Research Paper

# The Arab Gulf and Climate Change: Massive Steps or Greening Non-negotiable Fossil Fuel Revenues

**Ahmed El Adawy**

AFA
منتدى البدائل العربي
Arab Forum For alternatives

GREENPEACE
غرينبيس

**Arab Forum for Alternatives (AFA):** An independent Arab research center that acts as a platform for the interaction of experts and researchers for the purpose of knowledge production and the creation of an alternative discourse in the region. Through Contributing to the creation of alternative spaces and discourses and proposing alternative policies for different players in the public sphere across the Arab region.

**Greenpeace MENA:** Established in 2018, It offers solutions to the major environmental problems in the Middle East and North African region, notably the climate emergency. We work hand in hand with diverse regional and national stakeholders, focusing our work where we have expertise and experience and where we can make the greatest impact and contribution. Greenpeace MENA seeks to promote a greener, more sustainable, and more equitable future for everyone. We believe that a better world is not only possible but is already happening.





***August 2023***

**Summary:**

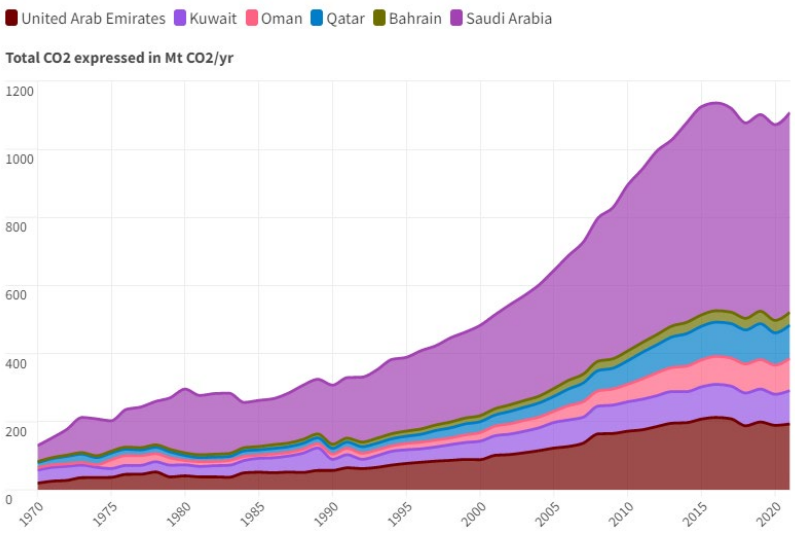
The 2023 Conference of the Parties of the UNFCCC (COP28) will be hosted in one of the Gulf Cooperation Council (GCC) states in November-December 2023. Having accelerated its signing of the Paris Agreement as the first Gulf nation to sign in 2016, the United Arab Emirates (UAE) wanted to establish itself as an international leader in sustainability. Moreover, diversifying its economy and making unprecedented investments in renewable energy and public transportation were the main pillars of UAE's strategies to achieve carbon neutrality by 2050. A review of the general vision which determines the paths of approved plans of the GCC states and UAE will be provided by this paper, followed by some comparisons to identify where disagreements and similarities are evident. In addition, we will explore the possibility of bias in climate change studies funded by the governments of the Gulf region. Moreover, we will investigate the contributions of the various rarely explored sectors and evaluate the convergence of policies announced with the sources of emissions.

Importantly, we will explore the centralization of oil production in the UAE plans and the seriousness of energy transformation compared to countries with huge reserves outside the region like Norway. On the other hand, the share of the marine shipping sector may reach 20% of emissions by 2050, so we will try to engage with the challenges facing the sector under the consequences of climate change. The GCC states considered the oil production sector as non-negotiable, so in return, huge procedures and pledges are paid in adaptation plans to enhance environmental health and finance renewable energy plans for poor countries with a focus on the UAE as the host for COP28. These highly supported technologies basically included carbon capture utilization and storage technologies, supporting the cultivation of trees (and mangroves) inside and outside the region, and prioritizing green hydrogen investments. We will conclude by showing how GCC states must take serious actions to prioritize preserving a sustainable environment in the Gulf region along with burgeoning green investments.

## GCC states' climate change vision: Origins and methods to hinder climate conversations.

Globally, major fossil companies actively worked to over-emphasize uncertainties in global warming, disintegrating climate models or even exaggerating global cooling periods as revealed by a recent Science journal paper (Supran et al., 2023). As such, ExxonMobil's public statements contradict its own scientific studies that are aligned with independent academic and government studies. In the same manner, the six GCC countries (ranked among the top 25 countries in terms of carbon dioxide emissions per capita ) are usually alleged to block global climate negotiations (Reiche, 2010). However, the Saudi energy minister denied these allegations (Greenpeace International, 2021; The New Arab, 2021). The emissions from the GCC States (49.6% of the world's oil reserves) have increased up to 80% during the period 2000–2010 (Al-Maamary et al., 2017). In response, Gulf countries sought to enhance their sustainability statistics through the media and even research institutions to improve their attractiveness to green investment and tourism.

