UNITED ARAB EMIRATES
MINISTRY OF ENERGY & INFRASTRUCTURE

United Arab Emirates

5th National Communications Report (NCR)

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EXECUTIVE SUMMARY

Executive summary

The United Arab Emirates (UAE) is delighted to present its 5th National Communications Report to the United Nations Framework Convention on Climate Change (UNFCCC). This report offers an overview of the primary findings, accomplishments, and steps taken by the UAE regarding climate change mitigation and adaptation.

National Circumstances

The United Arab Emirates is a constitutional federation established in December 1971, and operates as a federation of seven emirates, each with its own ruler and degree of autonomy. The UAE consists of seven emirates; Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah (it acceded to the new federation in February 1972), Ajman, Umm Al Quwain, and Fujairah. The UAE has its own flag, coat of arms and national anthem. All citizens of the UAE carry the unified nationality of the United Arab Emirates, which is recognised internationally.

The federal government, based in Abu Dhabi, oversees key areas such as defence, foreign policy, and energy resources. This decentralized governance structure allows for flexibility in implementing climate policies and initiatives at the local level. The federal government has taken a proactive role in climate action by establishing the UAE Ministry of Climate Change and Environment, which plays a pivotal role in coordinating climate-related policies and strategies across the emirates.

The local governments of the seven emirates exhibit variations in size and organizational structures, contingent on factors like population, geographical area, and developmental progress. Each emirate operates under an Executive Council supervised by the Ruler's Court, in conjunction with distinct autonomous agencies possessing well-defined authorities. For example, in Abu Dhabi, the Executive Council serves as the central governing body, collaborating with the Ruler to fulfill responsibilities and exercise power. The emirate is subdivided into three regions, each managed by a dedicated municipality. Additionally, an influential National Consultative Council, comprising 60 members selected from major tribal and familial groups, operates in Abu Dhabi. In Dubai, the Dubai Executive Council (DEC) stands as the primary decision-making authority, responsible for upholding security, public utilities, and the emirate's socio-economic advancement. DEC assists in devising developmental strategies and formulating local legislation. Each emirate follows a similar framework with its Executive Council, municipalities, departments, and independent agencies. Sharjah, for instance, supplements its Executive Council with a Consultative Council and embraces decentralization by devolving some authority to local branches within the Emiri Diwan, headed by Deputy Chairmen in Kalba and Khor Fakkan.

The arid desert climate of the UAE, characterized by high temperatures and limited precipitation, places immense pressure on the country's water resources. To address this, the UAE has invested significantly in desalination technology to meet its freshwater needs.

The energy-intensive process of desalination, coupled with the need for extensive air conditioning and cooling to combat extreme heat, significantly contributes to the country's overall energy consumption. Additionally, the UAE's reliance on food imports to sustain its population further exacerbates its energy footprint, as transportation and refrigeration of imported goods are energy-intensive processes. The combination of these factors results in a high per capita energy consumption in the UAE, highlighting the complex relationship between water scarcity, food security, and energy demand in the region.

Population: The UAE's population has been rapidly and has increased approximately by 4% since 2016 as per World Bank, with a population density of 130.7 people per square kilometre in 2020 driven by both natural increases and significant migration. This demographic trend poses challenges for climate mitigation and adaptation efforts, as the demand for energy, transportation, and water resources continues to rise.

Geography: Geographically and topographically, the UAE is characterized by its arid desert landscape and a coastline along the Arab Gulf and the Gulf of Oman. The arid landscape in the United Arab Emirates boasts a diverse range of geographical features such as sand dunes, oases, mangroves, salt flats (sabkhas), valleys (wadis), and marshes. Notably, the southwestern waters of Abu Dhabi, the Marawah marine biosphere reserve in Abu Dhabi, Jebel Ali in Dubai, Khor Kalba in Sharjah, and Sir Bu Na'air island are internationally acclaimed for their remarkable biodiversity and ecological importance. The low-lying nature of the country makes it particularly vulnerable to rising sea levels and coastal erosion due to climate change. Additionally, the extreme heat and dry conditions in the region exacerbate water scarcity issues and place stress on agricultural activities.

Climate: The UAE has an arid desert climate with two main seasons, winter and summer separated by two transitional periods, respectively.

The Summer season is characterized by hot and humid weather, whereas the winter season is notably mild and cool. The climate varies considerably between coastal and inner desert areas.

The annual average rainfall is less than 100 mm in general with variations in rainfall patterns, which increase particularly in the eastern mountains.In some occasions annual average rainfall may reach 130 mm (e.g. Year 2006).

Economy: The discovery of oil in the UAE in the 1950s transformed the country's economy and led to rapid economic development. Oil revenues became a major source of income for the UAE, and the country's economy was heavily dependent on the oil industry for many years.

However, in recent decades, the UAE has taken significant steps to diversify its economy and reduce its dependence on oil. The non-oil sector's share of the UAE's GDP has increased from approximately 30-40% in the 1970s to around 72.4% in 2022[1].

To diversify its economy and reduce its carbon footprint, the country has launched initiatives to promote sectors such as renewable energy, tourism, technology and industry.

Energy: The UAE's energy sector is thriving, fueled by vast oil and gas reserves, strategic positioning, and ambitious diversification efforts. As a major oil and gas producer and exporter, the sector plays a pivotal role in the national economy. Recognizing the need for sustainable energy, the UAE has embarked on a strategy to diversify its energy mix, shifting towards renewable sources. While the UAE's regulatory structure is decentralized, with each emirate having its own regulatory authority, the Federal Ministry of Energy and Infrastructure maintains central oversight of the electricity sector. Each emirate has its own regulatory body, such as the Department of Energy Abu Dhabi, DEWA, SEWGA, and Etihad WE. Energy demand in the UAE is increasing, driven by rapid urbanization and industrial growth. Additionally, due to the harsh climate and non-availability of natural potable water source, the UAE has to spend additional energy unlike most of its peers. To address this, the UAE has set ambitious goals to increase the share of clean energy sources and improve energy efficiency, as outlined in its Energy Strategy 2050. In 2021, clean energy contributed almost 20% to the overall energy mix of the country.

Transportation: The UAE boasts a modern and advanced road network, characterized by well-maintained highways, cutting-edge technologies, and efficient transportation systems. The country ranks favorably in terms of road quality and prioritizes sustainable practices, such as using energy-efficient LED lamps along its extensive road network. Notable road projects in the UAE include E11, E311, E611, Sheikh Khalifa Highway, Sheikh Khalifa bin Zayed Road, Dubai-Fujairah Road, Dubai-Al Ain Road, and Sheikh Zayed Bridge.

Etihad Rail, the UAE's national railway system, connects all seven emirates and provides links to neighboring Gulf Cooperation Council (GCC) countries. It aims to develop sustainable infrastructure that supports economic growth and enhances people's well-being. With a length of 1,200 kilometers, Etihad Rail will include freight terminals, distribution centers, and depots. Its first phase, covering 264 kilometers, has been operational since 2016, transporting granulated sulfur for ADNOC. The extensive network is expected to bring cost savings, reduced travel times, and environmental benefits, such as a 70-80% reduction in carbon dioxide emissions compared to trucks.

Also, the UAE is continuously upgrading its maritime infrastructure and assets under the regulation of the Federal Transport Authority-Land and Maritime. The UAE has ratified numerous International Maritime Organization (IMO) Conventions and aims to adopt the remaining ones soon. The country's maritime ambitions include enhancing its navigation systems, establishing a search and rescue

[1] UAE's First Long Term Strategy

center, and monitoring vessel positions. The UAE's hub ports handle over 14 million TEUs annually, facilitated by advanced infrastructure and modern management. The country is updating its Maritime Commercial Law and has made Dubai International Finance Center a hub for maritime arbitrations. The UAE is also expanding its tonnage under its flag and recognizes 12 Ship Classification Societies. The Ministry of Energy and Infrastructure oversees various maritime transport services, while Abu Dhabi and Dubai have their own ferry and water transportation systems.

Furthermore, the civil aviation sector plays a vital role in the UAE's economy, contributing significantly to GDP and employment. Government initiatives and investments in aerospace have attracted business partnerships and positioned the UAE as a leader in the region. The country boasts four major passenger aviation carriers and seven international airports, with Dubai International Airport standing out as one of the world's busiest. Despite pandemic-related challenges, the UAE aviation sector is recovering and remains a crucial component of the national economy.

Public Health: Public health is impacted by extreme climate conditions, particularly heat-related illnesses during the scorching summer months. Climate adaptation measures include public health campaigns to educate residents about heat stress and the importance of staying hydrated and cool. In response to these challenges, UAE has taken a proactive approach to address the intersection of climate change and public health. The UAE has committed to developing a climate-resilient health sector and has collaborated with WHO and conducted a National Framework for Action on Climate Change and Health, including assessments of vulnerabilities and adoption assessment of climate change on health, developing the Health National Adaptation Plan (H-NAP) and demonstrating the UAE's dedication to safeguarding public health in the face of changing climate conditions.

Education: Education is a priority in the UAE, with an emphasis on integrating climate education into the curriculum to raise awareness and build a climate-resilient society. Environmental education and awareness campaigns play a crucial role in fostering sustainable practices among the population.

The UAE, with its 98% literacy rate as of 2022 (World Bank), is well-positioned to leverage education to drive sustainability. Educational institutions can mobilize society, enhance climate change understanding, equip citizens with green skills, and instill sustainable practices. The UAE is taking action to integrate climate education into curricula, transform universities into sustainability hubs, foster industry-university collaboration, develop climate action plans, and promote nature-based solutions. These initiatives demonstrate the UAE's commitment to using education for a sustainable future.

Environment: In terms of the environment, the UAE is home to four unique ecosystems, these are desert, mountain, marine and wetlands ecosystems. Both the marine and wetland ecosystems include coral reefs and mangroves, which are vulnerable to climate change impacts such as sea-level rise and ocean acidification. UAE was home to 205.7 sq. km[2] in 2022, and aims to increase this area to 483 sq. km by 2030 through the '100 million mangrove planting. Also, the National Red List Project in the UAE has identified a rich biodiversity, including 58 mammal species, 72 species of amphibians and reptiles, 167 bird species, 598 plant species, and 272 selected marine species.

[2] The UAE is currently in the process of ascertaining the total carbon stock from mangroves using direct methods, and this exercise would be completed by 2024. Based on the updated calculation, future NCRs and biannual reports would be accordingly updated.

Agriculture: Agriculture faces significant challenges due to the arid climate and limited freshwater resources. UAE depends heavily on the import of food because of it's limitations, however, the country is exploring innovative agricultural practices such as hydroponics, heat and salinity tolerant crops, circular water systems, and aquaponics for sustainable food production. Climate-resilient crop varieties are also being researched to adapt to changing climatic conditions.

In 2021 the UAE produced a total of 1.3 million tons of vegetables, fruits and crops from 61,159 hectares of cultivated land.

National Greenhouse Gas Inventory

The UAE is a non-Annex I country since it is "especially vulnerable to adverse impacts of climate change with low-lying coastal areas and prone to desertification and drought. However, despite being categorised as non-Annex I country, the UAE has actively engaged actions and plans in pursuit of economic diversification that will also help reduce its Greenhouse Gas (GHG) emissions and support the country in its adaptation to the impacts of climate change.

This report presents the detailed GHG inventory of the year 2021. In 2021, UAE's total greenhouse gas emissions, excluding Forestry and Land Use related sink, amounted to 204,001,782 tCO2e and including the sink amounted to 202,928,087 tCO2e witnessing a decline of about 10% since 2019.

In 2021, GHG emissions excluding Forest and Land Use at the national level by type of gas were as follows: Emissions from CO2 accounted for 187.8 MtCO2e (92%); CH4 emissions accounted for 13.6 MtCO2e (7%); and N2O accounted for 2.4 MTCO2e (1%).

The largest contributor to greenhouse gas emissions in 2021 is the energy sector primarily representing energy consumption from power, transport, etc. *(including fuel combustion and fugitive emissions)* accounting for approximately 84% of the total national emissions of 202,928,087 tCO2e. Industrial processes and product use *(constituting of process emissions)* make up the second largest contributor of greenhouse gas emissions in the UAE, contributing 9% to the national total in 2021. CO2, CH4, and PFCs (C2F6 and CF4) were the primary greenhouse gases emitted from the sector.

The third largest source of greenhouse gases is the Waste sector. In 2021 this contributed 6% to the national total. This sector leads to emissions of CO2, CH4 and N2O, with emissions occurring from waste incineration, solid waste disposal on land, biological treatment and wastewater handling. CH4 is the dominant gas consisting of 88% of all emissions

Agriculture, Forestry and Land-Use (AFOLU) contains carbon sinks as well as sources of greenhouse gas emissions. AFOLU was a net sink in 2021.

Disclaimer on Land Use and Forestry: The country is currently undertaking a detailed study to accurately evaluate the various land use types. Results of this assessment will be incorporated into future national-level inventories. For now this section, only covers the negative emissions achieved through sizable levels of mangroves inherent to the UAE.

***Disclaimer on Agriculture and Waste*:** Emissions data for Agriculture and waste emissions are based on projections. With the operationalization of the MRV automated data collection tool, these emissions shall be evaluated more accurately in forthcoming years.

Preparation of the National GHG Inventory involved significant participation of the UAE ministries and governmental bodies. The Ministry of Energy and Infrastructure coordinated the preparation of the National Inventory and was responsible for convening different working groups that helped survey sectoral information.

The methodological approaches and guidance used in the National GHG Inventory were based on the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC,2006).

National climate change strategies and programs[3]

The Paris Agreement requires signatory parties to submit a Nationally Determined Contribution (NDC) every five years, outlining their strategies to limit global warming to well below 2°C, with a specific aim of 1.5°C. In 2016, the UAE submitted its first NDC, which focused on clean and renewable energy sector targets. In 2020, the UAE made a significant advancement by introducing economy-wide emissions reduction goals in its second NDC, expressed as reductions compared to a business-as-usual scenario. Subsequently, in 2022, the country enhanced the ambition of these targets in a revised second NDC.

In 2023, the UAE published the 3rd Update to the 2nd NDC, which establishes absolute, unconditional, economy-wide emissions reduction targets for 2030. Notably, despite continued economic and population growth, this target represents a 19% absolute reduction in GHG emissions by 2030 compared to 2019.

To further strengthen their efforts, the UAE is implementing a comprehensive set of strategies and initiatives, both at National and the Emirates which include,

- **UAE Net Zero 2050:** A national effort aimed at achieving net-zero emissions by 2050, positioning the Emirates as the first MENA[4] nation to commit to this ambitious goal. This initiative is closely aligned with the Principles of the 50[5] , the UAE's economic development roadmap. Moreover, as part of the UAE Net Zero 2050 Strategic Initiative, all the planned measures and policies are estimated to be around AED 134 billion between 2023 and 2030.
- **National Climate Adaptation Action Plan:** A comprehensive strategy with three key components aimed at assessing climate trends and their impacts on critical sectors

[3] Visit UAE Government Portal for details on these strategies and programs - https://u.ae/en/information-and-services/environment-and-energy

[4] Middle East and North Africa Region

[5] The Principles of the 50 are 10 principles that act as guidelines for all institutions in the UAE as the country approaches a new phase of development over the next 50 years. Read more

like food, ecosystems, business, etc. The plan focuses on addressing urgent concerns, such as increased demand for water and electricity.

- **National Hydrogen Strategy:** The primary goal of the strategy is to bolster environmentally friendly local industries, actively contribute to the pursuit of net zero emissions, and further solidify the UAE's standing as a major hydrogen producer by 2031.
- **The National Strategy to Combat Desertification:** Introduced to counteract land degradation, drought, and desertification, by 2030, the strategy aims to enhance land productivity, restore degraded lands, and safeguard water resources. The UAE government's objectives include a 40% improvement in production system efficiency, restoring at least 80% of degraded land, and achieving a 60% increase in the use of treated water while optimizing water consumption.
- **The National Biodiversity Strategy and Action Plan (NBSAP):** Currently undergoing updates to extend it relevance until 2031, the NBSAP encompasses six strategic goals, including the conservation, protection and development of natural system and local species; the preservation of local genetic recourses while ensuring fair and equitable benefit sharing; managing genetically modified organisms and their products effectively, to protect biodiversity and the community; the adoption of modern techniques and technologies along promoting the integration of scientific research and innovations in biodiversity conservation; enhancing awareness, education, capacity-building, and expertise in biodiversity conservation; and lastly, the enhancement of cooperation and coordination on national, regional, and international levels in all matters related to biodiversity.
- **UAE Wind Program:** The UAE Wind Program is a 103.5-megawatt clean energy project designed to seamlessly incorporate cost-effective, large-scale wind power into the UAE's electricity grid. The project is planned to annually provide energy for over 23,000 UAE households and reduce carbon dioxide emissions by 120,000 tonnes.
- **UAE Energy Strategy 2050:** With a goal to triple the renewable energy capacity, the strategy would entail substantial investments of AED 150 to AED 200 billion by 2030 to meet the growing energy demand resulting from the country's rapidly expanding economy.
- **The National Framework for Sustainable Development:** The National Framework for Sustainable Development in the UAE seeks to elevate the country's overall quality of life, stimulate economic diversification and prosperity, safeguard its ecosystems, maintain ecological resources, and contribute to the realization of the Sustainable Development Goals for 2030.
- **The UAE's Green Agenda – 2030:** By 2030, the UAE Green Agenda strives to increase the country's GDP by 4 to 5 percent, boost exports by approximately AED 24 to 25 billion while ensuring sustainable development and environmental preservation.

- .**The National Air Quality Agenda 2031:** The National Air Quality Agenda 2031 serves as a comprehensive framework to guide and coordinate federal and local government bodies and the private sector in their efforts to monitor and effectively manage air quality, reducing pollution for a healthier and safer environment.
- **The UAE National Invasive Species Strategy and Action Plan (NISSAP) 2022-2026:** The UAE's National Invasive Species Strategy and Action Plan (NISSAP) for 2022-2026 is dedicated to safeguarding the country's natural resources, environment, and communities from the adverse effects of invasive alien species (IAS).
- **National Water and Energy Demand Management Programme:** The National Water and Energy Demand Management Programme is committed to achieving 40% efficiency in the UAE's most energy-intensive sectors: transport, industry, and construction. This program encompasses three core pillars: energy, water, and consumption rationalization. It aims to significantly reduce energy demand by 40%, increase the share of renewable energy in the energy mix to ensure achieving net zero in the power and water sector by 2050, and expand water reuse by 95% by 2050. By uniting all stakeholders, the program aligns with the objectives of the UAE Energy Strategy 2050 and the UAE Water Security Strategy 2036, contributing to a sustainable and energy-efficient future.
- **National Food Security Strategy 2051:** The National Strategy for Food Security has ambitious objectives for the UAE, aiming to become the world's leader in the Global Food Security Index by 2051, while ranking among the top 10 countries by 2021.

- **National Climate Change Plan of the UAE 2017–2050:** The National Climate Change Plan of the UAE (2017-2050) serves as a comprehensive framework addressing climate change causes and impacts, with the aim of transitioning into a climate-resilient green economy and improving overall quality of life. Its three pillars are managing GHG emissions while sustaining economic growth, minimize climate-related risks and enhance adaptation capacity, safeguarding the UAE's economy, infrastructure, people, and ecosystems from climate impacts, and support economic diversification and foster strong growth in non-oil sectors.
- **The UAE Water Security Strategy 2036:** The UAE Water Security Strategy 2036 is designed to secure sustainable water access in both regular and emergency situations. Its objectives include reducing water demand by 21%, enhancing water productivity, lowering water scarcity,

increasing treated water reuse to 95%, and expanding national water storage capacity to two days.

- **Environment Vision 2030 (Abu Dhabi):** Abu Dhabi's Environment Vision 2030 is a strategic plan developed to promote integration among the three dimensions of sustainability: environmental, economic, and social well-being. The vision prioritizes five key areas: addressing climate change impact, ensuring clean air and reducing noise pollution for safe and healthy living, managing water resources efficiently, conserving biodiversity, habitats, and cultural heritage for current and future generations, and optimizing waste management to create value through improved material flows and waste handling.
- **Dubai Integrated Waste Management Strategy 2021-2041:** The Integrated Waste Management Strategy 2021-2041 is geared toward fostering innovation in waste management, recycling, and energy conversion. It envisions a 20-year timeline for implementing long-term projects aimed at offering practical solutions to environmental challenges, aligning with the government's environmental objectives. The strategy also seeks to enhance various vital areas and sectors. To execute this strategy, a budget of AED 74.5 billion is allocated, with AED 70.5 billion contributed directly by the private sector.
- **Dubai Food Security Strategy:** Dubai's Food Security Strategy focuses on diversifying food sources, bolstering local production, minimizing food waste, improving food safety and quality, and enhancing crisis readiness. It categorizes food products based on their nutritional value, consumer importance, demand levels, and irreplaceability, including raw materials for other products.
- **RAK Energy Efficiency and Renewable Energy Strategy 2040:** The primary goals are to achieve a minimum of 30% electricity consumption savings, a 20% reduction in water consumption, and a 20% contribution from renewable energy sources in the energy supply mix compared to business-as-usual scenarios. These targets are consistent with the RAK Vision 2030 objectives, aiming for 10% electricity savings and 5% of electricity demand to be met through solar power by 2030.
- **Dubai Clean Energy Strategy:** The Dubai Clean Energy Strategy is geared towards generating 75% of the emirate's energy needs from clean sources by 2050, while also positioning Dubai as a global hub for clean energy and the green economy. This strategy is founded on five key pillars: infrastructure, legislation, funding, capacity building, and an eco-friendly energy mix. Infrastructure initiatives include the impressive Mohammed Bin Rashid Al Maktoum Solar Park, set to be the world's largest solar energy generator with a capacity of 5,000 MW by 2030. The legislation pillar focuses on a legislative framework to support clean energy policies. The funding pillar involves the Dubai Green Fund, a substantial AED 100 billion resource offering affordable loans for clean energy investors. The fourth pillar aims to enhance human resources through global training programs, collaborating with international organizations and institutes. Lastly, the fifth pillar centers on an eco-friendly energy mix, with plans to increase clean energy sources to 75% by 2050, thereby positioning Dubai as the city with

the world's lowest carbon footprint.

The UAE also actively engages in international and bilateral cooperation to exchange knowledge, technology, and best practices in the fight against climate change, reinforcing its commitment to addressing global environmental challenges.

Vulnerability and Adaptation Measures

The UAE has recognized the pressing need for climate change adaptation measures due to its vulnerability to the impacts of climate change, such as rising temperatures, water scarcity, and desertification. Through various initiatives the UAE aims to enhance the country's resilience to climate-related challenges. Henceforth, to comprehensively assess the potential effects of climate-related risks, their likelihood, and magnitude, and to prioritize adaptation measures, the National Climate Change Adaptation Program (NCCAP) has conducted risk and impact assessments in four key sectors: energy, infrastructure, health, and the environment. Currently, the NCCAP is undergoing a review and update, notably with the addition of insurance as a new sector.

For each of these sectors, actionable adaptation plans that align with the National Adaptation Plan (NAP) requirements are being formulated at the emirate level to address the high-priority risks previously identified. The NAP's objective is to prioritize, integrate, implement, and monitor adaptation strategies across various sectors, involving both governmental and non-governmental stakeholders. These plans will include details on specific actions, responsible leaders and supporting entities, timelines, monitoring and evaluation criteria, as well as estimates of associated costs and impacts. This approach aims to mainstream climate change adaptation and resilience into sector-specific development strategies, enabling the identification of priority projects and action plans for funding. Through the NAP, the UAE will enhance its ability to adapt by identifying both short-term and long-term adaptation priorities.

Moreover, the UAE is actively investing in research and development to better understand regional climate dynamics and develop tailored adaptation strategies. By taking proactive measures and promoting international cooperation, the UAE is positioning itself as a model for climate adaptation efforts in arid and vulnerable regions, contributing to the global fight against climate change while safeguarding its own future sustainability.

