Yes (2019: National Strategy for Adaptation and Mitigation to Climate Change, 2020-2040)	Regulations for the management of climate affairs (2016)
Qatar	20% by 2030	No	-	Yes	National Climate Change Committee (chaired by the Ministry of Environment)
Saudi Arabia	50% by 2030	Yes, by 2060	2021: 14% reduction in peak demand Transportation CAFE standard in increase annual efficiency by 3%-4%	Yes (National Circular Carbon Economy Program)	National Committee for the Clean Development ; Mechanism/Designated National Authority(2009); Saudi Green Building Forum (2010);

²⁹ "Guide to the Circular Carbon Economy," King Abdullah Petroleum Studies and Research Center (KAPSARC), accessed November 22, 2021, <https://www.cceguide.org/guide/>.

³⁰ IRENA (2021). Renewable capacity statistics 2021 International Renewable Energy Agency (IRENA), Abu Dhabi, UAE.

			2020-2025 target efficiency improvements: 3.2% steel, 4.7% cement, 7% petrochemicals compared with 2018 levels		Saudi Energy Efficiency Center (2012)
UAE	Clean energy 50% (44% RE, 6% Nuclear) by 2050	Yes, by 2050	2050: increase energy efficiency to 40%	Yes (2017: National Climate Change Plan of the UAE 2017–2050)	Green Growth Strategy/UAE Green Agenda 2015-2030; Dubai Integrated Energy Strategy 2030

Conclusions

This paper discussed how climate change impacts the GCC states that have special economic condition characterized by heavy reliance on hydrocarbons. It showed that GCC countries are affected not only by the adverse physical impacts of climate change, but also by the measures taken in response to its effects, presenting a challenge to both oil and non-oil economic sectors. The paper also debated why taking action on climate could have multiple social, economic and environmental co-benefits in the GCC, including in areas of economic diversification, job creation, energy security, and improving air quality and reducing health costs. The paper also offered an overview of the current climate-related initiatives and programs that support GCC achievement of their climate mitigation and adaptation ambitions. It revealed that along with the having in place institutional architecture conducive to climate action (both mitigation and adaptation), all the GCC states have developed initiatives, regulations and programs that serve addressing climate change and achieving the goals set in their NDCs. These include in areas of energy efficiency, renewable energy, as well as committing to achieving net zero target by mid-century.