In 2018, a Qatari-funded study (Al-Asmakh and Al-Awainati, 2018) discussed the differences between the production-based and consumption-based accounting systems and suggested that Saudi Arabia could surpass $CO_2$ Per Capita emissions of Qatar that is widely accounted to be the top worldwide emitter per capita. The Qatari study also suggested ranking considering emissions per GDP changed the widely accepted ranking to improve the GCC image to come after China, Australia, USA as per the study authors' statements and feature the mitigation efforts done through exporting a "clean" form of energy, i.e., Liquefied natural gas (LNG). Similarly, an investigation by Bloomberg Green (Rathi et al., 2021) revealed that emissions generated from many of Saudi Aramco's refineries and petrochemical plants were excluded from its overall carbon disclosures. This could underestimate its actual carbon footprint by 50%. In November 2022, UAE approved plans for oil expansion of up to five million barrels per day of oil production by Abu Dhabi National Oil Company (ADNOC) in 2027 instead of 2030 along with the ADNOC Gas creation as per the rising global demand. Accentuating human ability to control weather is another tactic employed by GCC states. Despite cloud seeding being an increasingly popular technique to boost rainfall up to 30% in the UAE, recent studies have examined some of their environmental impacts (Farahat and Abuelgasim, 2021). As well, a Saudi Arabia-funded study explored how a mega solar panel installation (a geoengineered area encompassing 150000km$^2$ that is equivalent to over five times the current overall global power capacity) could impact local rainfall patterns along the western Red Sea coast (Mostamandi et al., 2022).



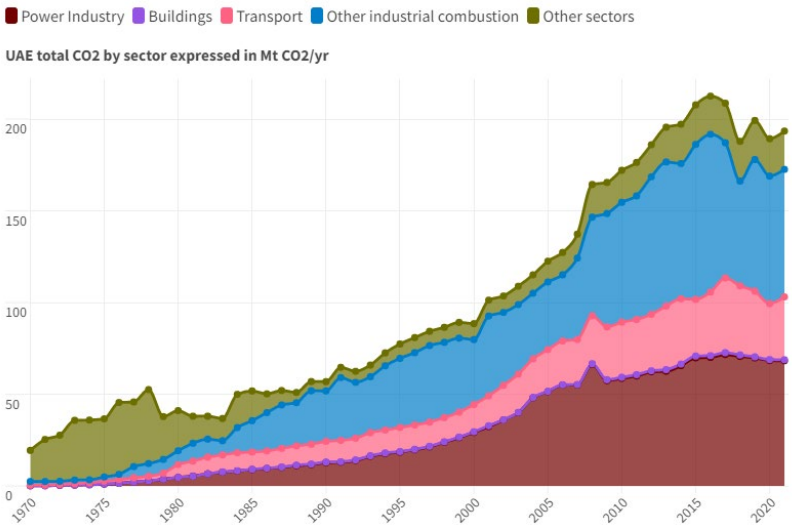



Figure 1: Top: Total $CO_2$ emission in the GCC states (1970-2021), Bottom: The UAE emissions per sector. Data plotted in the two panels as reported in the data sets by Crippa et al., (2021)

Sultan Al Jaber; Minister of Industry and Advanced Technology in the United Arab Emirates and President-Designate COP28 UAE stated that *"Oil and gas industry can and must play an important role in the transition to a lower-carbon Future"* (Walla, 2021). In the same direction, Qatar will expand LNG production by around 63% up to 126 million mt/y by 2027. The aforementioned narratives do not just imply a simple separation policy between climate change initiatives and their fossil fuel production increase plans but how nonnegotiable the fossil fuel industry is to the GCC states at least for the current decade. Regarding national contributions to the global carbon dioxide ($CO_2$) emission, GCC states, which include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, are significant contributors primarily due to their heavy reliance on fossil fuels for energy production and transportation (see figure 1 upper panel for all GCC states and right panel for UAE detailed sectors contributions). Although COP 27 in Egypt achieved a breakthrough agreement on a new "Loss and Damage" Fund for Vulnerable Countries (Wyns, 2023), the GCC states opposed an Indian proposal supported by European Union to phase down all fossil fuel (Abnett, 2023).

It is vital that the contributions of different sectors to emissions should be precisely investigated to address the effectiveness of the adopted climate policies and initiatives. The relative contribution of each sector should be addressed to evaluate the convergence of policies announced with the sources of emissions. Figure 1 (bottom) represents the main sectors emissions such as the power industry and other industrial combustion including combustion for industrial manufacturing and fuel production. Moreover, the transport system basically refers to road transport, non-and domestic aviation. Finally, the "other sectors" here refer to the emissions from industrial emissions. Despite fossil fuel emissions occurring largely in end-consumer countries, "other industrial combustion" figures, including fuel production, increased much faster than their domestic counterparts.

## UAE climate change vision

In its national climate change plan (MOCCAE, 2017), the UAE considered the climate change challenge not only as a threat to the fast economic growth potential but also as an opportunity for pushing diversifying the economy and adopting innovative green products and services. In addition, it emphasizes the most vulnerable sectors namely, water, coastal, marine, and dryland ecosystems; buildings and infrastructures; agriculture and food security, and public health. Although the plan acknowledged that the UAE's total Green House Gas (GHG) emissions are expected to continue rising in line with projected economic and population growth, it prioritized considering best practices for monitoring and managing all these sectoral emissions along with natural and artificial carbon sinks. On the other hand, evidence-based adaptation measures, enhancing resilience, and sustainable use of natural resources were among the main strategic objectives of the UAE vision. The means of implementing the plan highlighted Innovative green financing, capacity building, awareness raising, and enhancing international cooperation.

The long-term UAE actions consider local green diversification, supporting green start-ups, and promoting green businesses to follow overseas environmental standards. For the progress of the suggested "UAE's transition toward a green economy", a Mega solar project with a targeted final capacity of 5,000 MW by 2030 is being constructed. Moreover, subsidy reform policies, public lighting, green building regulations, and targeting 20% of trips using public transportation are the main pillars of the UAE plans. Surprisingly, integrating Dubai's "clean" coal plant (Al-Sarihi, 2018a) with the steel sector as a means for "efficient" carbon capture was previously suggested by the UAE as a climate mitigation measure. Interestingly, in February 2022, a decision was made to convert the 2,400MW Hassyan Power Complex from clean coal to natural gas. Several other initiatives, such as green vehicles (i.e., hybrid taxis), waste of energy, eco-tourism promotion, organic farming, and hydroponics, are also being considered. Last but not least, the Dubai green fund suggested AED 100 billion (USD 27 billion from local and international investors) for implementing green economy programs.