Mitigation Measures

The nation has taken decisive action to mitigate climate change and adapt to its impacts. In 2017, the UAE adopted the National Climate Change Plan 2017-2050, laying down a framework for the management of GHG emissions, climate change adaptation, and economic diversification driven by private sector innovation. In October 2021, the UAE embarked on a path towards net zero emissions, announcing the launch of a strategic initiative to pursue net zero, which builds on more than 30 existing strategies across all sectors . Additional policies, such as the Clean Energy Strategic Target 2035 in Abu Dhabi and the UAE Hydrogen Leadership Roadmap, were updated during the development of the net zero pathway. The UAE Net Zero by 2050 Strategic Initiative aligns with the Paris Agreement's call to implement long-term strategies to reduce emissions, with the aim of achieving global net zero GHG emissions in the second half of this century.

Furthermore, the UAE has set ambitious targets to increase the share of clean energy in its energy mix by 2050 to achieve Net Zero

emissions in the power and water sector, in line with the country's ambition. This commitment to renewable energy aligns with global climate goals and reduces the country's reliance on fuels contributing to greenhouse gas emissions.

Additionally, the UAE has implemented various energy efficiency initiatives, such as retrofitting existing buildings with energy-efficient technologies and introducing stricter energy efficiency standards for new construction projects. The country has also introduced emissions reduction targets for various sectors of its economy, including transportation and industry. These measures reflect the UAE's dedication to mitigating climate change by reducing its carbon footprint and transitioning towards a more sustainable and environmentally responsible future.

Other information

The UAE has been actively engaged in climate-related efforts to facilitate technology transfer, research, systematic observation, education, training, public awareness, capacity-building, and information sharing. In terms of technology transfer, the UAE has embraced the adoption of clean and sustainable technologies, particularly in the renewable energy sector. The country has encouraged collaboration with international partners to exchange best practices and knowledge related to green technologies. Additionally, the UAE's Research and Development initiatives have supported climate research, fostering innovation in areas such as climate modelling, sustainable agriculture, and water resource management.

In the realm of education, training, and public awareness, the UAE has placed a strong emphasis on educating its population about climate change and sustainability. Educational institutions and awareness campaigns have been launched to inform citizens about the impacts of climate change and the importance of sustainable practices. Moreover, capacity-building efforts in the UAE have focused on enhancing the skills and knowledge of professionals in various sectors, enabling them to contribute effectively to climate mitigation and adaptation efforts. Finally, the UAE has actively participated in global information and networking platforms related to climate change, sharing its experiences, research findings, and expertise to contribute to international climate cooperation and promote global action on this critical issue.

Constraints and challenges

Despite its classification as a non-Annex I country, the UAE is boldly pursuing ambitious climate goals. As a non-Annex I country experiencing sustained growth, the UAE underscores its developing and expanding nature in addressing climate challenges. Its non-Annex I status stems from its vulnerability to climate change's adverse impacts, with low-lying coastal areas and susceptibility to desertification and drought posing significant challenges.

The UAE is actively working on its infrastructure, including the development of a public transportation network. It is dedicating substantial efforts to enhance both its physical infrastructure, encompassing areas like roads, electricity, water generation, and ports, and its social infrastructure, which includes schools and medical facilities. These efforts showcase the UAE's commitment to building a sustainable and resilient future, recognizing its status as a developing, rapidly growing nation.

In terms of financial requirements, to achieve the UAE's climate objectives and expedite the transition to a low-carbon, sustainable economy, substantial investments are essential. As part of the UAE Net Zero 2050 initiative, a comprehensive financial

assessment estimates an investment of AED 134 billion from 2023 to 2030. The UAE Energy Strategy 2050 aims to triple renewable energy's contribution, with an investment of AED 150 to AED 200 billion by 2030. The country is actively pursuing policies to attract financing from the private sector and the UAE government, turning climate action into an appealing investment opportunity. Strategies like power purchase agreements (PPAs), foreign direct investment (FDI) attraction, and public-private partnerships (PPPs) are being employed to make the UAE an appealing destination for investments. This includes the funding of high-cost, long-term projects within the transport sector and areas like carbon capture and storage (CCS) and hydrogen.

The UAE is also working on technology and innovation requirements by focusing on key technologies such as Carbon Capture and Storage (CCS), Direct Air Capture (DAC), hydrogen production and distribution, and the use of recycled materials. It recognizes the importance of research and development (R&D) to achieve its ambitious objectives and has outlined a comprehensive strategy for technology and R&D. Initiatives like the Emirates Research and Development Council and the Virtual R&D Hub are mobilizing resources for technological advancements.

Furthermore, to build capacity and enhance human resources, the UAE is taking proactive measures, aiming to create job opportunities in the green economy and upskill its workforce. This includes preparing citizens to leverage opportunities arising from the emerging green economy, increasing awareness of climate change, and building capabilities for effective policy implementation. Initiatives like the UAE Climate Change Research Network (CCRN), the Jahiz program, and capacity-building programs for educators demonstrate the UAE's commitment to empowering its workforce and educational system.

In summary, the UAE's multifaceted approach, driven by its ambitious climate goals, is a testament to its commitment to addressing climate change related constraints and challenges despite its non-Annex I status and its unique vulnerabilities.

Addressing Climate Change: UAE's Commitment and Action

Welcome to UAE's 5th National Communications Report

In my capacity as Minister of Energy and Infrastructure of the United Arab Emirates, I am pleased to present the National Communication Report, which underscores our nation's steadfast commitment to tackling the global climate crisis. This report comprehensively outlines various aspects of our fight against climate change, including the national context, the National Greenhouse Gas Inventory, as well as our proactive efforts through local policies and actions and effective international collaborations.

Climate change is no longer a distant concern but an imminent and pressing challenge that necessitates unified concerted action. The UAE fully grasps the gravity of this issue and is resolutely dedicated to making a positive contribution to the worldwide endeavours aimed at mitigating its adverse impacts.

The UAE acknowledges that climate change presents a multifaceted challenge, impacting ecosystems - economies, and societies alike. In response, we have embarked on a transformative journey to shift our economy towards a more sustainable and low-carbon model. Central to this endeavour is our commitment to diversifying our energy sources, with a particular emphasis on renewable energy options, such as solar and wind power. We have set a target to achieve net-zero emissions by 2050 in line with the Paris Agreement, making us a leader in the region. The UAE's recently published third update of the second NDC showcases the country's 2030 emissions reductions target, increasing its ambition from previous NDC publications.

Furthermore, we are actively investing in research and development of clean technologies and sustainable practices. Initiatives like Masdar City, which serves as a shining example of sustainable living and a growing clean-tech cluster, underscore our dedication to innovation in the clean energy sector.

Our commitment to addressing climate change is enshrined in progressive policies and regulatory frameworks. We have implemented energy efficiency standards and are working on bolstering emission reduction goals and the adoption of carbon pricing mechanisms. These policies and initiatives will not only contribute to reducing our carbon footprint but also add to the global momentum toward a more sustainable future.

The industrial and energy sectors in the UAE are pivotal partners in our journey to combat

climate change. Our industrial sector is increasingly adopting cleaner production processes, while the energy sector is investing in advanced technologies to curtail emissions from traditional energy sources and gradually shift towards clean energy. Our holistic approach underscores the importance of transitioning to sustainable practices without compromising economic growth and development.

We firmly believe that climate change is a global challenge that requires global action. The UAE actively engages in international collaborations on climate change. Furthermore, we have committed to supporting developing nations in their climate change mitigation and adaptation efforts through financial aid and knowledge-sharing.

Despite the significant steps we've taken, the UAE remains vulnerable to the impacts of climate change, including rising temperatures, sea-level rise, and extreme weather events. Our desert landscape and coastal regions are particularly at risk. Recognizing the urgency, we are actively investing in infrastructure, research, and capacity-building to enhance our resilience through adaptation measures.

The United Arab Emirates is wholeheartedly committed to playing a key role in the global fight against climate change. We are making substantial strides to reduce our carbon emissions, diversify our energy portfolio, and collaborate with the international community. Simultaneously, we acknowledge our vulnerability to climate change and are taking proactive measures to fortify our resilience.

This National Communication Report reflects the UAE's unwavering determination to create a sustainable, resilient, and prosperous future for our citizens and the planet. Its preparation has been a collaborative effort involving numerous government and private sector stakeholders in the UAE, all operating under the United Nations Framework Convention on Climate Change. This report illustrates the systematic process and substantial progress that the UAE has achieved in addressing climate change-related issues.

We aspire that our actions will serve as inspiration for others to join us in this crucial journey toward a more sustainable and climate-resilient world. Together, we can make a lasting impact in the battle against climate change.

Suhail Mohamed Faraj Al Mazrouei

Minister of Energy and Infrastructure
United Arab Emirates

CHAPTER 1: NATIONAL CIRCUMSTANCES

Chapter 1

National circumstances

Governance

Being a federation comprised of seven emirates, the UAE approaches climate policies through a comprehensive, whole-government framework that involves various entities, in accordance with their constitutional legal and executive roles and jurisdictions. In 2022, the UAE established the UAE Council on Climate Action, an inter-ministerial and inter-emirate governing body, to ensure consistency and alignment between federal and emirate-level policies and initiatives. The UAE has demonstrated its commitment to addressing climate change and adapting to its effects through a series of decisive actions.

In 2017, the UAE introduced the National Climate Change Plan 2017-2050, which serves as a blueprint for managing GHG emissions, climate adaptation strategies, and promoting economic diversification through innovation in the private sector. In October 2021, the UAE embarked on a significant journey towards achieving net-zero emissions with development of the UAE Net Zero strategy. This initiative marked a strategic milestone and was built upon the foundation of more than 30 existing strategies spanning all sectors. Concurrently, other policies, such as the UAE Energy Strategy, Hydrogen Strategy, were revised or developed during the formulation of the net-zero pathway.

The UAE's Net Zero by 2050 Strategic Initiative aligns seamlessly with the objectives of the Paris Agreement, which calls for the implementation of long-term strategies to reduce emissions. The overarching aim is to attain global net-zero GHG emissions during the latter half of this century.

Figure 1: Programs considered in UAE Net Zero 2050 Strategic Initiative

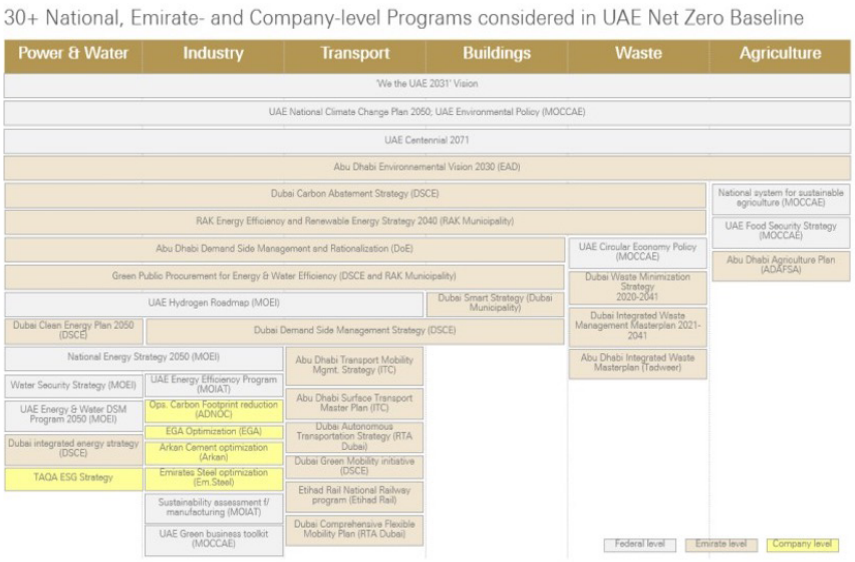


Image courtesy: Ministry of Climate Change and Environment, UAE

The governance system of the UAE is founded on a federal structure established by its constitution. Following the pattern commonly observed in federal systems, each of the individual emirates within the UAE retains specific powers. At the federal level, the governance framework encompasses a network of interconnected governing bodies, which includes the Federal Supreme Council, the Federal National Council (a parliamentary body), the UAE Cabinet, and the Federal Judiciary—an independent judicial branch.

The Federal Supreme Council holds the position of the highest constitutional authority in the UAE. Composed of the rulers of each constituent emirate, it also functions as the highest legislative and executive authority, responsible for formulating general policies endorsing various federal legislations, and electing a president from among its members, who serves a five-year term.

Following this, the Prime Minister/Vice President proposes the formation of the Cabinet, which necessitates the president's approval. Legislative authority is shared with the Federal National Council, which engages in discussions, reviews, and provides recommendations on federal draft laws, constitutional amendments, annual budgets, and international treaties. Comprising 40 members representing all seven emirates, with half of them directly elected by the citizenry and the other half appointed, the Federal National Council wields substantial influence in the process of crafting new legislation, given that most of their suggestions and amendments have been put into effect.

The Federal National Council (FNC) serves as the consultative and parliamentary body within the UAE. The FNC holds membership in both the International Parliamentary Union (IPU) and the Arab Parliamentary Union (APU). Its

primary roles encompass:

- Evaluating, modifying, or declining federal draft laws, including those related to financial matters.
- Reviewing the draft law for the Annual General Budget and the draft law for the final accounts.
- Deliberating international treaties and agreements.
- Engaging in discussions concerning general topics pertaining to the Federation and providing recommendations on these matters.

The executive arm of the UAE, known as the Cabinet or the Council of Ministers, is responsible for managing all domestic and international matters of the Federation in accordance with the UAE Constitution and federal laws. It operates under the oversight of the President and the Federal Supreme Council.

The Cabinet is composed of the following members:

- The Prime Minister
- Two Deputy Prime Ministers
- The Ministers of the UAE
- An operational General Secretariat staffed with several employees who assist in its daily operations.

The Federal Judiciary, whose autonomy is safeguarded by the Constitution, encompasses the Supreme Court and the Courts of First Instance. The Federal Supreme Court is comprised of five judges appointed by the Supreme Council. These judges preside over matters related to the constitutionality of laws, disputes between emirates, and conflicts between individual emirates and the federal government.

As the UAE embarks on a new phase marked by economic, political, and social growth, H.H. Sheikh Mohamed bin Zayed Al Nahyan, the President of the UAE, in conjunction with H.H. Sheikh Mohammed bin Rashid Al Maktoum, the Vice-President and Prime Minister of the UAE and the Ruler of Dubai, introduced the “Principles of the 50.” This framework establishes key priorities for the UAE government and its agencies, delineating the objectives for the forthcoming stage of the UAE’s development journey.

The local governments of the seven emirates in the United Arab Emirates exhibit variations in size and organizational structures, depending on factors such as population, geographical area, and development levels. Each emirate operates with an executive council functioning under the supervision of the emirate’s Ruler’s Court, alongside several autonomous agencies with distinct powers. Here is an overview of the local government structures in each of the seven emirates:

Abu Dhabi:

Abu Dhabi features a central governing body known as the Executive Council, which assists the Ruler in executing their duties and powers. Several departments and municipalities operate under this Council, implementing the emirate’s policies. Abu Dhabi is divided into three primary regions, each with a dedicated municipality to manage local affairs. Additionally, the emirate hosts the National

Consultative Council (NCC), comprising 60 members selected from the main tribal and familial groups.

Dubai:

Dubai's main decision-making government entity is the Dubai Executive Council (DEC), responsible for maintaining the city's security, public utilities, and fostering economic and social progress. DEC collaborates with the Ruler of Dubai, in devising development plans and local legislation.

Sharjah:

Sharjah's local government structure includes an Executive Council and a Consultative Council. The emirate practices decentralization by devolving authority on a local basis with branches of the Emiri Diwan, led by Deputy Chairmen in locations such as Kalba and Khor Fakkan.

The remaining emirates also maintain a similar pattern, consisting of Councils, municipalities, departments, and autonomous agencies as part of their local government structures.

The ministerial framework outlined by the UAE government comprises several ministries aimed at facilitating sustained national development. These ministries encompass:

Ministry of Defence: The Ministry of Defence is a crucial institution that safeguards the UAE's national defence, sovereignty, and victory against evolving threats. The Ministry plays a pivotal role in ensuring the nation's security and advancing its interests. Its mission encompasses understanding the strategic operating environment, designing future-oriented defence strategies, and optimizing the development and utilization of national capabilities. Collaborating with other national entities and international allies, the Ministry works tirelessly to protect the UAE's well-being.

Presidential Court: The Presidential Court, formerly known as the Ministry of Presidential Affairs, is a crucial institution that supports the UAE's decision-makers. The Court plays a pivotal role in providing support and consultation to the leadership, fostering a distinguished and high-quality level of competence, and enhancing the central role of the Court in developing national policies and community services. The Court's values, as defined by its Strategic Plan 2022-2024, are loyalty, integrity, team spirit, innovation, professionalism, social responsibility, and flexibility.

Ministry of Finance: The Ministry of Finance of the United Arab Emirates is a crucial institution that oversees the efficient and proactive management and development of the federal government's financial resources. It implements active fiscal policies, maintains excellent abilities, and strengthens local and international relations to achieve development, sustainability, and the integrity of the fiscal system in accordance with best practices. The Ministry aspires to be a global leader in the fiscal field, contributing to the fulfillment of the UAE Vision. Its values, teamwork, professionalism, leadership and excellence, transparency and accountability, innovation, and social responsibility, guide its employees to excel in their work and create a positive work environment. The Ministry's strategic goals aim to promote fiscal planning, enhance budget efficiency, maintain financial interests at an international level, strengthen UAE's competitiveness, provide quality administrative services, and promote innovation.

Ministry of Interior: The Ministry of Interior

(MoI) is a major federal agency in the UAE that plays a crucial role in ensuring the security and stability of the country. The MoI has undergone significant development to meet the evolving needs of UAE society. Its mission is to maintain security and order, prevent crime, promote a sense of security, contribute to achieving justice through the rule of law, and preserve the authority of the state by maintaining effective police services both in the field and in practice. The MoI's security strategy covers the state, the society and the individual, and aims to enhance the quality of security life by ensuring flexibility, proactiveness and innovation. This in turn consolidates the role of the security system in achieving the wellbeing of Emirati society, protecting its security and maintaining its stability, while maintaining full preparedness for changes and keeping abreast with global developments.

Ministry of Foreign Affairs: The Ministry of Foreign Affairs of the United Arab Emirates (UAE) is a government ministry responsible for the formulation and implementation of the UAE's foreign policy. The ministry is headed by the Minister of Foreign Affairs, who is appointed by the President of the UAE. The ministry's headquarters are in Abu Dhabi, the capital of the UAE. The UAE's foreign policy is based on the principles of peaceful coexistence, mutual respect, non-interference in other countries' internal affairs, and support for international peace and cooperation. The ministry works to promote these principles through its diplomatic relations with other countries, its participation in international organizations, and its humanitarian assistance programs. The Ministry of Foreign Affairs plays an important role in the UAE's international relations. It is responsible for promoting the UAE's interests abroad, protecting the rights of UAE citizens abroad, and contributing to the peace and stability of the world.

Ministry of Tolerance and Coexistence: The Ministry of Tolerance and Coexistence in the United Arab Emirates is tasked with overseeing and implementing the National Tolerance Program, which aims to promote tolerance, pluralism, and peaceful coexistence within the country and beyond. The ministry embodies the UAE's commitment to fostering a harmonious and inclusive society where individuals from diverse backgrounds can thrive. The ministry's responsibilities encompass various initiatives that promote tolerance and coexistence at all levels, from education and awareness-raising campaigns to intercultural dialogue and community engagement programs. It collaborates with various entities, communities, and affiliations both locally and globally to synergize its role as an enabler of tolerance and understanding.

Ministry of Cabinet Affairs: The Ministry of Cabinet Affairs in the United Arab Emirates (UAE) plays a pivotal role in supporting the Prime Minister, the Cabinet, and various ministerial councils. The ministry functions through the General Secretariat of the Cabinet and the Prime Minister's Office. Its core responsibilities include providing administrative and logistical support to the Prime Minister and the Cabinet, studying and analyzing assigned issues and projects, monitoring government performance, and spearheading excellence initiatives within the federal government. The ministry also conducts research and studies relevant to the federal government's strategy and vision, establishes frameworks and mandates for federal entities, and presents recommendations to the Prime Minister and Cabinet.

Ministry of Health and Prevention: The Ministry of Health and Prevention (MOHAP) in the United Arab Emirates (UAE) plays a crucial role in ensuring the health and well-being of the nation's citizens and residents. The ministry has consistently strived to provide comprehensive and high-quality healthcare services, prioritizing patient care and adopting global best practices.Guided by the UAE's wise leadership, MOHAP has implemented numerous initiatives and projects to promote community health through innovative and comprehensive services. The ministry has adopted a methodology that emphasizes excellence and professionalism, establishing state-of-the-art hospitals equipped with cutting-edge technology, employing highly experienced medical professionals, and launching various campaigns to enhance health awareness among the community. The UAE's commitment to the healthcare sector is evident in its national health strategy, which encompasses international standards in infrastructure management, quality systems, therapeutic safety, health and pharmaceutical systems, and a robust legislative framework for governance. MOHAP has also prioritized the development of health information systems and regulatory and oversight services for the healthcare sector. Furthermore, the UAE has embraced artificial intelligence (AI) and digital medical services, with MOHAP developing a comprehensive plan to integrate AI 100% into healthcare services, aligning with the UAE's AI Strategy and the nation's vision for 2071 to transform patient healthcare.

Ministry of State for Federal National Council Affairs: The Ministry of State for Federal National Council Affairs (MFNCA) is a federal ministry in the United Arab Emirates responsible for coordinating between the government and the Federal National Council (FNC), the country's legislative body. The ministry's mission is to promote integration and cooperation between the government and the FNC, and to develop awareness of parliamentary life and political participation among citizens. The ministry's values are innovation, integrity and transparency, happiness and positivity, leadership, efficiency, and teamwork. The ministry's objectives include raising the efficiency and effectiveness of cooperation and integration between the government and the FNC, developing awareness of parliamentary life and political participation among citizens, promoting the political empowerment of UAE citizens, attracting and empowering the best human talent and providing efficient and effective administrative services and digital infrastructure, and enhancing innovation practices based on agility, proactivity, responsiveness, and readiness within the work system.

Ministry of Energy and Infrastructure: The Ministry of Energy and Infrastructure in the United Arab Emirates (UAE) is a federal ministry responsible for organizing, developing, and enhancing the competitiveness of the UAE's energy, water, infrastructure, housing, and transportation sectors. The ministry's mission is to organize, develop, and enhance competitiveness in energy, mining, water resources, land and sea transportation, roads, utilities, housing, building and construction, sustainability of investment as well as the optimal use of partnerships, technology and advanced sciences, also adopting global innovative solutions to improve the quality of life of the society.

The ministry is responsible for a wide range of functions, including: planning and developing the UAE's energy sector, including oil and gas, renewable energy, and nuclear power,

managing the UAE's water resources, including desalination plants and dams, building and maintaining roads, bridges, and other infrastructure, providing housing for UAE citizens, managing the UAE's transportation systems, including roads, railways, airports, and ports, and developing innovative solutions to improve the quality of life in the UAE.

Ministry of Industry and Advanced Technology: The Ministry of Industry and Advanced Technology (MoIAT) is a government ministry in the United Arab Emirates responsible for overseeing and strengthening the country's industrial sector. The ministry's mission is to develop an integrated industrial system that leverages advanced technologies and Fourth Industrial Revolution solutions to contribute to building a sustainable, knowledge-based economy. MoIAT's key responsibilities include developing and implementing policies and strategies to promote industrial growth and development, encouraging the adoption of advanced technologies and innovations in the industrial sector, supporting the development of a robust quality infrastructure, attracting foreign direct investment (FDI) into the industrial sector, promoting exports of Made in the Emirates products.

Ministry of Education: The Ministry of Education is the federal government ministry responsible for overseeing and regulating education in the United Arab Emirates (UAE). The ministry is responsible for developing and implementing education policies and strategies, setting standards for curriculum and assessment, and overseeing the work of schools and higher education institutions. The ministry also plays a role in promoting innovation and creativity in education, and in supporting the development of a knowledge-based economy. The ministry has launched a number of initiatives to improve the quality of education in the UAE, including the development of a new national curriculum, the introduction of a standardized assessment system, and the establishment of a number of specialized schools.

Ministry of Economy: The Ministry of Economy is the federal government ministry responsible for overseeing and regulating the economy of the United Arab Emirates (UAE). The MoE is committed to playing a leading role in the UAE's economic development. The ministry's work is aimed at creating a world-class economy that is competitive, diversified, and sustainable. Key responsibilities of the Ministry of Economy UAE include: develop and implement economic policies and strategies, promote economic growth, diversification, and sustainability, attract foreign direct investment (FDI), promote exports, support small and medium-sized enterprises (SMEs).

Ministry of Community Development: The Ministry of Community Development (MOCD) is a government ministry in the United Arab Emirates responsible for social development in the country. The MOCD is committed to playing a leading role in the UAE's social development. The ministry's work is aimed at creating a world-class society that is inclusive, compassionate, and sustainable. Key responsibilities of the Ministry of Community Development UAE include: develop and implement social development policies and strategies, promote social cohesion and family harmony, empower individuals, families, and communities, provide social assistance and support to the most vulnerable members of society, protect the rights of children, people of determination, and other vulnerable groups, promote volunteering and community service, regulate social professions and organizations, conduct research and studies on social issues, represent the UAE in international forums on

social development.

Ministry of Climate Change and Environment: The Ministry of Climate Change and Environment (MoCCE) is a government ministry in the United Arab Emirates responsible for environmental protection and climate change mitigation and adaptation. MOCCAE's mission is to lead the UAE's efforts to address climate change and protect its unique environmental systems. The ministry is responsible for developing and implementing comprehensive policies and initiatives to mitigate and adapt to climate change, and to conserve and protect the UAE's natural resources. Moreover the Ministry is also responsible for submissions to the UNFCCC including the preparation of the following documents: Nationally Determined Contributions report, National Adaptation Plan, Biennal Transpency Report, Long-term Low Greenhouse Gas Emission Development Strategies, and the preparation of the National MRV Enhanced Transparency System to support the national inventory reporting in the future.

Ministry of Human Resources and Emiritisation: The Ministry of Human Resources and Emiratisation (MOHRE) is the government ministry in the United Arab Emirates responsible for human resources and labor affairs. MOHRE's mission is to empower Emirati talents and attract international expertise to support the UAE's economic growth and social development. The ministry is responsible for developing and implementing policies and strategies to promote employment, protect workers' rights, and enhance the quality of life for all UAE residents. MOHRE is committed to playing a leading role in the UAE's efforts to attract and retain talent. The ministry's work is aimed at creating a world-class labor market that supports the UAE's economic and social development. Key responsibilities of the Ministry of Human Resources and Emiratisation UAE include develop and implement policies and strategies to promote employment and protect workers' rights, manage the labor market, provide career guidance and, counseling, conduct labor inspections, enforce labor laws, resolve labor disputes, promote Emiratisation, attract international talent.

Ministry of Justice: The Ministry of Justice (MoJ) is a federal government ministry in the United Arab Emirates responsible for the administration and supervision of the UAE's judicial system. The MoJ's mission is to promote and uphold the rule of law in the UAE, and to ensure that the UAE's judicial system is fair, efficient, and accessible to all. The ministry is responsible for a wide range of functions, such as budgeting and financial management of the UAE's judicial system, overseeing the appointment of judges and other judicial officials, developing and implementing policies and strategies for the improvement of the UAE's judicial system, providing administrative and technical support to the UAE's courts, representing the UAE's judicial system in international forums.

Ministry of Culture and Youth: The Ministry of Culture and Youth is a federal government ministry in the United Arab Emirates responsible for culture and youth affairs. The ministry's mission is to preserve the UAE's identity, enhance and strengthen the position of the cultural and youth sectors globally and maximize their contribution as productive and effective sectors within the national economy. The ministry is responsible for a wide range of functions, including: developing and implementing, policies and strategies for the promotion of culture and youth affairs, supporting the UAE's cultural institutions,

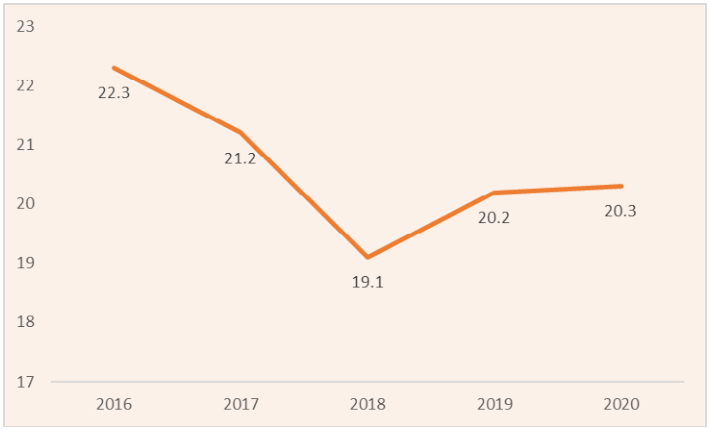
providing funding for cultural and youth projects, organizing cultural events and festivals, promoting Emirati culture and heritage, investing in youth development, supporting youth entrepreneurship, empowering youth to participate in decision-making.

Population

Over the past decade, the UAE has experienced a substantial surge in its foreign population, primarily driven by remarkable growth across various economic sectors. The UAE has become home to over 200 nationalities, drawn to the country for work and educational opportunities.

The UAE recognizes the importance of engaging its youthful population in climate action efforts. To achieve this, the country has established programs like low-carbon class activities, which serve as specialized sustainability initiatives tailored for young people. Moreover, the UAE is committed to promoting gender inclusivity across different economic and national endeavours including in its climate change related efforts. This commitment is evident in the substantial participation of women in the UAE's climate and energy sectors, including key roles within the UAE Office of the Special Envoy for Climate Change. Additionally, the country has established a dedicated platform called "Women in Sustainability, Environment, and Renewable Energy" (WiSER) to further empower and involve women in activities related to sustainability, the environment, and renewable energy. As per World Bank, the per capita CO2 emissions have reduced from 22.3 metric tons in 2016 to 20.3 by 2020 marking a decline of approximately 9%.

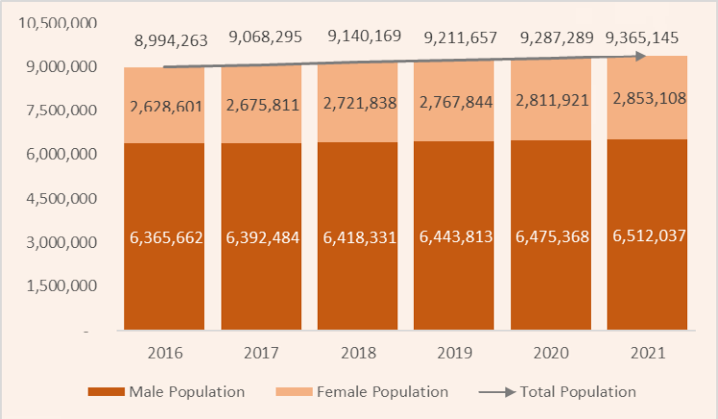
Figure 2: UAE per capita CO2 emissions (Tons per Capita), 2016 - 2020



Source: World Bank

According to data from the World Bank, in 2021, the UAE's population stood at approximately 9,365,145. Of the total population, 70 percent are male (6,512,037), while 30 percent are female (2,853,108).

Figure 3: UAE population statistics, 2016 - 2021



Source: World Bank

The UAE's population density in 2020 was 130.7 people per sq. km, however the majority of the UAE's population resides in its two largest cities, Abu Dhabi and Dubai. The harmonious coexistence of citizens and residents exemplifies the UAE's society as a model of tolerance and inclusivity. As part of the National Agenda, one of the key performance indicators (KPIs) aimed at fostering a cohesive society and preserving national identity is the National Identity Index. As of 2021, this composite indicator measured citizens' sense of belonging and national identity, and it registered at an impressive 97.8 percent.

Geography and Topography

The UAE, situated in the Middle East within the Gulf region between latitudes 22.0^{o} and 26.5^{o} North and about 51.0^{o} and 56.5^{o} East, has a predominantly flat terrain. It encompasses a coastal plain that transitions into expansive desolate desert expanses adorned with rolling sand dunes. Additionally, there are mountainous regions located in the eastern part of the country. The geographical diversity of the UAE makes it imperative to establish a stringent climate change framework to sustainably preserve and enrich the existing ecosystems.

Total land area is about 71,023.6 square kilometers. There are seven emirates that make up the UAE — the emirates of Abu Dhabi, Dubai, Sharjah, Umm-al-Quwain, Ajman, Ras Al Khaimah and Fujairah. Ongoing land reclamation projects in the Gulf are extending the coastline and increasing the total land area of the UAE. As the largest emirate, Abu Dhabi takes up over 80% of the UAE's total area, about 59,434.7 square kilometers, followed by Dubai and Sharjah. The smallest emirate, Ajman, encompasses just 268.2 square kilometers. The UAE has around 200 islands and the country shares significant portions of its borders with Oman (410 km) and Saudi Arabia (457 km), and has a coastline that extends for about 1,318 kilometers (819 miles)[6].

[6]Federal Competitiveness and Statistics Centre, UAE

Desert and Mountains

Image courtesy: Ministry of Climate Change and Environment, UAE

This arid landscape is characterized by a diverse array of geographical features, including sand dunes, oases, rocky-mountains, valleys, marshes, mangroves, and salt plains. The oases are primarily populated by date palms, with a significant number of them situated in the emirate of Abu Dhabi.

To the east, the country is bordered by the Hajjar Mountains, which run from north to south. These mountains are complemented by valleys known as “wadis” in Arabic. Typically dry, these wadis come to life during the cooler months when rainfall transforms them into vibrant watercourses with brooks and pools.

Wetland and marine ecosystems

The UAE has diverse marine life residing in its seas, including various fish species, invertebrates, and other marine creatures. Particularly, the southwestern waters of Abu Dhabi, the Marawah Marine Biosphere Reserve in Abu Dhabi, Jebel Ali in Dubai, Sir Bu Na’air Island, and Khor Kalba in Sharjah are globally recognized for their exceptional biodiversity and ecological significance. These marine habitats not only provide a haven for marine organisms but also serve as crucial defences against coastal erosion and contribute to mitigating climate change.

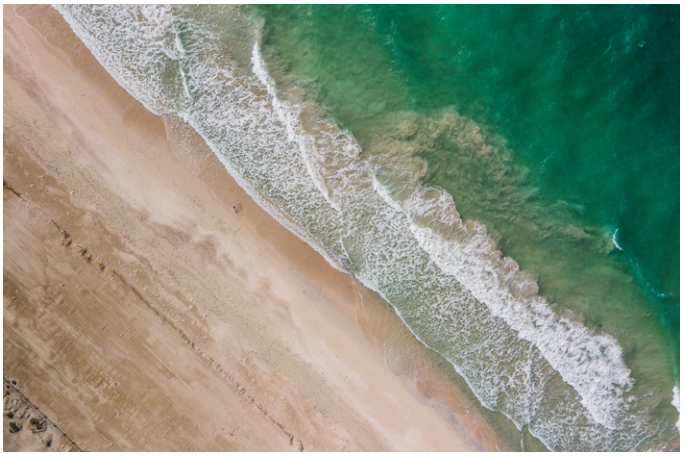


Image courtesy: Ministry of Climate Change and Environment, UAE

The distribution of marine life is influenced by several factors, including surface type, tidal patterns, water currents, wave exposure, temperature, and salinity levels. The marine biodiversity of the UAE is characterized by a wide array of fish, aquatic plants, and coral formations. The Arabian Gulf is home to significant populations of dugongs, eight species of dolphins, and marine turtles. The green turtle, in particular, is prevalent, with a diet primarily consisting of the extensive seagrass beds found in shallow waters. Hawkbill turtles are known to frequently nest on the UAE's coastlines and islands, while green turtles have been spotted to sporadically nest.

Mangroves, referred to as "qurms" in Arabic, play a vital role in the marine ecosystem. They are a distinctive feature of the UAE's coastal regions. Along with the Coral reefs they serve as vital habitats for numerous marine creatures. These areas are essential for fish breeding and feeding, in addition to safeguarding the shores from coastal erosion. Unfortunately, these fragile ecosystems face threats from coastal development, fishing activities, anchoring, and the actions of uninformed divers. Coral reefs are highly sensitive to changes in their environment and require decades to regenerate. The predominant marine life categories in the UAE coastal regions encompass fish, marine mammals, birds, and marine reptiles.

Salt plains, known as "sabkhas" in Arabic, are also commonly found in the country's landscape. These present-day sabkhas began forming around 4,000 years ago.

Climate

The Arabian Peninsula is known for its limited water resources and extreme heat. It has an arid climate characterized by infrequent rainfall patterns and it falls within the subtropical region, with scorching summers and relatively milder to cooler winters. Despite these challenging environmental conditions, the UAE has successfully adapted to its arid desert environment and has built a resilient economy. However, the ongoing climate crisis is projected to exacerbate difficulties for the UAE's environment, economy, and society, as depicted in the figure below:

Figure 4: Priority climate risks for UAE

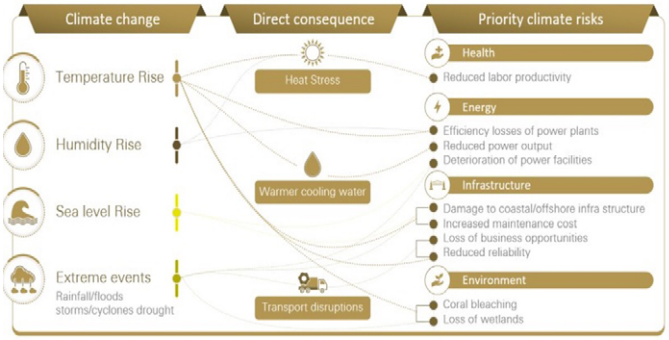
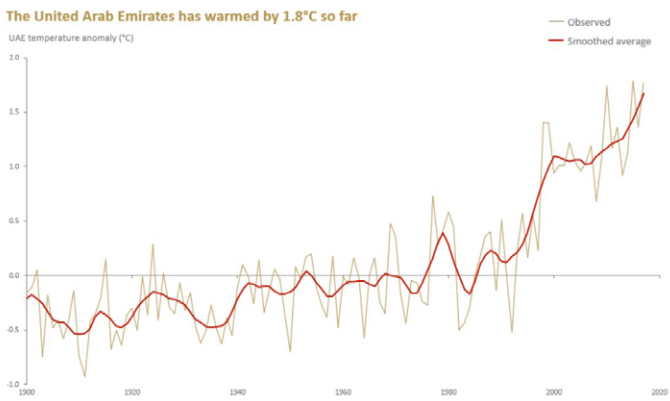


Image courtesy: Ministry of Climate Change and Environment, UAE

Figure 5: United Arab Emirates (UAE) temperature anomaly



Source: The UAE's third update of the second NDC

The UAE is already experiencing severe climate impacts, with significantly higher average temperature increases compared to the global average. Climate projections for the UAE and the Arabian Gulf region indicate that these challenges will intensify, leading to higher temperatures, increased humidity, longer periods of hot and humid weather, heavier rainfall, rising sea levels, and alterations in seawater salinity. Additionally, there is a heightened likelihood of more frequent and severe natural disasters. The UAE has been proactive in addressing the adverse effects extreme weather conditions across various sectors, primarily:

Energy

- Rising temperatures and climate change pose challenges to the domestic power industry, such as, leading erratic and highly unpredictable demand, impacting efficiencies of power plants etc.
- To combat climate change and promote sustainability, the UAE is expanding its clean energy generation and exploring eco-friendly cooling technologies and refrigerant reduction methods.
- The deployment of smart meters, especially in Dubai, is aimed at countering energy efficiency losses.

Infrastructure

- The UAE faces threats to coastal and offshore infrastructure from extreme weather events, rising sea levels, and changes in seawater characteristics.
- To bolster resilience, the UAE promotes the construction of green buildings and the refurbishment of existing structures.
- Urban planning, such as the Abu Dhabi 2030 Urban Structure Framework Plan and the Fujairah 2040 Plan, considers climate-resilient infrastructure.

Environment

- The UAE's arid environment is under pressure from increasing temperatures and extreme events, impacting ecosystems and biodiversity.
- The UAE's Climate Risk Assessment monitors climate change's effects on natural resources and habitats.
- The UAE enforces regulations, establishes protected areas, and encourages eco-friendly practices in sectors like fishing and farming.
- Efforts to protect coral reefs include monitoring, rehabilitation, and marine protected areas, covering 12% of territorial waters.

Climate overview

During the winter season, which spans from December to March, mean temperatures range from a mild 18°C to 23°C. As first transitional period approaches in April and May, mean temperatures transition to a range of 27°C to 32°C. The summer season, on the other hand, brings scorching mean temperatures, often exceeding 50°C, especially in the inland regions. During this time, the mean temperature hovers between 33°C and 36°C. As the country transitions into the second half of the year in October and November, mean temperatures settle in the range of 24°C to 29°C.

Winter Season (December to March):

Mean temperatures	18°C to 23°C
Mean maximum temperatures	24°C to 29°C
Mean minimum temperatures	13°C to 17°C
Highest recorded temperature	43.1°C
Lowest recorded temperature	-5.7°C

Source: National Center of Meteorology, UAE

First Transitional Period (April to May):

Mean temperatures	27°C to 32°C
Mean maximum temperatures	34°C to 39°C
Mean minimum temperatures	21°C to 25°C
Highest recorder temperature	50.2°C
Lowest recorded temperature	5°C

Source: National Center of Meteorology, UAE

The UAE's extended summer season is marked by intense heat, occasional dry spells in inland areas, and higher humidity along the coastal regions. In contrast, winter offers cooler conditions with occasional rainfall. The transitional months of April, May, October, and November are characterized by warm and mostly dry weather, creating pleasant conditions.

Summer Season (June to September):

Mean temperatures	33°C to 36°C
Mean maximum temperatures	39°C to 43°C
Mean minimum temperatures	26°C to 31°C
Highest recorder temperature	52°C
Lowest recorded temperature	14.1°C

Source: National Center of Meteorology, UAE

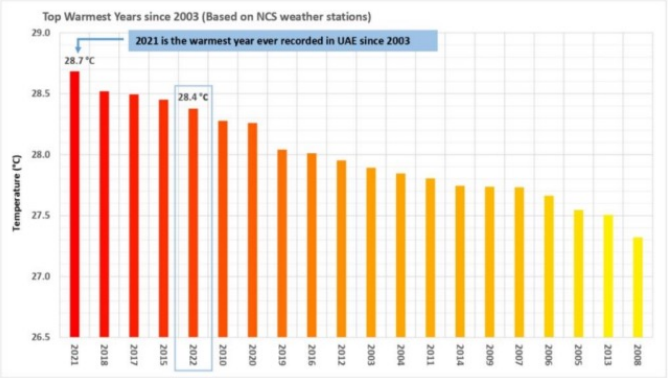
Second Transitional Period (October to November):

Mean temperatures	24°C to 29°C
Mean maximum temperatures	30°C to 36°C
Mean minimum temperatures	19°C to 25°C
Highest recorder temperature	46.3°C
Lowest recorded temperature	4.1°C

Source: National Center of Meteorology, UAE

The UAE experiences an annual mean rainfall of approximately 80 mm per year[7], based on data from 2003 to 2022. Notably, the mountainous and eastern coastal areas receive a higher amount of rainfall compared to other regions. In some exceptional instances, annual rainfall has reached up to 130 mm, such as in 2006. Thunderstorm activity plays a significant role in contributing to precipitation, particularly during the winter months when western upper air troughs pass through the region. Summer rainfall tends to be lower, especially in coastal and inland areas away from the mountains.

Figure 6: Temperature distribution (°C) from 2003 to 2022



Source: National Center of Meteorology, UAE

The UAE also encounters strong north-westerly winds known as the “Shamal.” These winds carry blowing sand and dust, primarily affecting exposed inland areas. Additionally, they cause rough sea conditions with significant wave heights. These winds reduce visibility over inland areas. Fog is a common weather phenomenon in the UAE, with radiation fog being the most prevalent type. It is most prominent during the winter and transitional months.

The UAE experiences a range of extreme climatic events due to its unique geographical location, characterized by arid desert landscapes and a coastline along the Arabian Gulf. The country encounters a hot desert climate, with extremely high temperatures during the summer months. These conditions often lead to heatwaves, which can pose significant health risks. Additionally, the UAE is susceptible to occasional intense rainfall and associated flash floods, especially during the winter season. Dust and sandstorms are also common, causing visibility issues and affecting air quality. Key observed extreme events between 2003 to 2022 are illustrated in the table below:

Extreme events:

Observed extreme events	Characteristics			
	Start	End	Duration	Affected areas with max values
Heat Waves	06/08/2017	10/08/2017	5 Days	Highest 51.4 ° C on 8 August 2017 at Mezaira (Al Dhafra Area)
	10/07/2018	14/07/2018	5 Days	Highest 51.5 ° c on 11 July 2018 at Mezaira (Al Dhafra Area)
	09/06/2019	13/06/2019	5 Days	Highest 51.8 °C on 11 June 2019 at Mezaira (Al Dhafra Area)
	08/08/2021	13/08/2021	6 Days	Highest 50.8 °C on 12 August 2021 at Sweihan
Extreme precipitation episode	17/04/2003		1 Day	Rezeen (153.6 mm)
	02/12/2006		1 Day	Dhudna (131.8 mm)
	13/12/2009		1 Day	Alfoah (121.2 mm)
	21/11/2013		1 Day	Khatam Al Shaklah (125.8 mm)
	09/03/2016		1 Day	Al Shiweb (287.6 mm)
	17/12/2017		1 Day	Fujairah Port(128.8 mm)
	28/10/2018		1 Day	Al Fujairah Port(102.8 mm)
	13/04/2019		1 Day	Ghazla (116.2 mm)
	14/04/2019		1 Day	Ghazla (131.2 mm)
	08/12/2019		1 Day	Mezyed (104.8 mm)
	11/01/2020		1 Day	Khatam Al Shaklah (147.3 mm)
	12/01/2020		1 Day	Saqr Port (115.2 mm)
	21/03/2020		1 Day	Jumeirah (100.4 mm)
	01/01/2022		1 Day	Saih Al Salem(132.8 mm)
	27/07/2022		1 Day	Fujairah port (220.9 mm) - Fujairah Airport (169.4 mm) - Masafi (123.3 mm)
Floods	27/07/2022		1 Day	Floods in Fujairah and surrounding areas
Maximum Wind / Gust	27/02/2010			Mebreh Mountain (141 km/h)
	09/03/2016			Al Bateen Airport (130 km/h)
	20/03/2020			Dalma (123 km/h)
	07/04/2013			Hafeet Mountain (121 km/h)
	10/04/2011			Al Ain Airport (124 km/h)
	16/04/2003			Al Ain Airport (137 km/h)
	17/04/2003			Al Ain Airport (135 km/h)
	03/06/2010			Mebreh Mountain (125 km/h)
	04/06/2010			Mebreh Mountain (121 km/h)
	05/07/2022			Al Ain Airport (130 km/h)
	22/07/2013			Al Ain Airport (120 km/h)
	04/08/2023			Al Hayer (128 km/h)
Sand storm/Dust storm	13/05/2018	13/05/2018	1 Day	Most parts of the country
	28/07/2018	31/07/2018	4 Days	Most parts of the country
	17/05/2022	19/05/2022	3 Days	Most parts of the country
	24/05/2022	26/05/2022	3 Days	Most parts of the country
	23/06/2022	27/05/2022	5 Days	Most parts of the country

Source: National Center of Meteorology, UAE

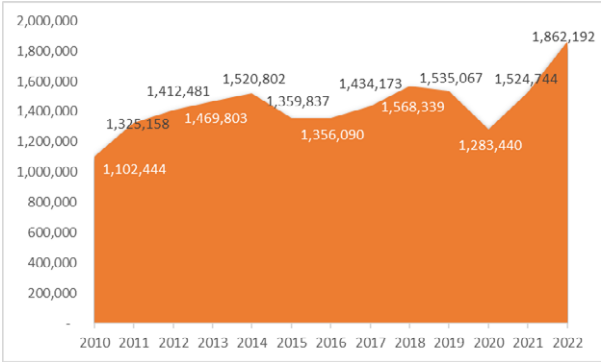
[7] National Center of Meteorology, UAE

Economy

The UAE's economy is set to experience significant growth. The UAE economy has confirmed a better-than-expected performance in 2022, where overall real GDP has reached a healthy growth rate of 7.9%, due to the strong performance of both oil (9.5%) and non-oil (7.2 %) GDP. The projected real GDP growth in the UAE for 2023 and 2024 is anticipated to be 3.4% and 4.0%, respectively. These growth figures for the overall real GDP can be attributed to a moderation in the expansion of the non-oil sector in 2023 and 2024, primarily due to the softening of global demand.