## Economic diversification as a one-shot miracle cure

Al-Sarihi, (2018b) explored the benefits of integration of climate change mitigation and adaptation strategies in the diversification strategies of the GCC countries. The study presented the renewable energy and energy efficiency targets included in the GCC plans for climate change adaptation and mitigation. Maritime transport is considered a success story towards enhancing economic diversification in the UAE. The sector contributes around $24.5 billion (Al Arabiya English, 2022) to the national GDP with around 19 million containers (World Bank, 2023) annually resulting in its port being ranked among the top 10 worldwide. Li et al., (2023) highlighted the global absence of shipping policies on carbon emissions mitigation for the world's high seas regions (global emissions annual growth of 7.26%). In the same direction, Selin et al., (2021) have identified five allocation options, all of which would distribute international shipping $CO_2$ emissions among ten countries to facilitate mitigation efforts. The

results showed that the Arab (also called Persian) Gulf showed one of the highest/dense $CO_2$ emissions from international maritime shipping routes worldwide with UAE ranked fourth based on the Bunker fuel allocation option. International shipping (equivalent to the 6th largest greenhouse gas (GHG) country emitter) is projected to make up 10%-17% of global GHG emissions by 2050 (Vandycke and Englert, 2023) but unfortunately, it is not included in any country NDC as the case for aviation.

Another sector that supports economic diversification is the travel and tourism sector which contributes 11.6% of the total UAE GDP with a targeted increase to 15% in 2030 (Ministry of Economy of UAE, 2023). Most of the Gulf countries (especially Saudi Arabia and the UAE) are willing to achieve radical transformations from an oil-based economy to a tourism hub considering the diverse coastal and marine resources in the Gulf and Red Sea (Gladstone et al., 2013). Knowing the fact revealed by a recent study (Gössling et al., 2023) that 72% of global tourism emissions are directly linked to air transport. In addition, considering the absence of this sector in countries NDC as discussed earlier and without any significant market changes or improvements to existing aircraft technology, it would be so challenging to mitigate the emissions from this growing sector. However, Masdar in collaboration with ADNOC will explore "sustainable" aviation from municipal solid waste (MASDAR, 2023a). Ironically, with the business-as-usual scenario of global warming, tourism revenues can be reduced by 55% along with considerable risks to the heritage sites (Yagoub and Al Yammahi, 2022) and marine resources (Mfarrej, 2019). To sum up, the economic diversification policy in the UAE case will not necessarily result in less projected overall emissions but less national oil-related emissions inside UAE.

**Green projects within and outside national borders**

Despite all announced progressive energy transition plans, the UAE along with all GCC states are still much less dependent on low-carbon energy sources (basically renewables) if compared with less developed countries regionally and across the globe (See figure 2). Recently, Masdar (a state-owned renewables developer) signed agreements with Angola, Uganda, and Zambia for investing in renewable energy projects with a total capacity of 5 gigawatts (GW) (MASDAR, 2023b). These growing investments in Africa came with a parallel investment in 500 megawatts in Ethiopia (Reuters, 2023). The latter direction of investments, if aligned with integrated ideas presented in a previous nature study (Sterl et al., 2021), could effectively contribute to mitigating the impacts of the controversial Ethiopian Dam. The UAE's investments in clean energy technologies went beyond developing countries in Africa and Asia and even investing in storage technologies in the UK (Erkul, 2023). Masdar announced a total of US$30 billion in investments in wind and solar projects in 40 countries since 2006. To put the number in the climate change financing context, according to a report by the African Development Bank, Africa's per capita GDP growth has been reduced by 5% to 15% due to climate change and its associated effects. Moreover, to fulfill its nationally determined contributions, Africa requires approximately $1.6 trillion between 2022 and 2030 (African Development Bank, 2022) as per their mitigation efforts to their limited emissions contributions. It is worth mentioning that adaptation annual costs in Africa are $52.7 billion by 2030 (Global Center On Adaptation, 2022).

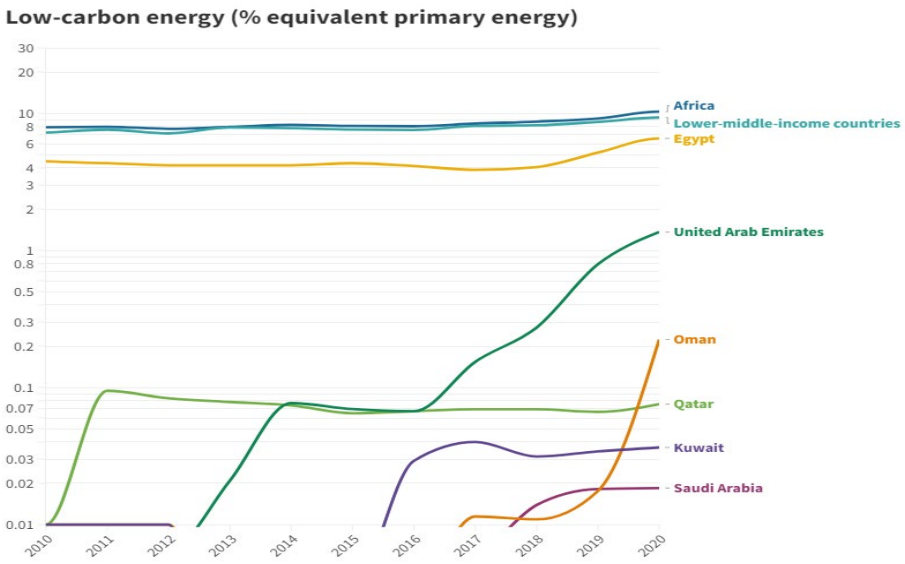



Figure 2: Evolution of percentage of primary Energy from renewables in GCC states compared to lower income countries (Y scale is logarithmic). The raw data are available on reported datasets (Dudley, 2018; Moore, 2022).