Additionally, there is a notable decline in oil production expected in 2023, resulting from the agreed cuts within the OPEC+ alliance, which is partially reversed in 2024 as certain production constraints ease. It's important to note that the forecasts for both 2023 and 2024 are subject to various uncertainties. These uncertainties are linked to factors such as the evolving situations in other countries, the possibility of a more rapid deceleration in global economic growth than expected, potential adjustments in OPEC+ production cuts, and the likelihood of subdued oil production among other OPEC+ member countries.

Figure 7: UAE GDP at current market prices (Million AED), 2010 - 2022



Source: Ministry of Economy, UAE

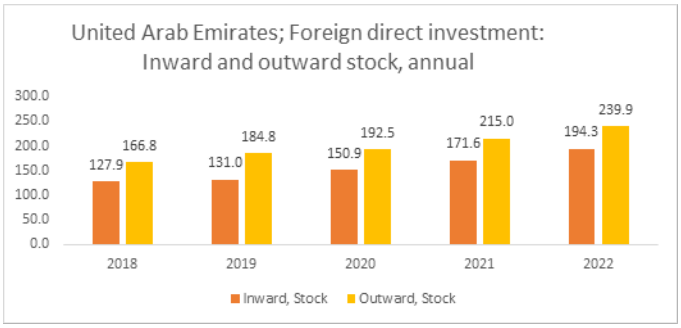
Over the past half-century, the UAE has undergone a remarkable economic transformation. It has shifted from an economy primarily reliant on pearl diving, fishing, and trade in the pre-oil era to one heavily centered on oil production. Following the discovery of oil reserves, the UAE concentrated on developing both its physical infrastructure (including roads, electricity generation, water supply, and ports) and social infrastructure (such as schools and healthcare facilities). The rapid economic expansion necessitated the recruitment of a significant expatriate workforce, leading to heightened demand for construction and infrastructure development.

Despite this pace of growth, the UAE remains committed to achieving absolute GHG emissions reductions, aiming to decouple its economic growth from GHG emissions. The UAE has consistently prioritized economic diversification and has made substantial strides in this regard. The non-oil sector's share of the UAE's GDP has increased from approximately 30-40% in the 1970s to around 72.4% in 2022, including well-established tourism, construction, whole and retail trade, and transportation sectors. The country has also developed a robust industrial sector, encompassing emissions-intensive processes such as cement, steel, aluminium, etc. , which collectively accounted for approximately 10% of total GHG emissions in 2021.

The economic objectives set by the UAE for the year 2030 primarily focus on expeditious economic recuperation and the resurgence of growth rates, all of which are aligned with a carefully planned and gradual trajectory towards establishing a knowledge-driven economy. The UAE's progression into the future will be influenced by strategic investments in

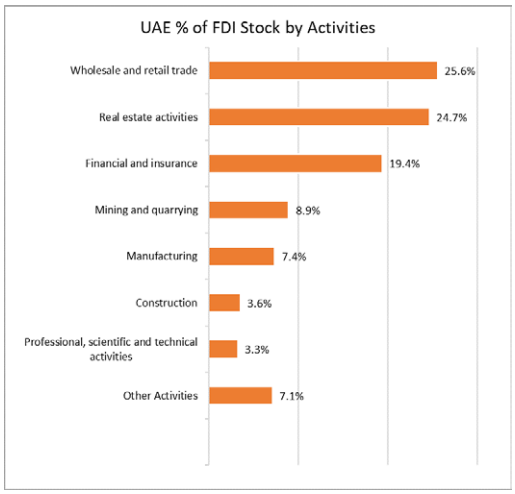
emerging technologies, the implementation of new residency policies aimed at attracting and retaining top-tier talent, and the introduction of more open and competitive economic policies designed to bolster the business environment within the nation.

Figur 8: UAE Foreign Direct Investment, 2018 – 2022 (Billion USD)



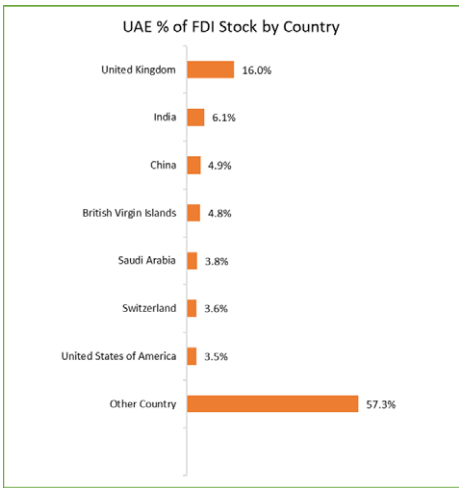
Source: Ministry of Economy, UAE

Figure 9: UAE % of FDI Stock by Activities, 2020



Source: Ministry of Economy, UAE

Figure 10: UAE % of FDI Stock by Country, 2020



Source: Ministry of Economy, UAE

The transition to a low-carbon economy presents an opportunity for further diversification by fostering a competitive, innovation-driven economy, transforming emissions-intensive industries, and positioning the UAE as an export hub for low-emissions technologies and fuels. For instance, The National Hydrogen Strategy 2050 aims to strengthen the UAE's position as a producer and supplier of low-emission hydrogen by 2031. The UAE will achieve this through the development of supply chains, the establishment of hydrogen oases and a dedicated national research and development centre for hydrogen technologies.

Even as this low-carbon transition gains momentum, the UAE acknowledges its responsibility as a reliable energy supplier and guardian of global energy security. To facilitate this transition, the UAE is addressing the issue through engaging in renewable energy investments globally. The UAE is actively supporting other nations in their transitions to renewable energy sources and has already channelled over USD 50 billion into renewable energy initiatives spanning 70 countries, encompassing 27 island nations. The UAE has outlined plans to inject an additional USD 50 billion into such projects by 2035[8].

Energy demand

The United Arab Emirates' (UAE) energy sector is one of the most dynamic and rapidly growing in the world, driven by its vast oil and gas reserves, strategic location, and ambitious diversification plans. The country is a major producer and exporter of oil and gas, and its energy sector plays a critical role in the national economy. In recent years, the UAE has been pursuing a strategy of diversifying its energy mix away from oil and gas and towards renewable energy sources. The country has set ambitious targets for renewable energy deployment, and it is investing heavily in solar, wind, and nuclear power. The UAE is also developing a carbon capture and storage (CCS) industry to reduce greenhouse gas emissions from its oil and gas sector.

Oil and Gas

The UAE's energy landscape is characterized by oil reserves, substantial production capabilities, and active participation in global energy trade. Oil and gas exports played a significant role in the nation's economy, but the country is promoting non-oil trade as non-oil

[8] UAE's First Long Term Strategy

foreign trade continues to grow as it crossed AED 2 Trillion[10] mark for the first time in the country's history in the year 2022, a 17 percent growth over 2021.

Further, under the UAE Net Zero by 2050 Strategic Initiative, the nation has set ambitious goals for reducing its reliance on fossil fuels aiming to significantly reduce the use of natural gas across various sectors. This commitment is noteworthy, especially considering significant economic and population growth.

On the production side, the UAE's Murban crude oil has a carbon intensity of less than half the global industry average. The UAE's oil and gas sector is committed to further emissions reductions. The Abu Dhabi National Oil Company (ADNOC) stands out as a leader in lower-carbon intensity energy production. ADNOC achieves this through its utilization of zero-carbon grid power, a pledge to eliminate routine flaring of gas, and the implementation of a substantial carbon capture project—the region's first of its kind.

ADNOC has consistently maintained one of the world's lowest carbon emissions intensities and has set an additional target of reducing its greenhouse gas emissions intensity by 25% by 2030. To achieve these goals, ADNOC has allocated USD 15 billion[9] for investments in low-carbon solutions, including carbon capture and storage, electrification, and ventures in hydrogen and renewables. Furthermore, ADNOC has publicly stated its ambition to achieve net-zero emissions by 2045.

The successful completion of ADNOC's Al-Reyadah CCUS facility in 2016 marked an important milestone in the country's journey to meet its commitments to emissions reduction and supporting the UAE's efforts towards decarbonizing the nation's economy. Al -Reyadah is the region's first commercial-scale CCUS facility, with an 800,000 tonnes per year of CO2 capture capacity. Al -Reyadah processes the CO2 captured from Emirates Steel Industries, which is then injected into UAE's onshore oilfields to safely store the CO2 while enhancing oil recovery.

Sector overview

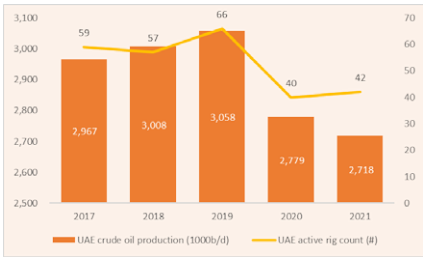
The UAE possesses substantial proven reserves within the energy sector, consolidating its position as a key player in the global energy landscape. Primarily concentrated in the Emirate of Abu Dhabi, the UAE has an estimated 111,000 million barrels of crude oil reserves, making it one of the world's leading holders of these valuable resources. Additionally, the country commands a significant presence in the natural gas market, with proved reserves amounting to approximately 8,200 billion cubic meters (bcm) as of 2021.

The UAE's role extends beyond mere reserves, as it actively participates in the production of oil and gas. In 2021, the country achieved a notable crude oil production rate of around 2.7 million barrels per day (b/d). Furthermore, it contributed approximately 1 million b/d of petroleum products to the global market during the same period. Within the sphere of natural gas, the UAE consistently maintained robust production levels, with an annual average of about 54.5 billion cubic meters in 2021.

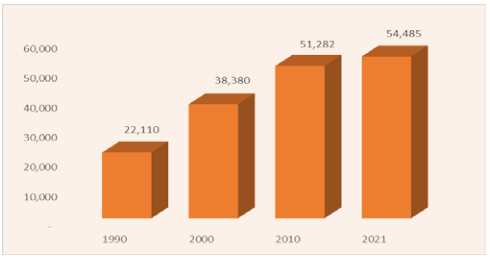
[9] UAE's First Long Term Strategy

[10] https://www.moec.gov.ae/en/-/uae-non-oil-foreign-trade-totals-aed-2.233-trillion-in-2022-setting-new-growth-record

UAE proven crude oil production (1000 b/d) and active rig count (#), 2017 - 2021



UAE annual marketed natural gas production (million cubic meter), 1990 - 2021



Source: Annual Statistical Bulletin 2022, OPEC

On the domestic front, the UAE's energy consumption pattern is influenced by its dual role as both a producer and consumer of oil and gas. While the domestic consumption of oil fuel remains relatively low, accounting for only a small fraction of daily production, the majority of the country's crude oil production is directed towards international exports. Conversely, the consumption of dry natural gas domestically is substantial, with an average of around 76.4 billion cubic meters (2.6 Tcf) in 2021. This divergence underscores the UAE's reliance on natural gas to meet its domestic energy needs while leveraging its substantial oil reserves for export revenue generation.

In terms of trade, the UAE plays a significant role on the global stage. It serves as a net exporter of crude oil, with a substantial portion of its oil exports directed towards the Asia Pacific region, particularly India and China. Conversely, all of the UAE's natural gas production is exported as liquefied natural gas (LNG) to various nations, including India and Japan, amounting to approximately 7.8 billion cubic meters in 2021. However, the UAE concurrently operates as a net importer of natural gas, bringing in approximately 21.5 billion cubic meters in 2021, with a significant portion sourced from Qatar through the Dolphin UAE-Qatar Natural Gas Pipeline. This dual role underscores regional energy cooperation and the UAE's strategy to fulfill its domestic energy requirements.

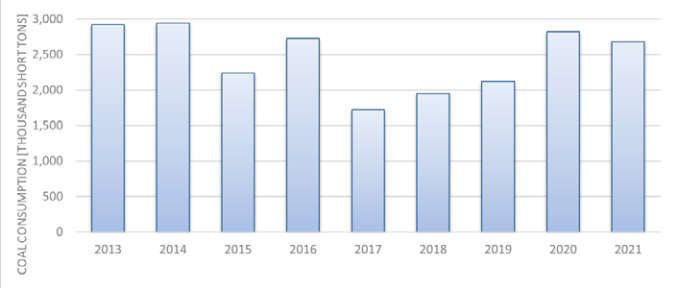
Coal

The Revised Energy Strategy's took substantial strides in addressing climate change and the already ceased coal utilization for power generation since 2022, deviating from the initially projected target in the 2017 Energy Strategy which entailed approximately 12% capacity for clean coal. The Hassyan power plant sets a great example of that, as it was initially designed and commissioned for coal, it is now converted to run on natural gas, furthering the UAE's commitment to emissions reduction.

In addition, the UAE is taking steps to lower emissions from baseload power generation, replacing it by cleaner source of nuclear energy, which provides a constant energy supply even during periods of low solar radiation complementing intermittent solar PV sources. As part of this effort, the UAE has shifted away from coal power generation totally.

The UAE does not possess domestic coal reserves, leading to a notable absence of coal production within its borders. As illustrated in the figure below, the UAE's coal consumption, which is mostly from industrial sector has maintained a relatively consistent pattern, averaging approximately 2.4 million short tons[11] per year over the period spanning from 2013 to 2021. Importantly, the entirety of this coal is sourced through international imports.

Figure 13: Total coal consumption (Thousand Short Tons) in the UAE, 2013-2021



Source: EIA, US

Electricity

Market Structure

The UAE depends on a single buyer approach as of now, where the energy mix is centrally decided, and Power Purchase Agreements (PPAs) are created to encourage private investment in the industry. This encompasses agreements for natural gas-based generation, renewable energy capacity, storage, and other necessary technologies. Furthermore, the UAE's electricity market operates with a decentralized regulatory structure, with each emirate following its regulatory authority. This decentralized approach allows individual emirates to tailor their regulations and policies to meet their specific energy needs and priorities. Here is an in-depth look at the market structure and key regulatory authorities:

[11] Energy Information Agency (EIA), US

Federal Level Regulation

The Federal Ministry of Energy and Infrastructure plays a central role in governing the electricity sector at the federal level. It establishes overarching policies and standards, and frameworks that guide the entire nation in ensuring a reliable, affordable, and sustainable electricity supply.

Emirate-Level Regulation

Emirate-level regulatory authorities oversee and manage the electricity markets within their respective regions. Each emirate has its regulatory body responsible for regulating and supervising electricity production, distribution, and pricing. Key emirates and their regulatory entities include:

Abu Dhabi: The Department of Energy (DoE) is the regulatory authority responsible for overseeing the electricity sector in Abu Dhabi, which includes setting regulations, ensuring compliance, and promoting sustainable practices. The Emirates Water and Electricity Company (EWEC) plays a significant role in electricity production and supply.

Dubai: The Dubai Electricity and Water Authority (DEWA), a self-regulated entity, and the Dubai Supreme Council of Energy (DSCE) jointly oversee the electricity sector in Dubai. DEWA is responsible for electricity generation, distribution, and retail, while DSCE sets policies and strategic directions to ensure energy security and sustainability.

Sharjah: The Sharjah Electricity, Water, and Gas Authority (SEWGA) is the regulatory body governing the electricity sector in Sharjah. SEWGA plays a crucial role in managing electricity supply, infrastructure development, and pricing in Sharjah.

Etihad Water & Electricity: EWE, regulated by Ministry of Energy and Infrastructure, is entrusted with the responsibility of catering to the electricity and desalinated water requirements of the northern emirates namely, Ajman, Umm Al Quwain, Ras Al Khaimah, and Fujairah. Federal Electricity and Water Authority (FEWA) was transformed to EWE to enhance the efficiency and upgrade the services provided by the authority, as stated in the Federal Decree-Law No. (31) of 2020. FEWA was transferred to the ownership of the UAE's sovereign wealth fund, the Emirates Investment Authority.

This multifaceted regulatory framework reflects the UAE's commitment to local governance and ensures that each emirate can independently manage its electricity sector while adhering to overarching federal policies and standards. It allows for flexibility in addressing unique challenges and opportunities within each emirate's energy landscape.

The UAE maintains its competitiveness in the area of energy and infrastructure globally, and has been ranked first in 6 KPIs in the field of Energy and Infrastructure:

- Reliability of electricity supply (Legatum Institute, 2023)
- Access to clean fuels and technology for cooking (Legatum Institute, 2023)
- Population with access to electricity (Legatum Institute, 2023)
- Energy infrastructure (IMD International, 2022)

Advancements in Clean Energy Capacity Transition

The UAE has taken significant strides towards mitigating climate change and transitioning to a more sustainable energy landscape with comprehensive efforts and notable projects underscoring UAE's commitment to diversifying its energy mix while securing a sustainable energy future:

Pioneering Projects in Clean Energy

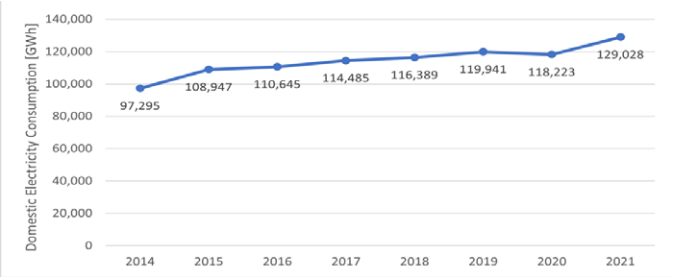
- The Barakah Power Plant is a ground-breaking achievement, marking the UAE's entrance into commercial nuclear power generation. With a planned capacity of 5.6 GW, it is poised to fulfill a significant portion of the UAE's energy needs after commissioning. This nuclear facility will play a crucial role in reducing carbon emissions and advancing sustainability goals preventing the release of 21 million tonnes of carbon emissions each year after completion of all four units in 2024.
- Positioned as the world's largest single-site solar park, the Mohammed bin Rashid Al Maktoum Solar Park is a flagship project for solar energy. With substantial investments totalling AED 50 billion, it makes a significant contribution to clean energy generation and carbon emissions reduction.
- Noor Abu Dhabi is the world's largest stand-alone operational solar plant in Abu Dhabi, Sweihan with a total capacity of 1.2 GW and more than 3.3 million of solar panels in one site. This project has one of the world's lowest solar tariffs
- The 103.5-MW UAE Wind Program, led by Abu Dhabi Future Energy Company PJSC – Masdar, is set to transform the country's energy landscape by introducing cost-effective, large-scale wind power to the grid, powering 23,000 homes, reducing 120,000 tonnes of CO2, and exemplifying the UAE's commitment to climate action.

Collectively, with other projects for reverse osmosis, hydropower, molten salt thermal energy storage system etc., they showcase the UAE's comprehensive strategy for addressing climate change, nurturing sustainability, and diversifying its energy portfolio. The nation's commitment to fostering a balanced energy mix, coupled with substantial investments in renewable energy, plays a pivotal role in realizing its ambitious environmental and energy objectives.

Electricity Consumption

In the year 2021, the UAE witnessed a substantial surge in its domestic electricity consumption, reaching a total of 129,028 gigawatt-hours (GWh). This marked a notable increase compared to the previous year, 2020, when electricity consumption stood at 118,223 GWh. The data reveals a consistent and upward trend in electricity demand spanning the eight-year period from 2014 to 2021, with an average annual consumption of approximately 111,460 GWh. This robust growth in electricity consumption highlights the UAE's expanding requirements for electrical power, primarily driven by factors such as increasing electrification in the nation, growing industrial demand, economic development, and the continued process of urbanization.

Fifure 14: Total domestic electricity consumption (GWh) in the UAE, 2014 – 2021



Source: Ministry of Energy and Infrastructure and Federal Competitiveness and Statistics Centre, UAE

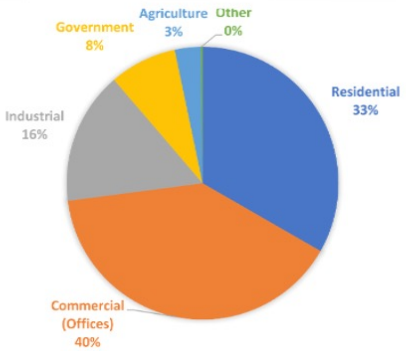
Detailed Sectoral Breakdown of Electricity Consumption

The year 2021 witnessed a multifaceted landscape in the sectoral breakdown of domestic electricity consumption within the UAE. The distribution of electricity consumption across various sectors is as follows:

- **Residential Sector:** Accounting for 33.3% of the total electricity consumption, the residential sector represents a significant portion of domestic power usage. This segment includes households and residential properties, reflecting the electricity needs of the UAE's population.
- **Commercial Sector (Offices):** The commercial sector, consisting of offices and businesses, contributed to 39.7% of the overall electricity consumption. This sector's substantial share underscores the thriving business and commercial activities that are integral to the UAE's economy.
- **Industrial Sector:** The industrial sector accounted for 15.8% of the total electricity consumption. This category includes various industrial processes and manufacturing activities that rely on electricity to power machinery and operations.
- **Government Sector:** Electricity consumption within government facilities and institutions represented 8.0% of the total. This sector encompasses government offices and administrative buildings.
- **Agricultural Sector:** The agricultural sector, which includes farming and agricultural activities, contributed to 3.1% of the electricity consumption. Electricity plays a role in irrigation, lighting, and other agricultural processes.
- **Other Sectors:** Miscellaneous sectors, collectively comprising 0.2% of the total electricity consumption, encompass a range of activities not classified in the primary sectors mentioned above.

This sectoral breakdown highlights the diversified nature of electricity demand within the UAE. While residential consumption reflects the needs of the population, the significant share of the commercial sector underscores the importance of business and commercial enterprises in the country's energy landscape.

Figure 15: Sectoral breakdown of domestic electricity consumption in 2021



Source: International Energy Agency

Total Generating Capacity (as of 2021)

The UAE maintained a robust total cumulative installed generating capacity of 35,678 megawatts (MW) in 2021. This capacity is distributed across various technological sources:

- **Gas Turbines:** Gas turbines accounted for 14.7% of the total generating capacity. These turbines are commonly used for electricity generation due to their efficiency and reliability.
- **Steam Turbines:** Steam turbines contributed 8.6% to the total generating capacity. Steam turbines are known for their versatility and are used in both fossil fuel and nuclear power plants.
- **Diesel Generators:** Diesel generators played a minor role, representing just 0.1% of the total capacity. They are typically used as backup or emergency power sources.
- **Combined Cycle Turbines:** Combined cycle turbines held the largest share, constituting 65.5% of the total generating capacity. Combined cycle power plants are highly efficient, utilizing both gas and steam turbines to generate electricity.
- **Solar:** Solar power made up 7.2% of the total generating capacity. The UAE has been investing in solar energy projects to harness its abundant sunlight for electricity generation.
- **Nuclear:** Nuclear technology contributed 3.9% to the total generating capacity. The emergence of nuclear power in the UAE reflects a commitment to diversifying energy sources and ensuring a reliable power supply.

This diverse mix of technologies underscores the UAE's commitment to a secure and sustainable energy landscape, with a significant emphasis on combined cycle turbines and growing contributions from solar and nuclear sources.*Total Electricity Generation in 2021.*

Total Electricity Generation in 2021

In 2021, the UAE achieved a remarkable total electricity generation of 149,053 gigawatt-hours (GWh). The breakdown of electricity generation by major entities is as follows:

- **EWEC (Emirates Water and Electricity Company):** EWEC was the leading contributor to electricity generation, accounting for 62.1% of the total. EWEC is the sole procurer of water and electricity within the Emirate of Abu Dhabi and exports to other Emirates as well, with the mandate to ensure the supply of water and power to consumers.
- **DEWA (Dubai Electricity and Water Authority):** DEWA closely followed, contributing 33.8% to the total electricity generation. DEWA serves the emirate of Dubai and plays a vital role in meeting the city's electricity needs.
- **SEWA (Sharjah Electricity and Water Authority):** SEWA made a smaller yet significant contribution, representing 3.7% of the total electricity generation. SEWA serves the emirate of Sharjah.

This distribution of electricity generation highlights the pivotal role of key entities such as EWEC and DEWA in ensuring a stable and efficient power supply for the UAE.

Transportation

The UAE Government is committed to pursuing sustainable development while safeguarding the environment as a primary focus for the nation's growth. To achieve this goal, the transportation sector must strike a balance between responsible expansion and economic and social development.

The UAE places a strong emphasis on improving air quality, conserving water resources, increasing the use of clean energy, and implementing eco-friendly growth strategies. In recent years, significant strides have been made in establishing a sustainable transportation sector and infrastructure while minimizing its ecological footprint.

The UAE Government has implemented several initiatives to promote sustainable transportation, including:

1. The UAE Railway Programme: Part of the Projects of the 50, this program involves a substantial investment of AED 50 billion and encompasses a comprehensive strategy for the country's railway sector over the coming decades. It includes a national railway network connecting the seven emirates and major cities, with potential economic opportunities totalling AED 200 billion.

2. Abu Dhabi Transportation Mobility Management Strategy: This strategy aims to foster a shift in attitudes and behaviours towards sustainable modes of transportation, enhance public transport accessibility for all, meet mobility demands, and alleviate traffic congestion and growth.

3. Abu Dhabi Rapid Transport Project: Abu Dhabi has recently also introduced the Automate Rapid Transit Project which can carry up to 200 passengers in a three carriage electric vehicle.

4. Surface Transport Master Plan (Abu Dhabi): The primary objective of this plan is to create a world-class, sustainable transportation system that aligns with Abu Dhabi's economic, social,

cultural, and environmental objectives. It is designed to provide efficient, safe, attractive, reliable, and environmentally responsible transport solutions.

5. Dubai 2040 Urban Master Plan: This strategic master plan integrates various urban development blueprints within the emirate, aligning them with Dubai's economic priorities and future requirements. The plan promotes mass transit, walking, cycling, and flexible transportation methods while enhancing planning databases and transparency.

6. National Electric Vehicles Policy: This policy encourages collaboration with federal, local, and private sector partners to establish a nationwide network of electric vehicle (EV) charging stations. It aims to serve EV owners while regulating the UAE's electric vehicle market.

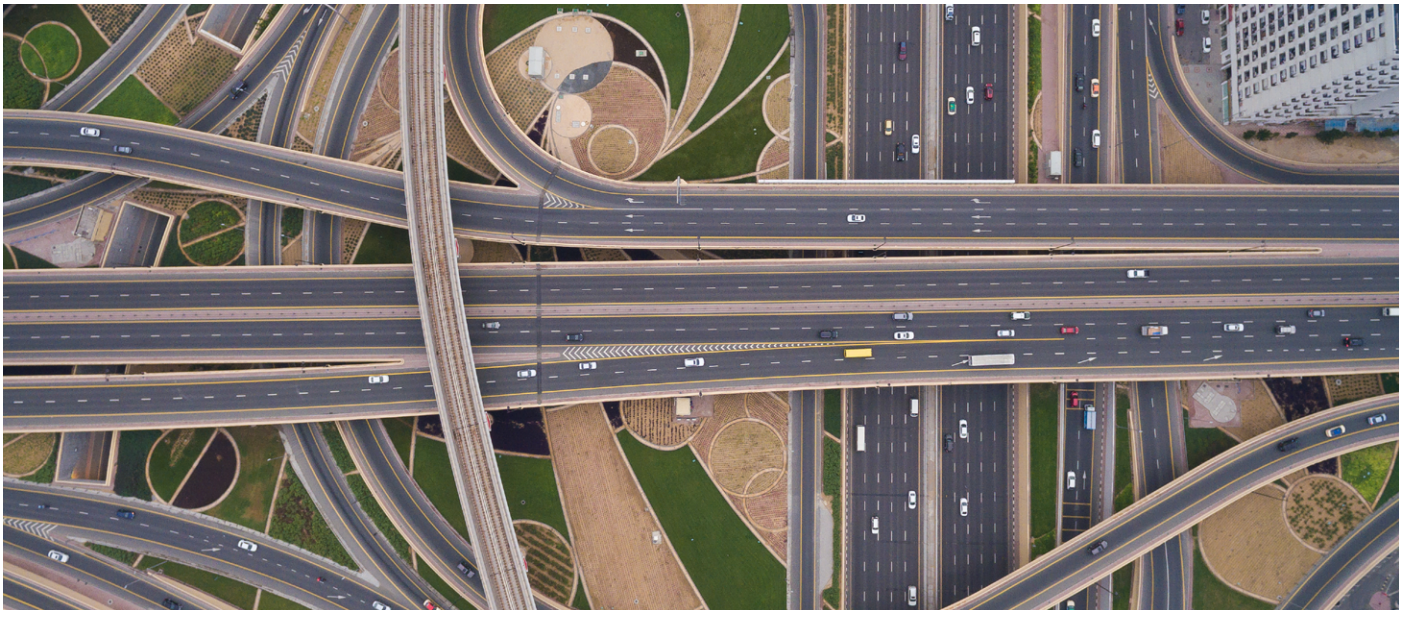
7. Dubai Autonomous Transportation Strategy: Dubai's strategy aims to transition 25 percent of its transportation to autonomous mode by 2030, with goals to reduce accidents, increase productivity, save travel time, and minimize parking requirements.

8. Dubai Green Mobility initiative: Launched by the Dubai Supreme Council of Energy, this initiative promotes sustainable transport and electric vehicles to contribute to the UAE's sustainable development objectives.

Furthermore, the UAE underscores the critical role of infrastructure in enabling economic, industrial, and social progress. The nation has set ambitious targets to become a global leader in road networks, ports, railways, airports, and shipping lanes, positioning itself as a hub for smart services in the Middle East. This reputation is attributed to the UAE's strategic geographic location and its modern, high-traffic airports and ports.

Land transport

Roadways



The UAE has a modern road network. The country has invested significantly in developing a state-of-the-art road infrastructure, characterized by well-maintained highways, advanced transportation systems, and cutting-edge technologies. Moreover, the road network in the UAE is known for its efficiency, safety standards, and integration with advanced urban planning, reflecting the country's commitment to excellence in infrastructure development.

As per the 2019 Global Competitiveness Report from the World Economic Forum, the UAE ranks seventh globally in terms of road quality. The Ministry of Interior Development has taken a significant step by replacing conventional lighting with energy-efficient LED lamps along all federal roads, spanning a total of 710 kilometers. These LEDs are environmentally friendlier, emitting fewer carbon emissions compared to traditional lighting, and have a longer lifespan of up to 10 years, leading to a 50 percent reduction in energy consumption.

Image courtesy: Ministry of Economy, UAE

The UAE continues to prioritize the construction and maintenance of roads in alignment with international standards, employing state-of-the-art technology tailored to the nation's unique environmental conditions. These road projects are aimed at enhancing traffic efficiency and establishing a modern road network that connects different regions of the country. Notable road projects in the UAE include:

- **E11**: This is the UAE's longest road, stretching from Al Silah in the emirate of Abu Dhabi to Ras Al Khaimah. It goes by various names along its route, including Sheikh Maktoum Road in Abu Dhabi, Sheikh Zayed Road in Dubai, and Sheikh Muhammad bin Salem Road in Ras Al Khaimah.
- **E311 or Sheikh Mohammed bin Zayed Road:** Formerly known as Emirates Road, this highway links Dubai to the other emirates.
- **E611 or Emirates Bypass Road:** Extending over 110 kilometers, this road offers an alternate route to Sheikh Zayed and Sheikh Mohammed bin Zayed Roads for travellers from Ras Al Khaimah, Umm Al Quwain, Ajman, and Sharjah en route to Abu Dhabi, bypassing downtown Dubai.
- **Sheikh Khalifa Highway:** This highway connects Dubai and Fujairah, reducing travel distance by 20 to 30 kilometers compared to older routes.
- **Sheikh Khalifa bin Zayed Road:** Linking various villages in the eastern region of the UAE.
- **Dubai-Fujairah Road:** Passing through the Hatta Mountain range and traversing the emirates of Dubai, Sharjah, and Ras Al Khaimah.
- **Dubai-Al Ain Road:** Establishing a connection between Dubai and Al Ain city.
- **Sheikh Zayed Bridge:** This 842-meter-long and 64-meter-high bridge serves as the third traffic route connecting the mainland to Abu Dhabi Island.

Railways

Etihad Rail serves as the UAE's national railway system, designed to establish connectivity among all seven emirates and establish links with five other Gulf Cooperation

Council (GCC) countries: Bahrain, Saudi Arabia, Qatar, Kuwait, and Oman. The primary objective of constructing Etihad Rail is to develop high-quality, dependable, sustainable, and resilient infrastructure, encompassing both regional and cross-border elements. This infrastructure aims to support economic development and enhance the well-being of people, with a strong emphasis on ensuring affordability and equitable access for all.

Key details about Etihad Rail include:

- Length and Coverage: Etihad Rail will span a total length of 1,200 kilometers. In the southern direction, it will extend up to the border with Saudi Arabia, and in the eastern direction, it will reach Oman. The railway network will include multiple freight terminals, distribution centers, and depots strategically positioned near major transportation hubs, warehouses, and storage facilities throughout the UAE.
- Services - Stage One: Etihad Rail initiated its commercial operations in January 2016 upon completing the first phase of its network, covering a distance of 264 kilometers from Shah and Habshan (located in the Abu Dhabi emirate's gas fields) to the port in Ruwais on the western coast of Abu Dhabi. Up until 2020, Etihad Rail successfully transported over 30 million tonnes of granulated Sulphur on behalf of the Abu Dhabi National Oil Company (ADNOC), which is equivalent to approximately 1.8 million trucks. Etihad Rail has the capacity to transport 22,000 tonnes of granulated sulphur daily.

Image courtesy: Etihad Rail, UAE

Etihad Rail's extensive network is expected to yield numerous benefits, including cost savings on freight charges and reduced travel times for businesses. It will facilitate the connection of various regions and contribute to the expansion of industries and communities. As a result, the region

anticipates experiencing significant economic, social, and cultural growth, leading to the creation of new job opportunities and diversification of industries. Furthermore, the railway system's environmental impact is noteworthy, as a single train can eliminate approximately 300 trucks from the road, resulting in a 70-80 percent reduction in carbon dioxide emissions compared to the emissions generated by trucks transporting the same amount of cargo.

Marine transport

The UAE is consistently expanding and modernizing its maritime infrastructure and assets. To accomplish this, the Federal Transport Authority-Land and Maritime is entrusted with the regulation and oversight of maritime affairs in the UAE, in strict adherence to the implementation of International Maritime Conventions. Over the years, the UAE has ratified 27 out of the 54 International Maritime Organization (IMO) Conventions currently in force, with plans to adopt the remaining conventions in the near future.

The UAE's aspirations in the maritime domain include:

- Continually upgrading its Aids to Navigation.
- Enhancing its Global Maritime Distress and Safety System (GMDSS).
- Establishing the UAE Search and Rescue Center (SAR).
- Monitoring the global positions of UAE-flagged vessels through the UAE Long Range Identification and Tracking system (LRIT).
- Forming the National Casualties Investigation Committee to reduce shipping accidents.
- Ensuring compliance with the International Ship and Port Facilities Security Code (ISPS) by issuing Statements of Compliance to compliant UAE ports.

Image courtesy: Ministry of Economy, UAE

Currently, UAE hub ports handle more than 14 million Twenty-foot Equivalent Units (TEUs) on an annual basis, serving a population of approximately 2 billion within close proximity. This achievement is made possible through advanced infrastructure, transhipment facilities, and modern, efficient management.

From a policy perspective, the UAE is in the process of updating its Maritime Commercial Law (Law no.26 of 1981). Additionally, the Dubai International Finance Center (DIFC), renowned internationally, has become a focal point for maritime arbitrations, marine insurance, and dispute resolution through its Maritime Court.

The UAE has also adopted a strategy to expand its tonnage under its flag, recognizing 12 Ship Classification Societies that are members of the International Association of Classification Societies (IACS), alongside the UAE Class Society (TASNEEF), the sole ship Classification Society in the entire region.

In terms of maritime transport services, the Ministry of Energy and Infrastructure oversees services catering to various categories, including pleasure boats, seafarers' affairs, commercial vessels, public relations officers (PROs), port services, and different modes of transportation.

In Abu Dhabi, the Integrated Transport Centre operates ferry services for passengers and vehicles between Delma Island and the mainland, including Mugharaq Port and Marsa Jabal Al Dhanna. In Dubai, the Roads and Transport Authority regulates water taxis, waterbuses, ferries, and abras:

- **Water Taxi:** A luxurious mode of transportation accommodating up to 10 passengers, operating between Al Mamzar and Dubai Marina via Dubai Creek.
- **Waterbus:** Cruises around Dubai Marina.
- **Ferries:** Offer scenic rides around Bur Dubai, Deira, Jumeirah, and Dubai Marina.
- **Abras:** Three types of abras, including motorized, electrical, and air-conditioned options, serving different routes such as the creek between Bur Dubai and Deira, joy rides in the Burj Khalifa lake, and the water passage in The Global Village.

Air transport

The civil aviation sector plays a crucial role in contributing to the UAE's economy. In 2019, prior to the pandemic, the International Air Transport Association (IATA) estimated that the aviation transport industry supported nearly 800,000 jobs and contributed USD 47.4 billion[12] to the annual Gross Domestic Product (GDP) of the UAE. Of this contribution, approximately USD 19.3 billion came directly from airlines and their supply chains, while over USD 28 billion was generated from the foreign tourism sector supported by aviation, constituting roughly 13% of the UAE's GDP. Despite the significant impact of the pandemic on the aviation sector, it is gradually recovering and remains a key component of the country's overall economy.

[12]UAE's First Long Term Strategy

Image courtesy: Emirates, UAE

Government initiatives and investments in the aerospace industry have created strong demand for business partnerships, positioning the UAE ahead of other regional markets. These initiatives encompass various programs, including the offset program, industrial clusters, and university programs. They have facilitated the signing of contracts for new manufacturing and maintenance, repair, and overhaul (MRO) projects in the UAE, aligning with the country's long-term strategy to transition into a knowledge-based economy.

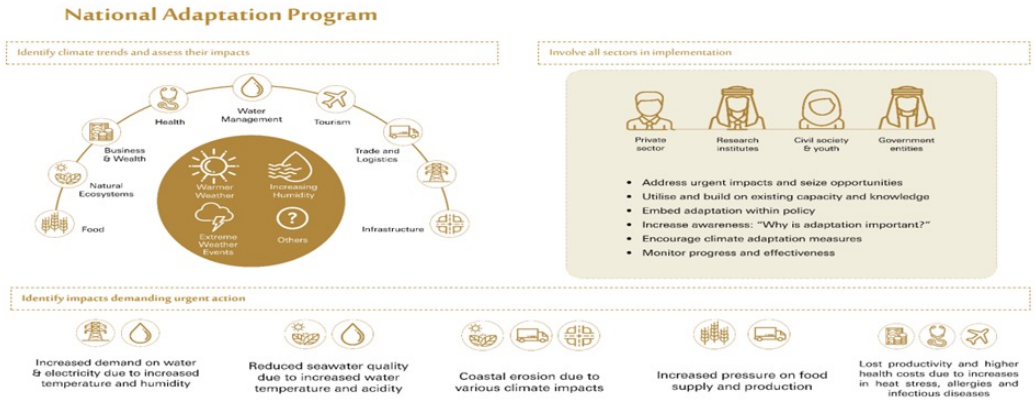
The UAE has four major passenger aviation carriers, which include Emirates Airline, headquartered in Dubai and operating as a full-service carrier since 1985; Etihad Airways, based in Abu Dhabi and operating as a full-service carrier since 2004; flydubai, a low-cost carrier since 2009; and Air Arabia, based in Sharjah and operating as a low-cost carrier since 2003. The UAE also features seven international airports, with Dubai International Airport (DXB) standing out as one of the world's largest and busiest international airports, alongside Abu Dhabi International Airport (AUH). Additionally, Abu Dhabi has entered into partnerships to establish budget airlines like Wizz Air Abu Dhabi and Air Arabia Abu Dhabi.

The UAE government has made substantial investments in airport development and expansion projects, including approximately USD 8.1 billion in Al Maktoum International Airport in Dubai, USD 7.6 billion for the Dubai International Airport Expansion Phase 4, USD 6.8 billion allocated for the development and expansion of Abu Dhabi Airport, and around USD 400 million invested in the expansion of Sharjah's International Airport terminal. While airports face cost reduction pressures and the delay of significant capital expenditures, some new projects have been cancelled or postponed. Nevertheless, UAE airports continue to leverage emerging technologies to enhance the passenger experience and solidify their role as prominent gateways.

Public health

UAE's Climate-Resilient Health Sector

The UAE has taken a leading role in addressing pressing global issues. Among these challenges, climate change stands out with its profound impacts on public health. Acknowledging this, the UAE has reaffirmed its dedication to building a climate-resilient healthcare sector. The country embraces a comprehensive, cross-sectoral strategy for climate action, with the goal of establishing a resilient ecosystem that connects all critical sectors, including healthcare,



recognizing the significant influence of climate on human well-being.

Image courtesy: Ministry of Health and Prevention, UAE

The Ministry of Health and Prevention (MOHAP) has actively engaged in the global effort to establish healthcare facilities that can withstand challenges. In collaboration with the World Health Organization (WHO), MOHAP has taken numerous measures to evaluate vulnerabilities and enhance its healthcare infrastructure.

In 2019, the UAE conducted a comprehensive assessment of climate-related risks for its healthcare sector. This report's purpose is to evaluate the potential threats posed by climate change to public health in the UAE and offer recommendations for adapting to these challenges. By addressing climate change risks to public health and implementing the recommended adaptation strategies, the UAE aims to construct a resilient and sustainable healthcare system capable of safeguarding the well-being of its population in the face of a shifting climate.

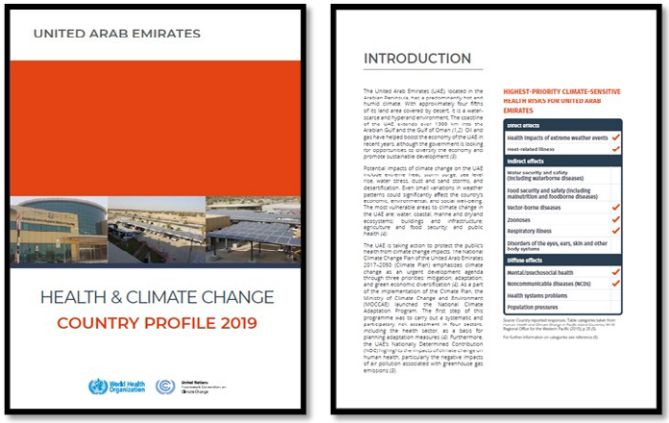
Consequently, a National Framework for Action on Climate Change and Health for the period 2019-2021 was developed in collaboration with WHO and subsequently executed at a national level. It revolves around four key areas:

- Governance, policy, and engagement for protecting health from the impacts of climate change.
- Developing a climate-resilient health system with strong surveillance, early warning systems,

and effective responses.

- Improving the management of environmental health interventions.
- Mobilizing support for the public health response to climate change.

The UAE has acknowledged the critical connection between health and climate change. In its 2019 country profile, the UAE addressed multiple aspects related to the intersection of health and climate change. In summary, the UAE's 2019 country profile underscores its determination to comprehend and tackle the health repercussions of climate change. This commitment involves identifying vulnerabilities, implementing both mitigation and adaptation strategies, and engaging in international collaboration to ensure the



protection of public health in the face of a changing climate.

Image courtesy: Ministry of Health and Prevention, UAE

In 2021, responding to the call from the United Kingdom, the COP26 Presidency, the UAE initiated efforts to establish an environmentally sustainable healthcare sector. The UAE has specifically recognized air pollution as a significant environmental risk to public health. Its objective is to reduce health-related incidents and improve residents' quality of life by preventing poor air quality and its impact on non-communicable diseases.

To address this, the Ministry of Health and Prevention revised public health legislation to protect air quality and monitor and reduce harmful emissions. Additionally, the National Air Quality Agenda 2031 by the Ministry of Climate Change and Environment establishes a cooperative framework between governmental and private entities to maintain air quality standards. This agenda not only focuses on environmental preservation but is closely linked to public health metrics such as air pollution and heatwaves. In this context, a proposal for an Early Warning System for Dust Storms and Air Pollution in the UAE is under review and development.

In 2023, the Ministry of Health and Prevention, in collaboration with the World Health Organization and various health and environment entities, conducted a significant National Workshop concentrating on Climate Change and Health Vulnerability and Adaptation Assessment, leading to the Health National Adaptation Plan (H-NAP). This workshop, which centered on a comprehensive assessment of health vulnerabilities and adaptation, revealed crucial insights into the challenges and risks posed by climate change to public health in the UAE. By precisely identifying these vulnerabilities, it has provided a valuable roadmap for decision-makers and stakeholders. The subsequent development of the H-NAP reaffirms the UAE's commitment to proactive planning, ensuring readiness to address and mitigate the health impacts of changing climate conditions. The plan demonstrates the importance of integrating health considerations into the broader climate adaptation agenda, reinforcing the country's dedication to the well-being of its residents.

Simultaneously, the Ministry of Health and Prevention (MOHAP) is collaborating with the World Health Organization and the Ministry of Climate Change and Environment (MOCCAE) to conduct a pilot study on carbon footprint analysis for two major hospitals. This initiative serves as a guide for the healthcare system to reduce carbon emissions from healthcare facilities, aligning with the UAE's broader climate change strategy and its commitment to building a climate-resilient healthcare system.

In addition, the UAE remains the fastest-growing healthcare market in the GCC, with a 20.8% annualized increase in private sector spending and an 8.5% increase in government spending over a four-year period. Of the total healthcare expenditure of USD 19.7 billion in 2020, 62.8% (USD 12.4 billion) was funded by the government. Per capita healthcare spending in the UAE reached USD 1,992.1 in 2020, the second highest in the GCC.