Although the updated second Nationally Determined Contribution (Ministry of climate change & Environment, 2022) of the UAE targeted a 31% emission reduction compared to the business as usual (BAU) scenario (i.e., the steadily growing consumption/production rates), the Climate action tracker (Climate Action Tracker, 2022a) rates this target as insufficient. Moreover, the overall target policies and actions, domestic targets, and most importantly based on UAE fair share as Highly insufficient. Lastly, a statement (The WHITE HOUSE, 2022) sets a goal of 100 gigawatts of clean energy by 2035 through the U.S.-UAE Partnership to Accelerate Transition to Clean Energy (PACE) via catalyzing $100 billion in clean energy financing in both countries.

**Critiquing the widely accepted indicators of addressing the global climate crisis**

Although a considerable attention has been linked to the emissions increase rates in each country, Fanning et al., (2022) suggest a more holistic approach to assess the ecological overshoot of nations. Again, Qatar and UAE topped the list in $CO_2$ Emissions but interestingly also based on ecological footprint and UAE was the second highest worldwide material footprint after Singapore. The study hypothesis highlighted the high correlation between the ecological overshot of nations and achieving social thresholds for five investigated social indicators. To accentuate the importance of this holistic assessment, figure 3 upper panel indicates the GCC states oil exports variation with time as reported by OPEC. On the other hand, the more holistic assessment representing the overshooting of resources, material, and ecological footprints along with $CO_2$ emissions are represented in the bottom panel of Figure 3. Beyond these planetary boundary limits (Running, 2012), the environment may not be able to self-regulate anymore. In the reported data of UAE, exceeding a value of 1 of any reported biophysical boundaries refer to an overshoot in this parameter. Although GCC states highly overshoot most biophysical boundaries, some social thresholds (i.e., Democratic Quality and equality) were not yet fully

achieved similar to the situation in most of the developed countries with high levels of social achievements.

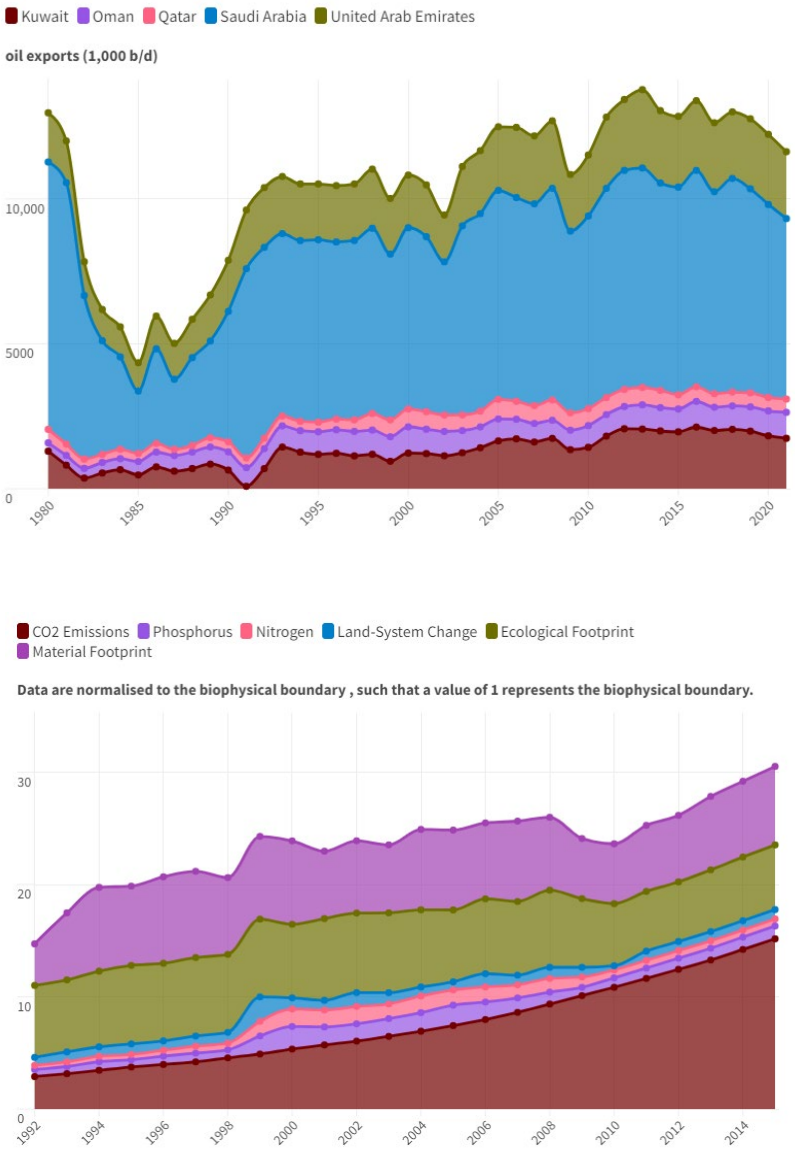



Figure 3: Upper: World crude oil exports from GCC states as reported by the Organization of the Petroleum Exporting Countries (OPEC, https://asb.opec.org/data/ASB_Data.php), Bottom: UAE Biophysical indicators (1992-2015) indicating the overshoot of resources as calculated by Fanning et al., (2022)

Little is known regarding the ecological degradation due to the booming GCC states development in the last decade (Afzal et al., 2022). For example, the impacts of coastal development in the UAE have not been widely independently assessed. Rare remote sensing-based studies (Mansour moghaddam et al., 2022) mostly by researchers based in Iran discussed some impacts but yet lack any solid field data

for validation. On the other side and to depict initiatives for "sustainable cities", Masdar City in Abu Dhabi will be completed in 2030 along with the construction of the Sustainable City in Dubai.

**Prioritizing Preserving Sustainable Environment**

The Earth's marine ecosystems are the primary long-term storage location for carbon in the biosphere, accounting for approximately 93% of the planet's carbon dioxide storage and cycling (Dige et al., 2022). The Arab Gulf provides a unique yet critical marine ecosystem experiencing the warmest water temperatures globally (Mashjoor et al., 2022). Burt, (2014) suggested that the Arab Gulf is in an irreversible coastal ecosystem degradation due to unprecedented coastal development, overfishing (Mashjoor et al., 2022), and industrial expansion associated with local human stressors. In addition, coastal development was achieved by carrying out land reclamation in conjunction with dredging and building operations. Unfortunately, this had a detrimental effect on marine ecosystems such as coral reefs, seagrass meadows, and mangroves (Bakker, 1998; Burt, 2014; Hanert et al., 2023) and even introduced new habitats (Afzal et al., 2022). Additionally, the Gulf reefs are being adversely affected by anthropogenic activities; a study reported that 70% of the reef will be lost and the remaining 27% is at risk of extinction (Hegazy, 1998). There was solid evidence of an increase in the frequency of coral bleaching in the Arabian Gulf (Abu Dhabi, Dubai, Sharjah) corals (Riegl, 2003). Wabnitz et al., (2018) predicted that the UAE and Qatar would experience a drop of 26% in future fish catch. Similarly, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Pörtner et al., 2022) reported that local extinctions are extremely likely in the Arab Gulf southwest, off the coasts of Saudi Arabia, Qatar, and the UAE.

Pal and Eltahir, (2016) made a grim prediction for human life in the Arabian Gulf region by 2100. Their study stated that the business-as-usual scenario of future greenhouse gas concentration will lead to exceeding the human adaptability threshold. Aside from the negative consequences of climate change on biodiversity in the Arabian Gulf region, the regional environment has also been challenged by the increasing frequency of dust storms (Hamza et al., 2011), potential inundation by the sea level rise (Hereher, 2020), and Seawater intrusion in the coastal aquifer (Sherif and Kacimov, 2007). Unfortunately, Beni et al., (2021) emphasized that adopting integrated environmental policies in the Gulf region and investing in renewables and associated revenue streams are challenged by regional political tensions. Notably, Keynoush, (2023) assumed that climate change massive consequences in Southeast Asia and Sub-Saharan Africa could even trigger climate-induced migration to the GCC states.

Alzaabi and Mezher, (2021) discussed the energy, water, and food nexus in the UAE. Similar to all other GCC states, per capita water consumption is high along with doubling their population with 70% of the water resources (Ministry of climate change & Environment, 2015) from extremely non-renewable resources (Power, 2014). The estimated remaining lifetime expectancy for the available groundwater aquifers ranges from two to four decades along with recorded 4 BCM annual groundwater extraction for

irrigation (Shahin and Salem, 2015). A holistic water-stress assessment based on the withdrawal-to-supply ratio by the world resource institute placed four Gulf countries (Qatar, Saudi Arabia, UAE, Kuwait) in the top 10 highly stressed countries worldwide (World Resource Institute, 2013). Similarly, 78% of the food in the UAE is imported, and the annual food consumption growth (ALPEN CAPITAL, 2017) is 5%. UAE is responding to these challenges through initiatives such as groundwater recharging through dams (Sherif et al., 2017), and investing in research in brackish water use in agriculture (Araus et al., 2021).

**GCC states climate policies benchmarking**

To assess the climate policies of the GCC states realistically, Norway, a major oil and gas supplier, was chosen to explore their policies and how relevant they were to the GCC states' policies. Although climate tracker action (Climate Action Tracker, 2022b) rates the domestic overall policies "excluding the exported emissions from Norwegian oil and gas along with expanding exploration" as "Almost sufficient". It claimed that 80% of greenhouse gas emissions were taxed, with domestic aviation and petroleum being the highest-taxed sectors. The domestic sustainable initiatives for emissions policies are highly separated from the exported end consumers' emissions. For example, 2025 could be the phase-out of fossil fuel vehicles while the share market of new (Electric + hybrid) cars reached 93.2 % by the end of 2022 as per the state subsidies (Lemphers et al., 2022).

It is worth highlighting that Land Use, Land-Use Change, and Forestry (LULUCF) are quite less studied in terms of emissions. Although the world bank reports an increase of 0.2% in the forest area in Norway in a decade (The World Bank, 2021). In Norway NDC (Norwegian Government, 2022), it was stated that *"The Land Use, Land-Use Change, and Forestry (LULUCF) Regulation regulates emissions and removals for the land use, land use change, and forestry sector. The regulation sets a national commitment to ensuring that emissions do not exceed removals in this sector".* Furthermore, Norway has previously pledged $1 billion to reduce deforestation and forest degradation in Indonesia which contributes to greenhouse gas emissions (Ecosystem Marketplace, 2010). Government Pension Fund Global (GPFG), worth USD 1.35tn, was advised by the Norwegian Central Bank to stop investments in oil and gas exploration and production companies and the government recognized the recommendation in 2019 (Norges Bank, 2018). Neither of these policies is aligned with those adopted by the GCC states.