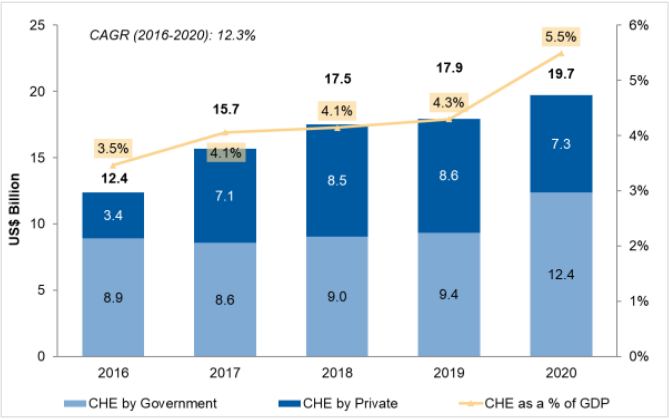


Figure 15: Healthcare expenditure by entity in UAE (USD billion), 2016 - 2020

Source: World Health Organization (WHO); International Monetary Fund (IMF)[13]

The UAE benefits from an extensive government-funded healthcare system, complemented by a developing private healthcare sector. This combination has

[13]CAGR – Compound Annual Growth Rate; CHE – Current Health Expenditure

enabled the country to achieve healthcare statistics comparable to those of highly developed nations. In 2019, life expectancy at birth in the UAE was 76.1 years in total, with males averaging 75.1 years and females 78.4 years. Healthy life expectancy at birth in 2019 stood at 66.0 years. Additionally, the mortality rate per 1000 live births in 2021 was as follows:

- **Under-five mortality rate:** 6
- **Neonatal mortality rate:** 3 (The eradication of endemic diseases has made cardiovascular disease the primary cause of death).

Building on the initial World Health Survey (WHS) conducted in 2009, the UAE Ministry of Health and Prevention (MOHAP), in collaboration with the World Health Organization (WHO), conducted the WHS 2017-2018 nationwide.

Key findings from the survey included:

- The highest self-reported raised blood sugar or diabetes prevalence was 34.7% among adult respondents aged 47 to 59 years.
- Among respondents in the age group of 47 to 59 years, 40.2% were receiving treatment for raised cholesterol, with approximately 70% of them using traditional medicine to manage their cholesterol levels.
- Overall, 27.8% of respondents were classified as obese, with higher prevalence among female respondents and notably among Emiratis, where 41.8% of female Emirati respondents were obese. Obesity was most prevalent in the 30-44 years age group.
- In total, 67.9% of respondents were classified as overweight, with a higher prevalence among males and a concentration in the 30-44 years age group.

Education

Education and culture are critical in the journey to net zero, with the UAE boasting a literacy rate of about 98% as of 2022 (World Bank).

The importance of education in achieving sustainability goals is emphasized by the UN's 17 Sustainable Development Goals (SDGs) and UNESCO's Education for Sustainable Development (ESD) for 2030. Educational institutions play a pivotal role in driving sustainability for four key reasons:

1. Mobilizing society: Through research, teaching, and outreach, educational institutions can effectively mobilize society, particularly younger generations, to take action towards sustainability.

2. Enhancing climate change understanding: By providing learning opportunities on the natural environment, educational institutions can foster a deeper understanding of climate change and its impacts.

3. Equipping citizens with greener career skills: Educational institutions empower individuals with the knowledge and skills necessary to pursue greener career paths that contribute to a sustainable future.

4. Introducing sustainable practices into daily life: Educational institutions can instill practices such as the circular economy, waste prevention, and resource efficiency into people's daily lives, shaping sustainable culture and habits.

The UAE and its institutions firmly align with this perspective, as evidenced by various initiatives that promote climate action through education. These initiatives include:

1. Training educators: The Ministry of Education, in collaboration with UNICEF, is training around 2850 master trainers and 1425 principals across the nation to integrate climate education into their curricula.

2. Transforming universities into incubators: The Dubai government's University Entrepreneurship Programme (UEP) collaborates with universities to transform them into incubators for students' business ideas focused on sustainability.

3. Fostering industry-university collaboration: Dubai's Heriot-Watt University partners closely with the Industrial Decarbonisation Research and Innovation Centre (IDRIC) to develop innovative solutions for industrial decarbonization.

4. Developing comprehensive climate action plans: American University of Sharjah (AUS) is developing a comprehensive Climate Action Plan to reduce its carbon emissions and align with the UAE Net Zero by 2050 Strategic Initiative.

5. Promoting nature-based solutions: Umm Al Quwain University's National Landscape initiative utilizes indigenous plants as nature-based solutions to promote native biodiversity, generate cultural benefits, and minimize cultivation costs.

These examples demonstrate the UAE's commitment to utilizing education as a powerful tool to achieve net zero emissions and create a sustainable future.

It's crucial to highlight the importance of education for sustainability and its significance in shaping a resilient and prosperous future where environmental sustainability is an utmost priority. The urgency and potential impact of governmental actions is key to mitigate climate change and promote sustainability to drive positive change and restore the ecosystem and create a more resilient and prosperous ecosystems globally.

A recent survey by UNESCO found that 77% of young people believe climate change is a global emergency, emphasizing the urgency to integrate sustainability education. Education is an essential strategic element of the global response to climate change. Climate change education addresses the challenges of climate change and of sustainable development. It helps learners to understand the causes and consequences of climate change and fosters the acquisition of skills and dispositions that individuals and communities need to achieve low-carbon and climate-resilient development. It also enhances the education system's preparedness for and responses to climate change, both in terms of mitigation and adaptation. The global youth population represents an invaluable resource for driving sustainability. Empowering young people through education and engagement can unlock their potential as agents of change. Research indicates that youth engagement in sustainability initiatives leads to increased civic participation and social cohesion.

The UAE Education Sector is committed towards combating Climate Change through multiple initiatives.

Greening Education Partnership

The UAE is committed towards Greening Education Partnership. The Greening Education Partnership is a global initiative that takes a whole-of-system approach to address the climate crisis by harnessing the critical role of education. As a collaborative platform for governments and stakeholders- including

inter-governmental organizations, civil society, youth, academia, and private sector- the Greening Education Partnership aims to deliver strong, coordinated, and comprehensive action and prepare every learner with the skills, values, attitudes and beliefs to tackle climate change.

By forging a strong multi-stakeholder alliance, it aims to provide expertise, resources, and diverse solutions that deliver on greening schools, curricula, and communities to foster climate change adaptation and sustainable development.

It builds on the longstanding work of Education for Sustainable Development (ESD) and its approach to holistic life-long learning, in particular SDG 4.7 and 13.3. Article 6 of the UN Framework Convention on Climate Change and Article 12 of the Paris Agreement which stresses the importance of climate change education.

The Greening Education Partnership (GEP) aims to empower learners from early childhood through adult education by collaborating with other global initiatives that support the greening and digital transitions – To ensure all learners acquire knowledge, skills, values, attitudes, and action to tackle climate change and ensure education systems climate-smart and crisis-resilient.

The Greening Education Partnership utilizes the power of education to combat the climate crisis. It brings together governments and stakeholders, including inter-governmental organizations, civil society, academia, and the private sector, to coordinate comprehensive actions. Its mission is to equip all learners with the skills, values, attitudes, and beliefs necessary to address climate change. The partnership is organized around four essential pillars of transformative education.

Greening Schools

The vision is to attain green school accreditation across all educational levels, from early childhood to adult education, encompassing teacher training and higher education institutions. The goal is for every country to embrace a green school accreditation scheme, resulting in a minimum of 50% of schools, colleges, and universities achieving green accreditation and functioning sustainably.

Greening Curriculum

The goal is to adopt a lifelong learning perspective that seamlessly incorporates climate education into every aspect of the educational landscape, including school curricula, technical and vocational education and training, workplace skills development, teaching resources, teaching methodologies, and evaluation systems. The goal is to significantly increase the number of countries integrating climate education into their pre-primary, primary, and secondary school curricula, aiming to double the current rate of approximately 45%.

Greening Capacities

Aims to provide robust support to educators and policymakers by infusing climate education into both pre-service and in-service teacher training programs, while also enhancing the capabilities of school administrators and key figures in the education sector. The goal is to ensure that every school leader, along with at least one teacher in every school, receives training on effectively integrating climate education into their teaching and learning

methods, thus fostering a widespread understanding of climate-related topics within educational institutions.

Greening Communities

Involving entire communities by incorporating climate education into lifelong learning endeavors, with a special focus on community learning centers and the concept of learning cities. The goal is for all countries to be capable of highlighting at least three distinct avenues through which learning opportunities are extended to adults beyond formal education systems. These opportunities aim to cultivate the skills, attitudes, and actions needed to bolster community resilience in addressing the challenges posed by climate change.

Image courtesy: Ministry of Education, UAE

As a member of the Greening education partnership (GEP) along with 79 countries to deliver strong, coordinated, and comprehensive action that will prepare every learner to acquire the knowledge, skills, values, and attitudes to tackle climate change and to promote sustainable development, the Ministry of Education seeks to accelerate global climate action through a National Greening Education Committee with all education/environment entities to ensure substantive outcomes and achievements of the targets set by the Greening Education Partnership (GEP). The national efforts of the UAE education sector in combating climate change are outlined below:

GREEN LEARNING

In partnership with IRENA, Ministry of Energy and Infrastructure and Department of Energy in Abu Dhabi the Ministry of Education designed a cross – curriculum Framework for formal education which is to be adapted by 100 % of the public and private schools, and for the 23 curriculums operating as part of the UAE diverse education system.

This framework aims to educate learners about the environment and facilitate their journey towards building a sustainable planet for generations to come. A cross-curricular framework refers to an educational approach that seeks to break down the traditional barriers between subjects and disciplines. It encourages the integration of knowledge, skills, and concepts from multiple areas of study, enabling students to make connections and see the relevance and interconnectedness of different subjects. it consists of four domains including Energy, The Earth's Biosphere, Resource Consumption and Climate Action, and Innovation for Sustainability. These domains are broken down into strands, each strand consists of four grade band-appropriate levels, each level highlights the students' capabilities and acquisition of environmental sustainability concepts and skills, and values.

Integrating environmental sustainability into different subjects can enhance student engagement and motivation. By demonstrating the practical relevance and real-world implications of sustainability, students become more interested and invested in learning. They develop a sense of purpose and responsibility towards the environment, driving their motivation to make positive changes.

The Environmental sustainability cross-curricular framework is offering all students the required knowledge, skills, and values based on their level. It provides stakeholders with an outline of how to develop dispositions of environmental sustainability concepts and practices across subject curricula, it consists of four domains including Energy, The Earth's Biosphere, Resource Consumption and Climate Action, and Innovation for Sustainability. These domains are broken down into strands, each strand consists of four grade band-appropriate levels, each level highlights the students' capabilities and acquisition of environmental sustainability concepts and skills, and values.

In Non formal Education, the Ministry of education is establishing a framework in alignment with U.A.E.'s education policy to guide the creation of sustainability focused co-curricular activities for different levels of educational institutions in U.A.E, by Creating a tool kit of sustainability focused co-curricular activities that could be adopted by various curriculums and levels of schools and universities. As this is a dynamic field, the toolkit will be refreshed on an annual basis. Create guidebooks for administrators and teacher training materials for deploying tool kit. And will create and run monitoring & assessment tools to ensure the appropriate implementation of the sustainability focused co-curricular activities, to raise global awareness of U.A.E.'s leadership in sustainability focused learning & co-curricular activities.

GREEN CAPACITIES

Greening Teacher Training and Education Systems' Capacities

The Ministry of Education is aiming to support teachers and policy makers through the integration of climate education in pre-service and in-service teacher training, building the capacity of school leaders and key education stakeholders. In Collaboration with UNICEF, MOE is training 2850 master trainers and 1425 principals (1 principal and 2 teachers per school) in all UAE, to cover 100 % of the private and public schools, to be ready to implement the cross curriculum and extra-curriculum activities guidelines, which commenced at the beginning of the academic year 2023-2024. Every school should nominate 2 master teachers to represent their school, and to be able to train all the others teachers' schools in the next phase of the initiative. The Ministry of Education's ambition is that 100 % of teachers will be trained at the end of 2030.

GREEN SCHOOLS

According to latest research, successful outreach and education among just 16 percent of high school students in rich and developing countries could result in a reduction of about 19 gigaton of carbon dioxide by 2050.

The Ministry of Education is aiming to green 50 % of schools and universities pre COP28, in partnership with Foundation of Environmental Education (Eco Schools Program and Environment Agency Abu Dhabi (sustainable School), As UAE has committed to educate children of all ages, The Early Childhood Authority is piloting the green nurseries in Abu Dhabi.

GREENING COMMUNITIES

The Ministry of Education is aiming to raise the national awareness on climate change and environmental issues by connecting the community to the school and by offering different learning experience in the community to promote collaborative effort among the

community and youth to collectively work towards a more sustainable resilient future and fostering a sense of shared responsibility for environmental stewardship. In partnership with Abdulla AlGhurair Foundation and Goum book, climate awareness workshops will be conducted pre COP28, more than 20 sustainability and climate action workshops engaging over 1,000 intergenerational participants across the UAE. promote collaborative effort among the community and youth to collectively work towards a more sustainable resilient future and fostering a sense of shared responsibility for environmental stewardship. As part of hand on learning approach MoE, AGF and Sheraa is launching entrepreneurship program (ecopreneurship) which is an instrumental program in addressing climate change and environmental concerns as it educates, foster innovation, encourage collaboration, and contribute to both economic growth and job creation, and build a greener and more sustainable future for communities worldwide.

Environment

The UAE is characterized by four primary ecosystems, each contributing to its distinctive ecological diversity. These ecosystems comprise the vast desert, which encompasses 80% of the country's land area, mountainous regions, wetlands and marine environments. The UAE's unique landscape has a wide variety of plant and animal species, adding to its ecological significance.

However, the rapid pace of urbanization and development in the UAE has given rise to a series of challenges that pose a threat to its biodiversity. These challenges encompass the loss and degradation of natural habitats, pollution, overfishing, and the introduction of invasive species. Furthermore, the effects of climate change, such as rising sea levels and escalating temperatures, exacerbate these issues, particularly affecting marine and terrestrial ecosystems.

In response to these pressing challenges, the UAE has put in place a set of federal laws with the explicit aim of conserving biodiversity. These legislative measures include Federal Law No. 23 of 1999, which focuses on the safeguarding and enhancement of marine species, and Federal Law No. 24 of 1999, centred on environmental protection and development. Additionally, Federal law No. 11 of 2002 regarding the regulation and control of international trade in endangered species of wild fauna and flora. Federal law No. 9 of 2020 on biosafety of Genetically Modified Organisms. Federal law No. 8 of 2021 on the access to genetic resources and the fair and equitable sharing of benefits arising from their utilization. On the international stage, the UAE is a signatory to 14 conventions and organizations related to biodiversity, including CITES[14], UNCCD[15], CMS[16], CBD[17], and Ramsar, underscoring its commitment to global conservation efforts.

[14]Convention on International Trade in Endangered Species of Wild Fauna and Flora
[15]United Nations Convention to Combat Desertification
[16]The Convention on Migratory Species
[17]Convention on Biological Diversity

The Ministry of Climate Change and Environment (MoCCaE) has taken collaborative steps with relevant sectors to craft and implement a comprehensive range of policies. These initiatives span from the National Biodiversity Strategy and the National Strategy to Combat Desertification to specific action plans for safeguarding various species and ecosystems.

The country is also actively engaged in the protection, breeding, and reintroduction of endangered species, and it regulates to combat invasive species to further enhance its conservation efforts. The Ministry of Climate Change and Environment (MoCCaE) has played a pivotal role in executing significant collaborative projects with various sectors dedicated to biodiversity, all aimed at enriching the national biodiversity database. The results of these projects are as follows:

- **National Red List Project:** This initiative has brought to light the UAE's role as a habitat for a diverse array of species. This includes 58 mammal species, 72 amphibians and reptiles, 167 bird species, 598 plant species, and 272 selected marine species.
- **Important Birds Area Project:** The UAE serves as a crucial host to over 400 species of migratory birds. This project has successfully identified 30 areas vital for bird conservation efforts.
- **Key Biodiversity Areas Project:** Through this project, the UAE has pinpointed nine key biodiversity areas, and notably, five of these areas have been granted full protection to safeguard their ecological importance.
- **UAE Ecosystem Accounts Project:** Currently in progress, this project seeks to provide comprehensive evaluations of the ecosystem services provided by the UAE's natural resources. The primary objective is to equip decision-makers with the essential information to make informed choices regarding land use, investment opportunities, and business improvements.

The Abu Dhabi Red List for Ecosystems: this assessment is in coordination with the IUCN and included the assessment of terrestrial and marine ecosystems in Abu Dhabi. The ecosystem Red List will support efforts to effectively protect threatened habitats whilst aiding development through encouraging the growth of the emirate without compromising the preservation of ecosystems.

In the international arena, the UAE has garnered acclaim for its conservation endeavours. This recognition includes the designation of 10 Wetlands of International Importance (Ramsar Sites), acknowledgment of five Ecologically or Biologically Significant Marine Areas (EBSA), the establishment of two UNESCO Man and Biosphere Reserves, and certification of one site by the International Union for Conservation of Nature (IUCN) onto the Green List of Protected and Conserved Areas, a remarkable achievement for the region.

These projects and international recognitions serve as testament to the UAE's unwavering commitment to biodiversity conservation and sustainable development, making it a model for integrated environmental stewardship.

Coral Conservation:

The UAE is a habitat to around 100 types of corals. Initiatives such as 'Creating Super Corals' are aimed at rehabilitating areas affected by climate change and human activities, with a focus on identifying the most adaptable coral species.

Mangrove Rehabilitation:

In 2021, the UAE was home to 183 sq. km of mangroves which was estimated to sequester 4.4 million tons of CO2 annually as per the Intergovernmental Panel on Climate Change (IPCC) methodology (Source: IPCC 2014 Supplement on Mangroves). This has increased to approximately 60 million mangroves, covering an extensive area of 205.7 sq. km[18] in 2022 . The '100 million mangrove planting' initiative aims to significantly expand this area to 483 sq. km.

Integrated Approach to Sustainability:

The achievements in biodiversity conservation are attributed to an integrated approach that involves not only the government but also the private sector, non-governmental organizations (NGOs), and educational institutions. This collaborative model serves to reinforce the UAE's dedication to environmental conservation and the protection of biodiversity, highlighting a comprehensive and holistic commitment to sustainability.

Moreover, the fisheries sector within the UAE has made substantial economic and social contributions. In the year 2022, this sector yielded a total of 65,000 tonnes of fish, with a market value amounting to AED 1.4 billion. Furthermore, it furnished employment opportunities for approximately 30,000 individuals and operated with a fleet comprising approximately 6,000 boats.

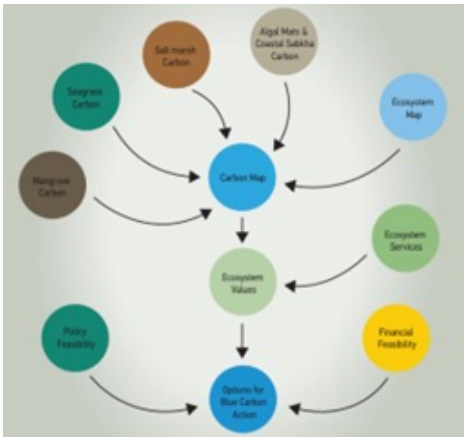
The commercial fisheries landings in 2022 consisted of a diverse array of 60 different species. Among these species, several stood out in terms of volume, namely Shekheli (Lethrinus lentjan), Sheary (Lethrinus nebulosus), Hamour (Epinephelus Coioides), Kanaad (Scomberomorus commerson), and Safi (Siganus canaliculatus). Together, these species accounted for 43.0% of the total volume of fish landed.

Encouragingly, the overall status of fish stocks within the UAE has demonstrated improvement. There has been a noticeable increase in the level of Biomass, accompanied by a decrease in fishing effort, which indicates a shift towards more sustainable fishing practices. The Sustainable Exploitation Index (SEI), a pivotal metric used to gauge the sustainability of fish stocks, has also displayed a positive trend. It rose from 41% in 2017 to 59.0% in 2022.

These advancements not only underscore the economic significance of the fisheries sector but also emphasize the UAE's unwavering dedication to promoting sustainable fishing practices and the conservation of marine ecosystems. *For further details, refer to the UAE's Biodiversity Map*

Additional key projects undertaken to address these environmental challenges include:

The Abu Dhabi Blue Carbon Demonstration Project



Relation of project components

Image courtesy: Abu Dhabi Global Environmental Data Initiative (AGEDI), UAE

[18]The UAE is currently in the process of ascertaining the total carbon stock from mangroves using direct methods, and this exercise would be completed by 2024. Based on the updated calculation, future NCRs and biannual reports would be accordingly updated

Launched in 2012, the project focuses on enhancing understanding of carbon sequestration and storage in blue carbon ecosystems in Abu Dhabi. These ecosystems were found to store over 41 million tonnes of CO2 equivalent.

The UAE Hydrological Map

The hydrological map assesses the suitability of the country's ground and surface water resources for constructing dams and other water facilities. The collected data encompass various aspects of the natural environment, including groundwater, well locations, geological and topographical features, land use, and surface water sources such as ponds, dams, and springs.

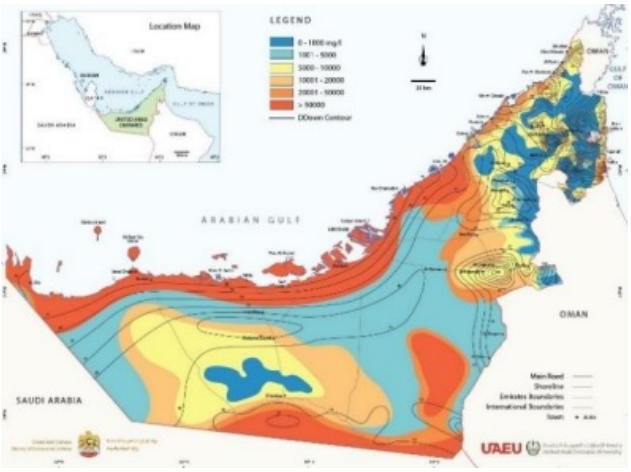


Image courtesy: Ministry of Climate Change and Environment, UAE

Furthermore, the UAE actively participates in numerous regional and international dialogues and environmental conventions, including the UN Framework Convention on Climate Change, Convention on Biological Diversity, UN Convention to Combat Desertification, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Agriculture

Situated within an arid zone where deserts occupy over three-quarters of its total land area, the UAE faces environmental challenges characterized by scant rainfall, high temperatures, infertile soil, and a scarcity of natural waterways. In response, the UAE has undertaken extensive efforts to establish a sustainable agricultural and animal husbandry industry capable of enhancing food security and contributing to the national economy.

Agriculture in the UAE has historical roots in regions such as Ras Al Khaimah, Fujairah, Al Ain, and select oases like the Liwa oasis. However, significant developments have occurred since 1971, despite facing numerous obstacles, including water scarcity, salinized soil, adverse environmental conditions, high production costs, agricultural pests, and post-harvest losses. The agricultural sector has evolved into a technologically advanced industry, with a pivotal role played by the late Sheikh Zayed bin Sultan Al Nahyan in its development.

Image courtesy: Ministry of Climate Change and Environment, UAE

To address water resource preservation, there has been a strong focus on promoting the adoption of modern irrigation systems, and promote drought tolerant crops . The UAE has initiated a series of strategic endeavours to revamp the national agricultural sector, including:

Ag Tech Accelerators

The UAE is committed to driving innovation in agriculture. In 2019, Abu Dhabi Investment Office (ADIO) introduced a program to develop agricultural technologies, valued at US$272 million. So far, ADIO announced partnerships with seven companies (AeroFarms, Madar, Farms, RNZ, RDI, Pure Harvest, FreshToHome and Nanoracks) where these companies received financial and non-financial incentives totalling USD 140 million. The research and technologies developed by these companies will expand existing capabilities in the UAE's AgTech ecosystem and promote innovation in the sector to address global food security challenges.