Global defense market is another sector that is seldom explored and could be relevant to the GCC states. Saudi Arabia, Qatar, and the UAE are ranked in the top 10 list (SIPRI, 2021) and collectively received 17.8% of all imports of major arms. In the case of Norway, a study utilized the life cycle approach (Sparrevik and Utstøl, 2020) to assess all direct and indirect emissions and other environmental impacts during production, and operational phases within all activities of the defense sector. The study concluded the total annual sector emissions to be 0.8 million tonnes of $CO_2$ equivalents (0.37 million tonnes related to military assets and systems while 0.269 million tonnes for operational activities).

## Conclusions

The Sixth Assessment Report of the IPCC emphasized that Asia continent per capita GHG emissions in 2019 showed the highest increase trend compared to all other continents from emissions in 1990 (Pörtner et al., 2022). This indicates that China, India, and Gulf countries must accelerate their green transition progress. Koch, (2022) analyzed how governments profiting from fossil fuels (e.g., UAE, and Norway) are investing in diversification, sustainability, and energy transitions to continue profits or maintain their control over global energy through a strategy he called "Greening oil money".

Curiously, preserving the Gulf environment and preserving their role as natural carbon sequestration systems (Cusack et al., 2018) are not well prioritized given the regional pressure on the land-ocean ecosystems. It is inevitable that environmental degradation will limit the scope of economic diversification policies as a transition into the post-oil era, and discourage long-term investment, such as in the tourism and travel industries (Beni et al., 2021). Although the previous discussions highlighted how the UAE is planning substantial steps compared with other GCC states, all the GCC states climate change policies are still highly insufficient considering that they are some of the wealthiest countries in the world.

## References

Abnett, K., 2023. EU agrees to push for fossil fuel phaseout ahead of COP28 [WWW Document]. URL https://www.reuters.com/business/environment/eu-agrees-push-fossil-fuel-phaseout-ahead-cop28-2023-03-09/ (accessed 4.11.23).

African development Bank, 2022. Africa loses up to 15% of its GDP per capita annually because of climate change –African Development Bank Acting Chief Economist Kevin Urama [WWW Document]. URL https://www.afdb.org/en/news-and-events/press-releases/africa-loses-15-its-gdp-capita-annually-because-climate-change-african-development-bank-acting-chief-economist-kevin-urama-54660#_ftn1 (accessed 3.1.23).

Afzal, M.S., Tahir, F., Al-Ghamdi, S.G., 2022. Recommendations and strategies to mitigate environmental implications of artificial island developments in the Gulf. Sustainability 14, 5027.

Al-Asmakh, M., Al-Awainati, N., 2018. Counting the Carbon: Assessing Qatar's Carbon Dioxide Emissions, in: Qatar Foundation Annual Research Conference Proceedings. HBKU Press Qatar, p. EEPD592.

Al-Maamary, H.M.S., Kazem, H.A., Chaichan, M.T., 2017. Climate change: the game changer in the Gulf Cooperation Council region. Renew. Sustain. Energy Rev. 76, 555–576.

Al-Sarihi, A., 2018a. Why oil-and gas-rich Gulf Arab states are turning to coal. AGSIW Blog Post. Retrieved December 7, 2021.

Al-Sarihi, A., 2018b. Prospects for climate change integration into GCC economic diversification strategies.

Al Arabiya English, 2022. UAE spent $10 billion in maritime, energy development projects under Sheikh Khalifa.

ALPEN CAPITAL, 2017. GCC Food Industry.

Alzaabi, M.S.M.A., Mezher, T., 2021. Analyzing existing UAE national water, energy and food nexus related strategies. Renew. Sustain. Energy Rev. 144, 111031.

Araus, J.L., Rezzouk, F.Z., Thushar, S., Shahid, M., Elouafi, I.A., Bort, J., Serret, M.D., 2021. Effect of irrigation

salinity and ecotype on the growth, physiological indicators and seed yield and quality of Salicornia europaea. Plant Sci. 304, 110819.

Bakker, K., 1998. City--analysis of urban trends, culture, theory, policy, action. Eur. Plan. Stud. 6, 108.

Beni, A.N., Marriner, N., Sharifi, A., Azizpour, J., Kabiri, K., Djamali, M., Kirman, A., 2021. Climate change: A driver of future conflicts in the Persian Gulf Region? Heliyon 7, e06288.

Burt, J.A., 2014. The environmental costs of coastal urbanization in the Arabian Gulf. City 18, 760–770.

Climate Action Tracker, 2022a. UAE profile [WWW Document]. URL https://climateactiontracker.org/countries/uae/ (accessed 3.22.23).

Climate Action Tracker, 2022b. Norway Profile.

Crippa, M., Guizzardi, D., Solazzo, E., Muntean, M., Schaaf, E., Monforti-Ferrario, F., Banja, M., Olivier, J., Grassi, G., Rossi, S., 2021. GHG emissions of all world countries. Publ. Off. Eur. Union. https//publications. jrc. ec. Eur. eu/repository/handle/JRC126363.

Cusack, M., Saderne, V., Arias-Ortiz, A., Masque, P., Krishnakumar, P.K., Rabaoui, L., Qurban, M.A., Qasem, A.M., Prihartato, P., Loughland, R.A., 2018. Organic carbon sequestration and storage in vegetated coastal habitats along the western coast of the Arabian Gulf. Environ. Res. Lett. 13, 74007.

Dige, G., Erhard, M., van Aardenne, J., Reker, J.B., Bastrup-Birk, A., Zal, N., 2022. Carbon stocks and sequestration in terrestrial and marine ecosystems: a lever for nature restoration? Eur. Environ. Agency 1–11.

Dudley, B., 2018. BP statistical review of world energy 2018. Energy Econ. Cent. energy Econ. Res. policy. Br. Pet. Available via https//www. bp. com/en/global/corporate/energy-economics/statistical-review-of-world-energy/electricity. html 5.