Badia Farms opened the region's first urban commercial vertical indoor farm in Dubai in 2018. In 2020, the company launched a large-scale high-tech vertical farm in Dubai Industrial City with a capacity to produce 3,500 kg of fruits and vegetables per year. In addition, Emirates Airlines built the largest vertical farm in the world - Bustanica. It is a state-of-the-art vertical farm that reduces the UAE's reliance on fresh produce imports and reduces the amount of water required to grow produce by 95% by creating the optimal growing environment for these plants all year round. The facility spans a 31,000 m2 farm equivalent to farmland that is two times the area of Dubai International Airport. In other words it has a production output equivalent to 900 acres of farmland at 2,700 kg per day. Pure Harvest Smart Farms, an Abu Dhabi start-up, is growing from strength to strength becoming MENA's Most Funded Start up 2022, and growing beyond the UAE exporting both produce and technology to the region and as far as Malaysia and Singapore. 2022 witnessed a preliminary agreement with the Singapore Food Agency to develop the city-state's first hybrid greenhouse tomato farm that is aimed at boosting sustainable food security.

National System for Sustainable Agriculture

Approved by the UAE Cabinet on June 28, 2020, this system seeks to enhance farm efficiency, promote food self-sufficiency, create new opportunities, and consistently rank the agriculture sector among the best. Agriculture Hydroponics

Agriculture Hydroponics

The UAE's Ministry of Climate Change and Environment prioritizes the adoption of hydroponic technology among farmers, which involves growing plants with nutrient-rich water and minimal or no soil. This method can save up to 70% of water, extend the growing season, and reduce the use of harmful chemicals. Currently, over 87 commercial farms employ this technology.

Organic Farming

The UAE has an organic food certification scheme that is currently implemented by the Ministry of Industry and Advanced technology (MoIAT). This scheme is accompanied by a logo that allows consumers to easily differentiate organic products from conventional ones. Around half of the 40 existing organic farms have already received certification, while others are in the process.

In addition to technological initiatives, the UAE has launched programs aimed at fostering entrepreneurial participation in the agro-based industry. Notably, the Food and Agriculture Entrepreneurs Programme, scheduled to run from 2023 to 2025, will empower young Emiratis to develop their skills in managing agriculture and livestock projects. This program aligns with the "Transformational Projects" initiative, which supports Emiratis in establishing their agricultural companies. It aims to equip participants with knowledge in agricultural planning, entrepreneurship, and commercial management of agriculture and livestock projects, forging partnerships with the private sector.

Food Tech Valley

UAE's latest and largest project in the field of food systems innovation is the Food Tech Valley in Dubai. The first-of-its-kind agtech city in the world aims to serve as a testbed for pioneering agricultural innovations that will spearhead the regional transformation to more sustainable food systems. Spanning 16 million square feet, the Food Tech Valley takes a holistic approach to agriculture in line with the objectives of the National Food Security Strategy 2051 and the National Net Zero by 2050 Pathway. The project seeks to position the UAE as a leading exporter of sustainable agricultural solutions. *Further information is available at https:// www.foodtechvalley.ae/.*

FoodTech Challenge

To promote the development and implementation of sustainable and technology-driven solutions across the food value chain, UAE launched the FoodTech Challenge, the largest global competition of its kind. The Challenge is a driving force for innovation for the UAE's food security and self-sufficiency at the national, community, and household levels. In line with the objectives of the National Food Security Strategy, the competition calls upon youth, innovators, entrepreneurs, companies, and scientific and research institutions from around the world to identify and propose ground breaking ideas to enhance food security in the UAE. In the latest edition, four winners (out of almost 700 participating teams) benefited from a $2M award pool consisting of a cash prize, start-up incentives, acceleration services, innovation grants, localization support, and mentorship programs. Further information is available at www.foodtechchallenge.com

Furthermore, the Ministry of Climate Change and Environment (MoCCaE) has seamlessly incorporated initiatives aimed at promoting and supporting sustainable agricultural practices into its Key Performance Indicators (KPIs) and within the framework of the Emirates Food Security Council. The UAE has established a series of national committees, each with specific mandates dedicated to advancing sustainable practices in agriculture:

UAE Sustainable Farming Mark

A control scheme issued by Ministry of Industry and Advanced Technology (MoIAT) that provides the criteria for granting the UAE sustainable Farming Mark. The scheme expands with the inclusion of diversified farming categories including responsible aquaculture, organic feed, and hydroponics to cover sustainability requirements that suit the UAE climate, as well as highlight sustainably produced products in the market.

Agricultural Research and Development (R&D) Committee

This committee is responsible for promoting agricultural research and development efforts in the pursuit of sustainable practices.

Image courtesy: Ministry of Climate Change and Environment, UAE

Committee for Development of Sustainable Local Production:

This committee focuses on strategies and actions to enhance the sustainability of local agricultural production.

Food Loss and Waste Committee:

This committee is dedicated to addressing issues related to food loss and waste in the agricultural sector, seeking to minimize such losses and inefficiencies.

ne’ma

ne’ma, the National Food Loss and Waste Initiative, is a collaborative effort between the Ministry of Climate Change and Environment and Emirates Foundation. It aims to promote and coordinate actions among key national stakeholders, including government, private sector, NGOs, and communities, to combat food loss and waste throughout the entire food supply chain, encompassing production, distribution, retail, restaurants, and households. The primary goal is to transform current behaviours and attitudes into new national social norms focused on responsible consumption, contributing to a reduction in food loss and waste. ne’ma represents a significant step in the UAE’s commitment to addressing food loss and waste in alignment with the United Nations’ Sustainable Development Goal 12.3, which seeks to cut food loss and waste by 50% by 2030. To achieve this, ne’ma will establish a national baseline to measure food loss and waste, identify critical points within the food value chain, explore the root causes of wasteful behaviours, enhance policies, foster innovative solutions, and raise community awareness through campaigns and individual success stories, mobilizing collective action.

Image courtesy: Ministry of Climate Change and Environment, UAE

Moreover, the UAE has developed farmer incentive programs that have been restructured to prioritize farmers who adopt sustainable practices and employ organic farming methods. These programs have expanded the list of materials eligible for incentives, ensuring they are well-suited for UAE's specific conditions and are grounded in scientific research. Some materials, such as those used in net houses and solar power technology to boost production and productivity, have been the subject of research and development projects conducted within the Ministry.

CHAPTER 2: National Greenhouse Gas Inventory

Chapter 2
National Greenhouse Gas Inventory

Introduction

This section presents the National inventory of anthropogenic emissions by sources and removal by sinks of greenhouse gases not controlled by the Montreal Protocol for the year 2021. This inventory has been prepared in response to the UAE's commitment to UNFCCC to submit its fifth National Communication.

The 2021 national inventory of anthropogenic emissions of greenhouse gases by sources and removal by sinks for UAE was developed according to the 2006 IPCC Guidelines. The major findings including a description of the inventory development methodology, sources of data, conversion factors and uncertainty estimation process are presented in the following subsections.

Inventory Development Process

The inventory development process included the following major steps.

1. Detailed review of the 2006 IPCC Guidelines to identify the types of data to be collected from each emission source category and sub-sectors (under each category);

2. Identification of input sources for the inventory data and preparation of a list of government ministries and other governmental, semi-governmental, and private organizations to be contacted for the required data.

3. Development of data collection templates to source the required information from the selected ministries and organizations;
4. Coordination with the different ministries and other entities to collect the inventory data from the identified sources;
5. An initial analysis of the collected data to ensure completeness, and tabulation in the IPCC 2006 worksheets;
6. Calculation of greenhouse gas emissions and carbon removal based on methodologies recommended by the 2006 IPCC Guidelines;
7. A detailed review process with the ministries and experts to validate the calculations, sources of data, assumptions taken in the calculation and sector and sub-sector specific methodology;
8. Development of the national inventory report and summary of total anthropogenic emissions of greenhouse gases and carbon removal.

MRV – Transparency Project

The UAE is prioritizing the establishment of a Monitoring, Reporting, and Verification (MRV) system to fulfil its reporting obligations under the Paris Agreement's Enhanced Transparency Framework (ETF). Article 13 of the Paris Agreement underscores the importance of transparency in sharing climate change mitigation data to support the goal of limiting global temperature rise to below 1.5 degrees Celsius.

This MRV-Transparency System will provide comprehensive information on GHG emissions and air pollutant emissions, following the IPCC 2006 guidelines. The aim is to facilitate effective emissions management and air quality control. To achieve this, the project will develop an Integrated Emission Quantification Tool (IEQT) tailored to UAE's specific conditions, current and future data, and stakeholder requirements. The IEQT tool will be adaptable, allowing for enhancements as the country's resources and experience evolve.

MOCCAE is developing the capabilities to respond to the monitoring and reporting requirements set by international organizations. Various national-level and emirate-level entities play a role in ensuring the flow of necessary data, each with designated focal points. A technical team composed of sectoral leads, supporting leads, and reviewers will oversee GHG and air quality inventories after data is submitted through the IEQT tool. Their responsibilities include quality control and consistency checks across different sectors.

The project and the tool will be instrumental in the UAE's national reporting to the UNFCCC under the Paris Agreement. This involves reporting a National Communication (NC) every four years, a Biennial Transparency Report (BTR) every two years from 2024 onwards, and an update to the Nationally Determined Contribution (NDC) every five years. However, challenges have been encountered in terms of organizations' awareness of the ETF and its requirements, as well as in data collection and disclosure efforts. Foreseen challenges include resource and capacity constraints, knowledge gaps among stakeholders and data providers, and the need for effective data collection processes. MOCCAE has initiated capacity-building activities to address these issues, yet there remains a substantial knowledge and practice gap that needs to be addressed.

Also, in cooperation with MoEI and environmental entities in UAE, MoIAT issued the technical regulation for control the

measurements of Air Quality elements such as SO2, CO, CO2, O3, which is conducted by the environmental monitoring networks and calibration laboratories. This Regulation is approved by the Cabinet decree no 86/2023, aiming to implement best practices in the field of measurements to enable the decision makers to make correct decisions regarding the quantity of emissions based on accurate results. The project is expected to be implemented in 2024 through a cooperation between MoEI & MoIAT and the accreditation departments in UAE, as well as other stakeholders.

Moreover, the engagement of the Ministry of Foreign Affairs (MOFA) is vital in the UAE's national greenhouse gas (GHG) inventory, as it will oversee the validation and financing of pertinent climate action commitments through the "pledges fund" within MOFA. Under MOFA's directive to enhance proficiency in technical domains, this endeavor will contribute to bolstering the UAE's capabilities in international negotiations and advocating for UAE interests on the global stage.

Monitoring the CO2 emissions of the UAE is currently under the mandate of the Ministry of Energy and Infrastructure as most of the emissions arise from the Energy sector activities. However, this will transition to become part of the Biannual Transparency Report (BTR) in the future, and will be prepared by MOCCAE. The UAE GHG Inventory has been commissioned to estimate the impact of the activities in the Nation on the global issue of climate change. The annual update of the UAE GHG Inventory will provide the collection of data and closing of data gaps which is necessary to create the baseline and further evaluate the mitigation efforts to reduce carbon emissions and support the future UAE INDC submissions which are the mandate of the Paris Agreement.

Data collection and sources

A structured approach was followed to collect data in accordance with the IPCC guidelines, involving various ministries and governmental entities to ensure compliance and accuracy in reporting emission data.

The GHG inventory cycle was initiated in collaboration with the key stakeholders, informing them about the UAE's past efforts, the stages of GHG Inventory and their role in the data gathering process. Expected future steps were provided to them and a general overview of the project plan was presented for their necessary action. This collaboration not only increased awareness and understanding among the stakeholders, but also resulted in more effective communication channels by identifying relevant focal points and accurate data collection by clarifying data requirements.

Data collection templates were prepared in accordance with the IPCC workbooks, specifically aligned with the 2006 guidelines. The workbooks outline the specific data points and format for data submission. The data collection templates were shared with the relevant ministries and entities that needed to provide data for specific sectors and sub-sectors.

Stakeholders who own significant data repositories pertaining to GHG emissions, such as Federal Competitiveness and Statistics Centre (FCSC), the Ministry for Climate Change and Environment (MoCCAE) and the Ministry of Energy and Infrastructure (MoEI), national energy statistics were closely involved in the data collection process. The FCSC was instrumental in providing data from all over the UAE. Additionally, data was directly received from manufacturing companies, resulting in better quality of data and enabling us to use higher tiers of calculation for certain sectors in this inventory cycle.

Global warming potential (GWP) of greenhouse gases

The six greenhouse gases encompassed by the Kyoto Protocol include the following: Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6).

The direct emissions include CO2, CH4 and N2O and hence are given the highest priority for reporting by the IPCC guidelines followed by HFCs, PFCs and SF6. The second criteria used for selecting the gases that are accounted for and reported include the relative importance of the source and sink activities within the country and the availability of relevant information. However, the PFC emissions are accounted for as per the applicability and availability of the activity data.

The GWP values considered for the inventory preparation are provided in the table below.

Global warming potential (GWP) of few greenhouse gases

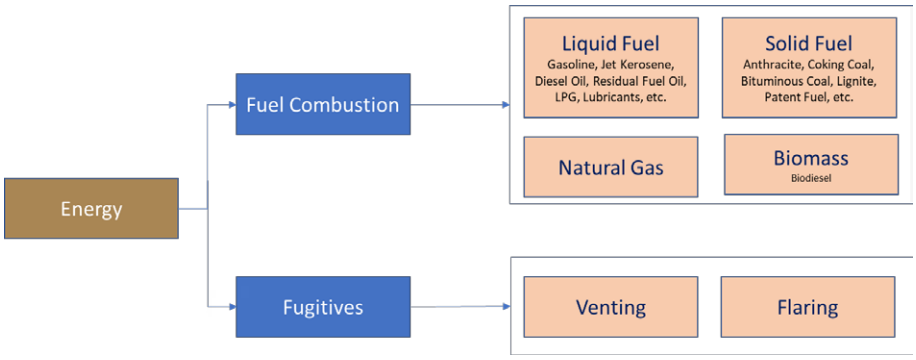
Global warming potential (GWP) of greenhouse gases Name	Chemical Formula	GWP values for 100-year time horizon
Carbon Dioxide	CO2	1
Methane	CH4	25
Nitrous Oxide	N2O	298
Carbon Tetrafluoride	CF4	7,390
Hexafluoroethane	C2F6	12,200

Source: IPCC Fourth Assessment Report

Methodological approach

The inventory was prepared using the IPCC methodology prescribed by the Convention based on the reference manual IPCC 2006 Guidelines for National GHG Inventories, and the recommended IPCC emission factors were predominantly used. The methodology used for each sector was based on the most appropriate tier based on the availability of data.

Part 1: Energy: The emission estimation in this section is based on a top-down approach using the country's domestic fuel sales data to estimate the emissions of CO2, CH4, and N2O from combustion, supported by carbon content and conversion factors provided by IPCC in the 2006 guidelines. This approach was selected for the sector considering the limited availability of data to use a bottom-up approach. This is noted as an area of improvement for the next GHG inventory cycle.



Part 2: Industrial Processes and Product Use (IPPU): Different tiers were used for different industries based on the availability of data.

Mineral Industries

Cement - The emission estimation in this section is based on Tier 2 approach using the plant specific clinker production data to calculate the CO2 emissions supported by emission factor for clinker provided by IPCC in the 2006 guidelines.

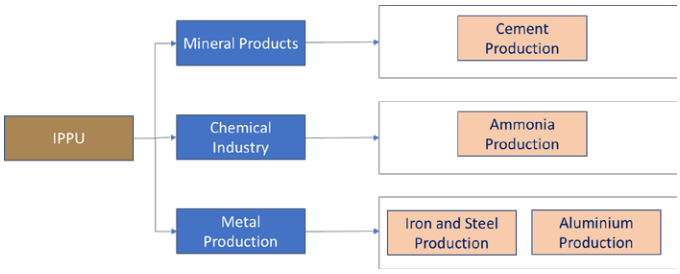
Metal Industries

Iron and Steel - The emission estimation in this section is based on Tier 1 approach using the national steel production data split by different production methods i.e., Electric Arc Furnace, DRI, etc. to calculate the CO2 and CH4 emissions supported by emission factor for per tonne production provided by IPCC in the 2006 guidelines.

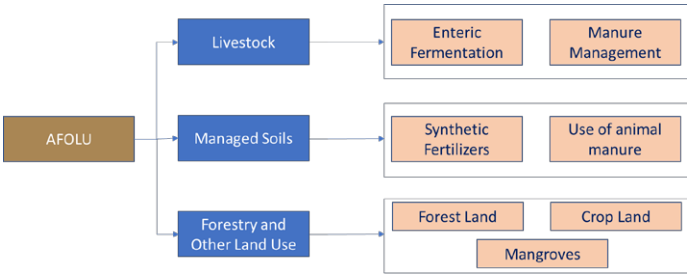
Aluminium - The emission estimation in this section is based on Tier 3 approach based on data and emission factors directly sources from the companies. The GHGs estimated for this sector are CO2 and PFCs (CF4 and C2F6).

Chemical Industries

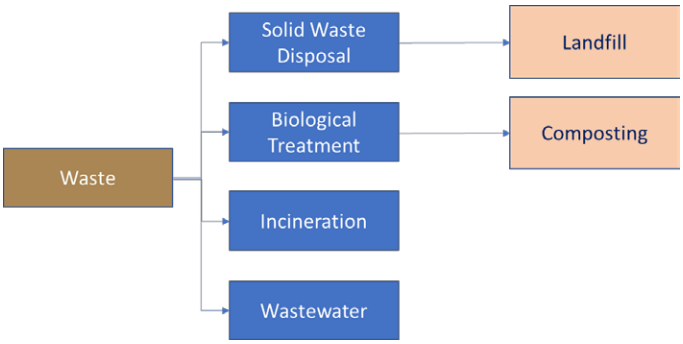
Ammonia - The emission estimation in this section is based on a Tier 1 methodology where the CO2 emission factor is determined from default values provided by IPCC in the 2006 guidelines.



Part 3: Agriculture, Forestry and Other Land Use (AFOLU): The emission estimation in this section is based on a Tier 1 approach using the emission factors provided by IPCC in the 2006 guidelines, and 2013 supplement for the emission calculations for mangroves.



Part 4: Waste: The emission estimation in this section is based on a Tier 1 approach for landfill, composting and incineration, and IPCC default wastewater treatment and disposal methodology for estimating emissions from wastewater treatment.



Uncertainties

- Uncertainties are a factor in any estimate of national emissions. Some important causes of uncertainty are:
- Uncertainty associated with the emission factors used for the GHG inventory calculations
- Uncertainty associated with measuring and collection of data on activities
- Use of simplified representations with

"averaged" values, especially emission factors and related assumptions to represent characteristics of a given population

- Uncertainty in the basic socio-economic activity data which drives some of the calculations
- Inherent uncertainty in the scientific understanding of the basic processes leading to emissions and removals

Quality Assurance and Control

1. A systematic review was conducted on the information gathered, including activity data and associated calculations, in collaboration with the entities responsible for the specific sectors. This involved workshops with the key stakeholders to review the data, formulas and assumptions used in the GHG inventory, and any assumption used to address a gap in the data were validated by the concerned expert authority.

2. Cross-Validation with Independent Models: The results from the Inventory estimation were compared with the outputs of independently constructed emission estimation models for the UAE. Deviations were analysed to ensure they are reasonable, considering the differences in the modeling approaches and emission factors.

3. Best Possible Estimates: The final inventory results represent the best possible estimates of emissions based on the current state of scientific knowledge and data availability in the UAE.

The ongoing development of the Monitoring, Reporting, and Verification (MRV) System is expected to significantly enhance the quality control aspects of the inventory process for future cycles.

The uncertainty of activity data and emission factor are estimated based on expert judgment in line with the IPCC 2006 guidelines. Based on this cycle's assessment, the uncertainty stands at an estimated +/-10%.

Sector overview

The emissions' source/sink categories are grouped into four major sectors below which are: energy, industrial processes and product use (IPPU), agriculture, forestry and land-use (AFOLU), and waste. These categories listed cover most of the UAE's activities emitting or removing greenhouse gases, based on the data obtained from 2021.

1. Energy
2. Industrial Processes and Product Use (IPPU)
3. Agriculture, Forestry and Land-Use Change and Forestry (AFOLU)
4. Waste

Energy

Energy emissions refer to the total emission of all greenhouse gases from stationary and mobile energy activities (fuel combustion as well as fugitive fuel emissions). The estimates of sectoral emissions have been calculated using a top-down approach due to inconsistencies in the reporting of subsector fuel consumption patterns. All water sector emissions are attributed to this section.

Fuel Combustion

- Solid Fuel
- Liquid Fuel
- Natural Gas
- Biomass

Fugitives

- Venting
- Flaring
- Other Fugitives
- HFCs

Industrial Processes and Product Use (IPPU)

Emissions within this sector comprise by-product or fugitive emissions of greenhouse gases from industrial processes. Emissions from fuel combustion in industry are reported under Energy's fuel combustion subsection.

- Cement Production
- Ammonia Production
- Iron and Steel Production
- Aluminium Production

Other sources of emission within the industry section, such as lime production has not been included in this cycle of GHG inventory due to unavailability of data. However, the emissions from this source is not a major contributor of emissions for the UAE, in the inventory cycle where emission from lime production was estimated, it accounted for less than 1.7% of the overall emissions within IPPU.

Agriculture, Forestry and Land-Use Change and Forestry (AFOLU)

Includes all anthropogenic emissions from agriculture sector, except for fuel combustion emissions and sewage emissions, which are covered in Energy and Waste sectors.

Enteric Fermentation Manure Management Agricultural Soils

Total emissions and removals from forest and land use change activities are included in this sector. This sector accounts for emissions, carbon stock and removal from Forest Land, Mangroves and Crop Land in the UAE.

Waste

All the emissions associated with waste management are included in this sector.

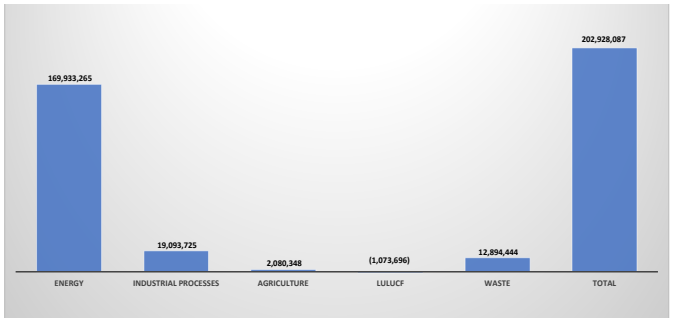
- Solid waste disposal on land
- *Landfills*
- Biological treatment
- *Composting*
- Incineration
- Wastewater

National GHG Inventory

National emissions

The UAE has total GHG emissions of 202,928,087 tCO2e from the emission activities within the country. The largest emissions are from the energy sector, whereas the agriculture sector contributes the least. The following sections provide detailed breakdown of the emissions per sector and the contribution of the key greenhouse gases to the total emissions.