Ecosystem Marketplace, 2010. Norway Pledges $1 billion for REDD as Indonesia Re-Affirms Commitment to Scheme [WWW Document]. URL https://www.ecosystemmarketplace.com/articles/norway-pledges-1-billion-for-redd-as-indonesia-re-affirms-commitment-to-scheme/ (accessed 3.17.23).

Erkul, N., 2023. UAE's Masdar to invest $1.2B in UK battery storage projects [WWW Document]. URL https://www.aa.com.tr/en/middle-east/uaes-masdar-to-invest-12b-in-uk-battery-storage-projects/2834896# (accessed 2.15.23).

Fanning, A.L., O'Neill, D.W., Hickel, J., Roux, N., 2022. The social shortfall and ecological overshoot of nations. Nat. Sustain. 5, 26–36.

Farahat, A., Abuelgasim, A., 2021. Effect of cloud seeding on aerosol properties and particulate matter variability in the United Arab Emirates. Int. J. Environ. Sci. Technol. 1–18.

Gladstone, W., Curley, B., Shokri, M.R., 2013. Environmental impacts of tourism in the Gulf and the Red Sea. Mar. Pollut. Bull. 72, 375–388.

Global Center On Adaptation, 2022. New report reveals Africa is facing a crisis in funding for climate adaptation [WWW Document]. URL https://gca.org/news/new-report-reveals-africa-is-facing-a-crisis-in-funding-for-climate-adaptation/#:~:text=In 2019 and 2020 an,estimated African countries will need. (accessed 3.24.23).

Gössling, S., Balas, M., Mayer, M., Sun, Y.-Y., 2023. A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management. Tour. Manag. 95, 104681.

Greenpeace International, 2021. Saudi Arabian negotiators move to cripple COP26 – Greenpeace response [WWW Document]. URL https://www.greenpeace.org/international/press-release/50547/cop26-saudi-arabia-negotiators-cripple/ (accessed 4.12.23).

Hamza, W., Enan, M.R., Al-Hassini, H., Stuut, J.-B., De-Beer, D., 2011. Dust storms over the Arabian Gulf: a possible indicator of climate changes consequences. Aquat. Ecosyst. Health Manag. 14, 260–268.

Hanert, E., Mohammed, A.V., Veerasingam, S., Dobbelaere, T., Vallaeys, V., Vethamony, P., 2023. A multiscale ocean modelling system for the central Arabian/Persian Gulf: From regional to structure scale circulation patterns. Estuar. Coast. Shelf Sci. 108230.

Hegazy, A.K., 1998. Perspectives on survival, phenology, litter fall and decomposition, and caloric content ofAvicennia marinain the Arabian Gulf region. J. Arid Environ. 40, 417–429.

Hereher, M.E., 2020. Assessment of climate change impacts on sea surface temperatures and sea level rise—The Arabian Gulf. Climate 8, 50.

Keynoush, B., 2023. Climate-induced migration in the GCC states: A looming challenge [WWW Document]. Middle East Inst. URL https://www.mei.edu/publications/climate-induced-migration-gcc-states-looming-challenge (accessed 4.11.23).

Koch, N., 2022. Greening oil money: The geopolitics of energy finance going green. Energy Res. Soc. Sci. 93, 102833.

Lemphers, N., Bernstein, S., Hoffmann, M., Wolfe, D.A., 2022. Rooted in place: Regional innovation, assets, and the politics of electric vehicle leadership in California, Norway, and Québec. Energy Res. Soc. Sci. 87, 102462.

Li, Y., Jia, P., Jiang, S., Li, H., Kuang, H., Hong, Y., Wang, S., Zhao, X., Guan, D., 2023. The climate impact of high seas shipping. Natl. Sci. Rev. 10, nwac279.

Mansourmoghaddam, M., Ghafarian Malamiri, H.R., Rousta, I., Olafsson, H., Zhang, H., 2022. Assessment of Palm Jumeirah Island's construction effects on the surrounding water quality and surface temperatures during 2001–2020. Water 14, 634.

MASDAR, 2023a. Masdar, ADNOC, bp, Tadweer and Etihad Airways explore production in the UAE of sustainable aviation fuel from municipal solid waste and renewable hydrogen [WWW Document]. Press release. URL https://news.masdar.ae/News/2023/01/20/15/20/Production-of-sustainable-aviation-fuel-from-solid-waste (accessed 4.5.23).

MASDAR, 2023b. Masdar to Develop 5 GW of Renewable Energy Projects [WWW Document]. URL https://news.masdar.ae/News/2023/01/20/10/11/Masdar-to-Develop-5-GW-of-Renewable-Energy-Projects (accessed 2.17.23).

Mashjoor, S., Kamrani, E., Aziz, R., 2022. Overfishing and warming put Persian Gulf at risk. Science (80-. ). 378, 365.

Mfarrej, M.F.B., 2019. Climate change patterns in the UAE: A qualitative research and review. Nat. Environ. Pollut. Technol. 18, 261–268.

Ministry of climate change & Environment, 2022. Updated second national determined contribution of the UAE.

Ministry of climate change & Environment, 2015. UAE State of Environment Report 2015.

Ministry of Economy of UAE, 2023. The Contribution of the Travel and Tourism Sector to the UAE's GDP

[WWW Document]. URL https://www.moec.gov.ae/en/tourism-indicators (accessed 3.28.23).

MOCCAE, 2017. National climate change plan of the United Arab Emirates: 2017–2050. UAE Ministry of Climate Change and Environment (MoCCE) Dubai, UAE.

Moore, C.E., 2022. European Electricity Review 2022.

Mostamandi, S., Predybaylo, E., Osipov, S., Zolina, O., Gulev, S., Parajuli, S., Stenchikov, G., 2022. Sea breeze geoengineering to increase rainfall over the Arabian Red Sea coastal plains. J. Hydrometeorol. 23, 3–24.

Norges Bank, 2018. Energy stocks in the Government Pension Fund Global [WWW Document]. URL https://www.nbim.no/en/publications/submissions-to-ministry/2018/energy-stocks-in-the-government-pension-fund-global/

Norwegian Government, 2022. Update of Norway's nationally determined contribution.

Pal, J.S., Eltahir, E.A.B., 2016. Future temperature in southwest Asia projected to exceed a threshold for human adaptability. Nat. Clim. Chang. 6, 197–200.

Pörtner, H.-O., Roberts, D.C., Adams, H., Adler, C., Aldunce, P., Ali, E., Begum, R.A., Betts, R., Kerr, R.B., Biesbroek, R., 2022. Climate change 2022: Impacts, adaptation and vulnerability. IPCC Geneva, Switzerland:

Power, L., 2014. Scarcity and abundance: UAE food and water security. Glob. Food Water Cris. Res. Progr.

Rathi, A., Martin, M., Di Paola, A., 2021. Saudi Oil Giant Understates Carbon Footprint by Up to 50%.

Reiche, D., 2010. Energy Policies of Gulf Cooperation Council (GCC) countries—possibilities and limitations of ecological modernization in rentier states. Energy Policy 38, 2395–2403.

Reuters, 2023. Ethiopia signs deal with UAE's Masdar for 500 MW solar plant [WWW Document]. URL https://www.reuters.com/business/energy/ethiopia-signs-deal-with-uaes-masdar-500-mw-solar-plant-2023-01-18/ (accessed 3.4.23).

Riegl, B., 2003. Climate change and coral reefs: different effects in two high-latitude areas (Arabian Gulf, South Africa). Coral reefs 22, 433–446.

Running, S.W., 2012. A measurable planetary boundary for the biosphere. Science (80-. ). 337, 1458–1459.

Selin, H., Zhang, Y., Dunn, R., Selin, N.E., Lau, A.K.H., 2021. Mitigation of CO2 emissions from international shipping through national allocation. Environ. Res. Lett. 16, 45009.

Shahin, S.M., Salem, M.A., 2015. The challenges of water scarcity and the future of food security in the United Arab Emirates (UAE). Nat. Resour. Conserv. 3, 1–6.

Sherif, M., Ebraheem, A., Shetty, A., 2017. Groundwater recharge from dams in United Arab Emirates, in: World Environmental and Water Resources Congress 2017. pp. 139–146.

Sherif, M., Kacimov, A., 2007. Seawater intrusion in the coastal aquifer of Wadi Ham, UAE. IAHS Publ. 312, 315.

SIPRI, 2021. International arms transfers level off after years of sharp growth; Middle Eastern arms imports grow most [WWW Document]. Stock. Int. PEACE Res. Inst.

Sparrevik, M., Utstøl, S., 2020. Assessing life cycle greenhouse gas emissions in the Norwegian defence sector for climate change mitigation. J. Clean. Prod. 248, 119196.

Sterl, S., Fadly, D., Liersch, S., Koch, H., Thiery, W., 2021. Linking solar and wind power in eastern Africa with operation of the Grand Ethiopian Renaissance Dam. Nat. Energy 6, 407–418.

Supran, G., Rahmstorf, S., Oreskes, N., 2023. Assessing ExxonMobil's global warming projections. Science (80-. ). 379, eabk0063.

The New Arab, 2021. Saudi Arabia dismisses "lie" that it's blocking COP26 deal [WWW Document]. URL https://www.newarab.com/news/saudi-calls-accusation-its-blocking-cop26-deal-lie (accessed 4.8.23).

The WHITE HOUSE, 2022. Statement by White House Press Secretary Karine Jean-Pierre on the U.S.-UAE Partnership to Accelerate Transition to Clean Energy (PACE) [WWW Document]. URL https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/01/statement-by-white-house-press-secretary-karine-jean-pierre-on-the-u-s-uae-partnership-to-accelerate-transition-to-clean-energy-pace/ (accessed 3.22.23).

The World Bank, 2021. Forest area (% of land area) [WWW Document]. URL https://data.worldbank.org/indicator/AG.LND.FRST.ZS

Vandycke, N., Englert, D., 2023. Three reasons why maritime transport must act on climate change [WWW Document]. World Bank Blogs. URL https://blogs.worldbank.org/transport/three-reasons-why-maritime-transport-must-act-climate-change (accessed 2.20.23).

Wabnitz, C.C.C., Lam, V.W.Y., Reygondeau, G., Teh, L.C.L., Al-Abdulrazzak, D., Khalfallah, M., Pauly, D., Palomares, M.L.D., Zeller, D., Cheung, W.W.L., 2018. Climate change impacts on marine biodiversity, fisheries and society in the Arabian Gulf. PLoS One 13, e0194537.

Walla, K., 2021. Transcript: Global Energy Forum conversations with Sultan Al Jaber, Suhail Al Mazrouei, and Musabbeh Al Kaabi. Atl. Counc.

World Bank, 2023. Container port traffic (TEU: 20 foot equivalent units) - United Arab Emirates [WWW Document]. World Bank Dataset. URL https://data.albankaldawli.org/indicator/IS.SHP.GOOD.TU?end=2020&locations=AE&start=2000&view=chart (accessed 4.5.23).

World Resource Institute, 2013. Aqueduct Country and River Basin Rankings.

Wyns, A., 2023. COP27 establishes loss and damage fund to respond to human cost of climate change. Lancet Planet. Heal. 7, e21–e22.

Yagoub, M.M., Al Yammahi, A.A., 2022. Spatial distribution of natural hazards and their proximity to heritage sites: Case of the United Arab Emirates. Int. J. Disaster Risk Reduct. 71, 102827.