Figure 15: UAE's 2021 GHG emissions profile



UAE Emissions by Sector and GHG type, 2021

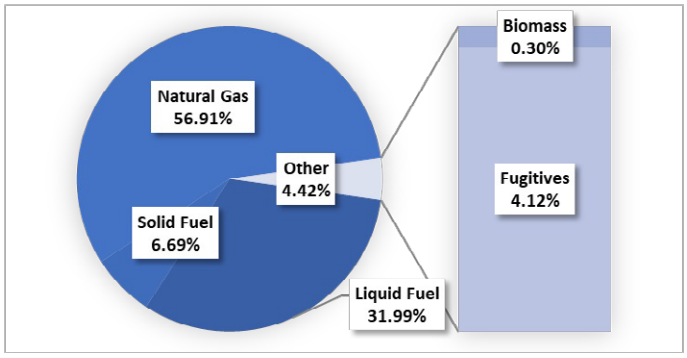
UAE Emissions by Sector and GHG type, 2021										
Greenhouse gas source and sink categories, 2021	CO_2 Emissions	CO_2 Removal	CH_4	N_2O	CH4	N_2O	PFCs	HFCs	Total GHG	Total GHG
	Gg	Gg	Gg	Gg	$GgCO_2e$	$GgCO_2e$	$GgCO_2e$	$GgCO_2e$	$GgCO_2e$	tCO_2e
Energy	168,804.54	-	28.56	1.32	714.11	392.50	-	22.11	169,933.27	169,933,265.24
Industrial Processes	18,964.11	-	0.04	-	0.91	-	128.70	-	19,093.73	19,093,725.16
Agriculture	-	-	64.14	1.60	1,603.39	476.96	-	-	2,080.35	2,080,347.96
LUCF	-	(1,073.70)	-	-	-	-	-	-	(1,073.70)	(1,073,695.59)
Waste	34.02	-	453.74	5.09	11,343.58	1,516.85	-	-	12,894.44	12,894,443.86
Total	187,802.67	(1,073.70)	546.48	8.01	13,661.99	2,386.31	128.70	22.11	202,928.09	202,928,086.64

Disclaimer on Land Use and Forestry: *The country is currently undertaking a detailed study to accurately evaluate the various land use types. Results of this assessment will be incorporated into future national-level inventories. For now this section, only covers the negative emissions achieved through sizable levels of mangroves inherent to the UAE.*

Disclaimer on Agriculture and Waste: *Emissions data for Agriculture and waste emissions are based on projections. With the operationalization of the MRV automated data collection tool, these emissions shall be evaluated more accurately in forthcoming years.*

Energy

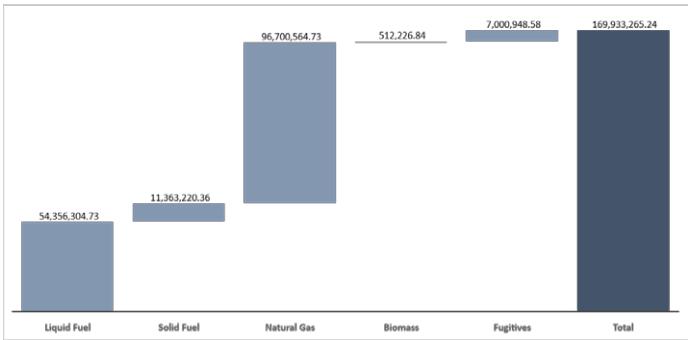
Figure 16: Energy emission distribution by fuel category, 2021



The total emissions from the Energy sector within the UAE amount to an estimated 169,933,265 tCO2e. The breakdown of the emission distribution is as show in the above figure. The largest source of GHG emissions within the energy sector is natural gas combustion, which amounts to 96,700,565 tCO2e. Most of the power generation plants employ co-generation and utilize natural gas as fuel. Given the climatic and geographical conditions of the UAE and water scarcity, there is high dependence on electricity for the generation of water for the population.

The emissions from water desalination are included within the public electricity production sub-sector due to the energy intensive nature of the water generation process in the country. It is important to note that the large-scale developments in clean energy conducted presently by the UAE will reduce the emissions of the energy sector. For example, The Barakah Nuclear Power Plant represents a pioneering energy initiative at the forefront of the energy transition. When all four reactors are in full operation, they will annually mitigate 22.4 million tonnes of carbon emissions, which are the primary drivers of climate change.

Figure 17: Energy sector emissions, 2021 (tCO2 eq.)



The second largest contributors to the energy sector emissions include liquid fuel combustion comprising primarily of gasoline, diesel oil, fuel oil etc. and it amounts to 54,356,305 tCO2e.

UAE Emissions within Energy sector, 2021

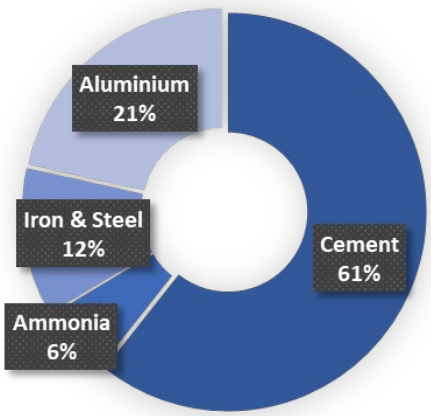
UAE Emissions within Energy sector, 2021						
	Gg			$GgCO_2$ eq.		tCO_2 eq.
	CO_2	CH_4	N_2O	CH_4	N_2O	Total GHG
Total Energy	**168,804.54**	**28.56**	**1.32**	**714.11**	**392.50**	**169,933,265.24**
Fuel Combustion Activities	**162,371.75**	**7.11**	**1.28**	**177.86**	**382.71**	**162,932,316.67**
Liquid fuel	54,090.04	3.35	0.61	83.71	182.56	54,356,304.73
Solid fuel	11,306.86	0.12	0.18	2.99	53.37	11,363,220.36
Natural gas	96,464.45	3.63	0.49	90.63	145.49	96,700,564.73
Biomass	510.40	0.02	0.004	0.54	1.29	512,226.84
Fugitive Emissions	**6,432.80**	**21.45**	**0.03**	**536.25**	**9.79**	**7,000,948.58**
Venting	11.42	4.41	-	110.17	-	121,595.70
Flaring	988.05	7.69	0.03	192.25	9.79	1,190,087.79
Other Fugitives	5,433.33	9.35	-	233.83	-	5,667,157.98
HFCs	-	-	-	-	-	22,107.10
Memo Item						
Aviation	10,879.47	0.46	0.09	11.41	27.21	10,918,088.51
Marine bunker	584.06	0.02	0.004	0.53	1.27	549,853.14

The remaining 4% of emissions are from the fugitive emissions specifically from oil and gas venting and flaring activities. The amount of emissions from this subsector is 7,000,949 tCO2e. The fugitive emissions, in the energy sector, account for the venting and flaring activities of oil and natural gas in petroleum refineries.

Industrial Processes and Product Use (IPPU)

The total emissions from the IPPU Sector amount to an estimated 19,093,725 tCO2e. The breakdown of the emission distribution is as show in the above figure. The largest contribution to the industrial processes emissions comes from the mineral products sub-sector that includes cement manufacturing. The emissions from cement manufacturing have the largest share with a total value of 11,583,168 tCO2e. The source of emissions in the cement manufacturing process is the production of clinker whose total production, from the thirteen identified cement manufacturers in UAE, amounts to over 21 million tons of clinker. The aluminium industry has the second largest share of emissions in the industrial process sector. This sub-sector covers the production of aluminium using different technologies in the UAE and its total emissions are 4,106,798 tCO2e.

Figure 18: Industrial process emissions distribution by sector, 2021



UAE Emissions by Sub-sectors within IPPU sector, 2021

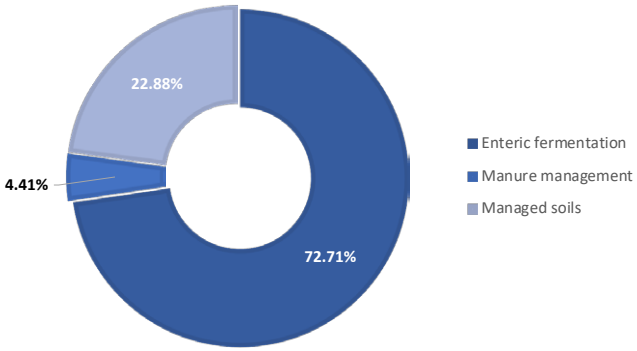
UAE Emissions by Sub-sectors within IPPU sector, 2021								
	Gg			GgCO eq.				tCO2 eq.
	CO2	CH4	N2O	CH4	N2O	PFCs	Total GHG	Total GHG
Total IPPU	18,964.11	0.04	-	0.91	-	128.70	19,093.73	19,093,725.16
Mineral Industry	11,583.17	-	-	-	-	-	11,583.17	11,583,168.01
Cement	11,583.17	-	-	-	-	-	11,583.17	11,583,168.01
Chemical Industry	1,107.09	-	-	-	-	-	1,107.09	1,107,092.48
Ammonia	1,107.09		-	-	-	-	1,107.09	1,107,092.48
Metal Industry	6,273.85	0.04	-	0.91	-	128.70	6,403.46	6,403,464.67
Iron & Steel	2,295.75	0.04	-	0.91	-	-	2,296.67	2,296,666.88
Aluminium	3,978.09	-	-	-	-	128.70	4,106.80	4,106,797.79

The metal production subsector altogether contributes to a total of 6,403,465 tCO2e, which is from the emissions of the iron, steel and aluminium production. The iron and steel production activities in UAE have a higher share in the metal production with emissions of 2,296,667 tCO2e. Emissions from Ammonia production are significantly offset by urea production on-site.

Agriculture, Forestry and Other Land Use (AFOLU)

The total emissions from the Agricultural sector in the UAE amount to 2,080,348 tCO2e. The breakdown of the emission distribution is as show in the below figure. The enteric fermentation in the digestive tracts of the livestock in the country is the major contributor to the agricultural sector emissions with a total of 1,512,589 tCO2e. The other two subsectors, agricultural soils and manure management, have emissions of 476,045 tCO2e and 91,714 tCO2e respectively.

FIGURE 19: Emissions by Sub-sectors within agriculture sector, 2021



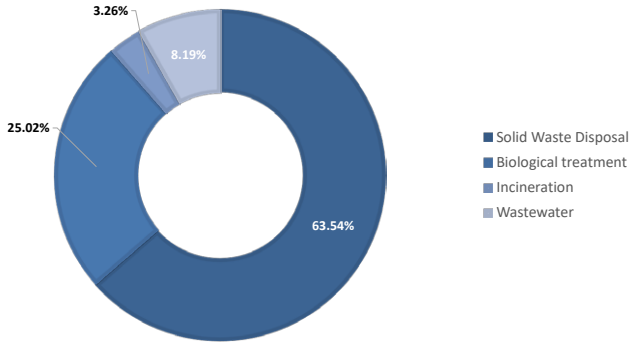
UAE Emissions by Sub-sectors within agriculture sector, 2021

Emissions for Sub Sectors within Agriculture					
	Gg		Gg CO2e		tCO2e
GHG Categories	CH4	N2O	CH4	N2O	Total GHG
Agriculture	64.14	1.60	1,603.39	476.96	2,080,348.00
Enteric Fermentation	60.50	-	1,512.59	-	1,512,589.00
Manure Management	3.63	0.003	90.80	0.92	91,714.00
Managed Soils	-	1.60	-	476.05	476,045.00

Waste

The total emission from the Waste Sector is and estimated 12,894,444 tCO2e. The breakdown of the emission distribution is as shown below. Majority of the emissions arise from the Solid Waste that is disposed of and allowed to degrade in the landfills. The emissions are in terms of methane gas being released during the degradation process, which amounts to 8,192,601 tCO2e.

Figure 20: Percentage contribution of subsectors, 2021



UAE Emissions by Sub-sectors within waste sector, 2021

UAE Emissions within Waste sector, 2021						
	Gg			$GgCO_2$ eq.		tCO_2 eq.
	CO_2	CH_4	N_2O	CH_4	N_2O	Total GHG
Total Waste	**34.02**	**453.74**	**5.09**	**11,343.58**	**1,516.85**	**12,894,443.86**
Solid Waste Disposal	**-**	**327.70**	**-**	**8,192.60**	**-**	**8,192,600.96**
Landfill	-	327.70	-	8,192.60	-	8,192,600.96
Biological treatment	**-**	**75.22**	**4.51**	**1,880.61**	**1,345.13**	**3,225,740.56**
Composting	-	75.22	4.51	1,880.61	1,345.13	3,225,740.56
Incineration	**34.02**	**15.37**	**0.01**	**384.30**	**1.68**	**420,000.00**
Wastewater	**-**	**35.44**	**0.57**	**886.07**	**170.03**	**1,056,102.35**

The emissions from the sludge handling systems are included to ensure that emissions are not underestimated. The records obtained from the Federal Competitiveness and Statistics Centre national waste statistics show that sludge from waste-water treatment, for both domestic and commercial consumption, apart from composting is dumped in landfills and this is accounted for in the landfill subsection. Also, landfill dump of waste from construction and demolition, general industrial waste (including commercial waste), and animal non-hazardous waste have been accounted to estimate emissions from landfills.

Biological treatment is the second largest contributor to the overall waste related GHG emissions, amounting to about 3,225,741 tCO2e, followed by wastewater treatment and incineration with “8.2%” and “3.3%” contributions respectively.

CHAPTER 3: National climate change strategies and programs

Chapter 3
National climate change strategies and programs

National Initiatives and projects

Prominent initiatives and projects aimed at advancing the UAE's fundamental national objectives in the areas of environmental conservation and energy promotion include:

The National Climate Adaptation Action Plan

The National Climate Adaptation Plan by the Ministry of Climate Change and Environment (MoCCaE) has been meticulously crafted to deliver clear and actionable outcomes that can be readily implemented by policymakers, businesses, and the broader society. This comprehensive action plan is structured into three distinct segments:

Identification of Climate Trends and Assessment of Their Impacts on:

- Food production
- Natural ecosystems
- Business and economic wealth
- Public health
- Water resource management
- Tourism industry
- Trade and logistics sector
- Electricity and energy utilization
- Infrastructure development

Identification of Urgent Impacts Requiring Immediate Attention, Such as:

- Escalating demand for water and electricity due to rising temperatures and humidity levels
- Deterioration in seawater quality stemming from increased water temperature and acidity
- Coastal erosion induced by various climate-related factors
- Heightened pressure on food supply and production
- Reduced productivity and elevated health-related costs attributed to heat stress, allergies, and infectious diseases

Engagement of All Sectors in Plan Implementation to:

- Address pressing impacts and capitalize on opportunities
- Harness and expand upon existing capacity and knowledge
- Embed adaptation principles within policy frameworks
- Raise awareness about the significance of adaptation measures
- Encourage the adoption of climate adaptation strategies
- Continuously monitor progress and evaluate the effectiveness of adaptation efforts.

The National Framework for Sustainable Development

The National Framework for Sustainable Development has the overarching objective of enriching the quality of life within the nation, fostering economic diversification and prosperity, safeguarding the UAE's ecosystems, preserving its ecological resources and services, and aligning with the Sustainable Development Goals of 2030.

This framework serves as a comprehensive blueprint encompassing all officially endorsed national strategies, policies, and initiatives related to environmental stewardship within the UAE. Its primary goal is to ensure the establishment of a sustainable environment that harmoniously supports economic growth.

The framework is structured around five primary pillars:

- Nature
- Environmental Health
- Climate Change
- Living Organisms
- Biosecurity

National Climate Change Plan of the UAE 2017–2050

The National Climate Change Plan of the UAE for the period 2017 to 2050 serves as a comprehensive framework designed to address both the causes and consequences of climate change. Its overarching objectives are to facilitate the transition towards a climate-resilient green economy and improve overall quality of life. The primary aims of the Climate Plan encompass:

Managing Greenhouse Gas Emissions while Sustaining Economic Growth:

Recognizing that the UAE's total greenhouse gas emissions are anticipated to rise alongside economic and population growth projections, the Climate Change Plan is focused on the effective management of emissions. It seeks to ensure that climate action aligns with and supports the achievement of economic objectives.

Minimizing Risks and Enhancing Adaptive Capacity to Climate Change:

The plan underscores the importance of promoting a climate-resilient economy, a crucial prerequisite for realizing the transformation outlined in Vision 2021. A systematic and scientifically driven assessment of climate-related risks and vulnerabilities is at the core of the Climate Change Plan. It emphasizes the need to safeguard the economy, infrastructure, people, and ecosystems from climate-related impacts.

Advancing the UAE's Economic Diversification Agenda through Innovative Solutions:

As the UAE continues its investments in non-oil sectors with substantial growth potential, the Climate Change Plan plays a pivotal role in accelerating growth in key emerging industries. This is achieved through the implementation of innovative measures aimed at generating added value for these burgeoning sectors, promoting job creation in green businesses, and harnessing the mutually beneficial relationship between climate action and economic diversification.

UAE Net Zero 2050

The UAE's Net Zero by 2050 strategic initiative is a national endeavor aimed at achieving net-zero emissions by 2050, establishing the Emirates as the first country in the Middle East and North Africa (MENA) region to do so.

Strategic Alignment

The initiative aligns with the Principles of the 50, which is the UAE's roadmap for

accelerating national economic development as the nation enters a new 50-year cycle of growth. The pursuit of net zero emissions presents significant economic opportunities that directly support the vision of transforming the Emirates into the world's most dynamic economy.

In line with the Paris Agreement

The UAE Net Zero 2050 strategic initiative is in harmony with the Paris Agreement, which calls on nations to prepare long-term strategies to reduce greenhouse gas (GHG) emissions and limit global temperature increases to 1.5 degrees Celsius compared to pre-industrial levels.

Coordination of Efforts

The Ministry of Climate Change and Environment (MOCCAE) will take the lead in coordinating efforts to implement the UAE Net Zero by 2050 strategic initiative, ensuring collaboration at the national level to achieve this objective. Key sectors like energy, economy, industry, infrastructure, transport, waste, agriculture, and the environment will update their plans, strategies, and policies to align with their specific needs and growth requirements, thereby contributing to the goal of achieving net zero emissions by 2050.

Government Responsibilities

Both federal and local government authorities will be responsible for conducting comprehensive studies and developing plans that introduce necessary measures to reduce emissions while also fostering economic growth based on sustainability principles.

Promoting Renewable Energy

The deployment and utilization of clean energy solutions play a central role in the UAE's approach to addressing climate change and reducing GHG emissions. The country has been financing clean energy projects for over 15 years and has invested over 40 billion USD in the sector to date. Current projections indicate that the production capacity of clean energy, including solar and nuclear, will reach 19.8 GW by 2030.

Global Support for Clean Energy

The UAE actively supports green infrastructure and clean energy projects worldwide and has invested in renewable energy initiatives totaling approximately 16.8 billion USD in 70 countries, with a particular focus on developing nations. Additionally, the UAE has provided over 400 million USD in aid and soft loans for clean energy projects.

Building on Climate Action History

The UAE's Net Zero by 2050 strategic initiative builds upon the country's three decades of climate efforts and sets a strategic target for the next three decades.

National Carbon Sequestration Project

In November 2021, during the 26th UN Climate Change Conference (COP26) in Glasgow, the UAE formally launched the National Carbon Sequestration Project. This initiative aligns with the UAE's strategic goals of adopting nature-based solutions to address environmental challenges and intensifying efforts to capture carbon dioxide, thus mitigating the impacts of climate change and enhancing adaptability. In December 2022, the UAE unveiled a comprehensive roadmap, with the ambitious aim of planting 100 million mangroves nationwide by 2030.

The project is structured into several phases: assessing the current state of mangrove forests in the UAE, identifying suitable locations for new mangrove plantations, executing the plantation and restoration programs, and continuously monitoring the health and expansion of the mangrove ecosystems. To achieve these objectives, the ministry has devised a stakeholder engagement plan and established a plantation program in collaboration with relevant entities to ensure the timely planting of mangrove seedlings. Regular updates are provided on the number, locations, and distribution of mangroves across the emirates to accurately track the project's progress. Planting activities have been carried out in various areas, including khors, protected zones, and degraded mangrove wetlands.

Industrial decarbonization roadmap

MOIAT is currently working on "The UAE Industrial Decarbonization Roadmap," which serves as a blueprint outlining how the industrial sector aligns with the country's goal of achieving net-zero emissions by 2050. This roadmap involves the creation of decarbonization "pathways" leading up to 2050, identifying and examining various technologies to reduce emissions while maintaining competitiveness. It acknowledges that there is no single solution to achieve net-zero emissions by 2050, underscoring the importance of exploring and concurrently utilizing all known solutions, technologies, and innovations.

The roadmap covers each industrial sub-sector (oil and gas, refinery, petrochemicals, cement, steel, and aluminium), evaluating their potential for carbon abatement, the necessary technologies, and the required enablers, policy levers, and market interventions necessary to drive adoption. It informs future policy decisions and offers strategic insights to steer decarbonization efforts toward the net-zero emissions target by 2050. Ultimately, the UAE Industrial Decarbonization Roadmap serves as an essential tool in guiding the industrial sector towards a sustainable, low-carbon future.

The roadmap is being developed in consultation with key government stakeholders such as the Ministry of Climate Change and Environment, the Ministry of Energy and Infrastructure, as well as key players and national champions in the industrial sector. The roadmap is targeted to be completed by the end of November this year. It will include various recommendations for enablers and policy levers needed to drive the adoption of decarbonization technologies in the industrial sector, spanning multiple areas such as carbon capture and storage, clean electricity, hydrogen, carbon pricing, standards and specifications, the use of recycled materials/ scrap, and procurement initiatives.

Industrial census project

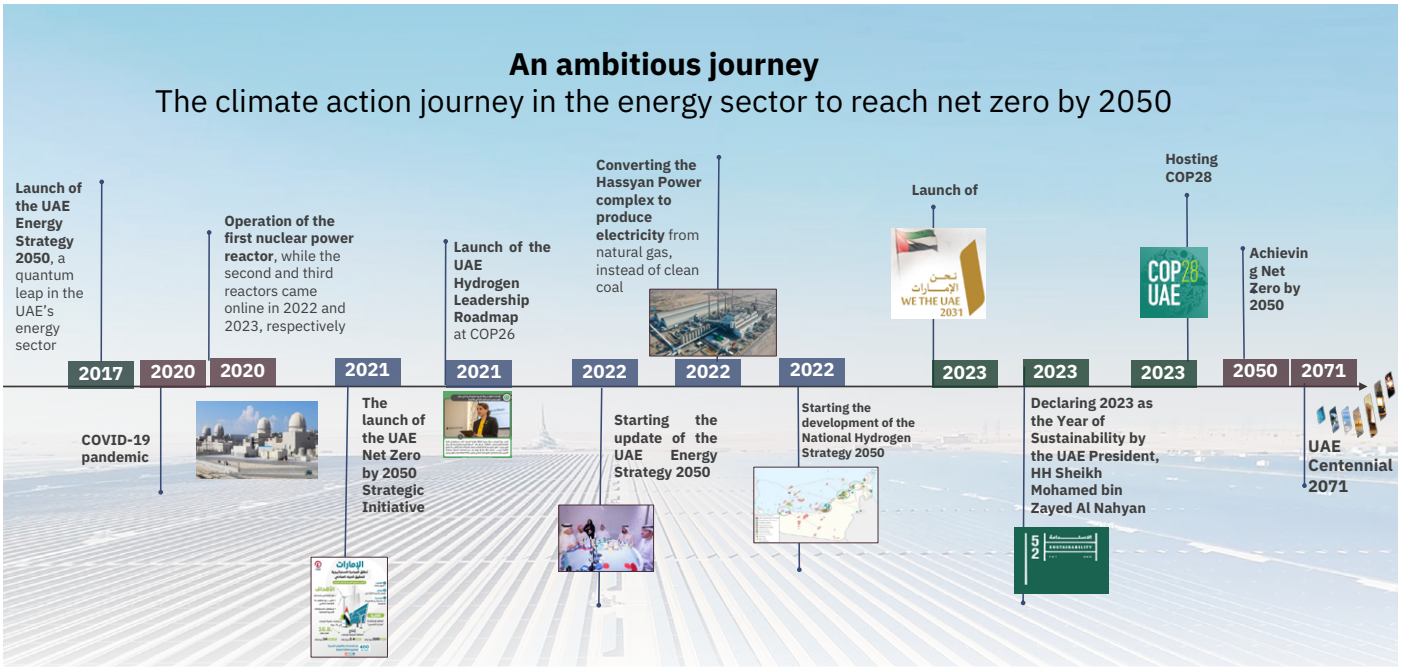
Despite the existence of many ambitious initiatives and projects aimed at making a difference to achieve environmental sustainability, and despite the support and rational government direction adopted and supportive of these projects, collecting actual data for many inputs to assess the current situation and measure the impact of improvement is still a challenge with the presence of several sources and institutions concerned with providing this data, and some of this data may be owned by investors or entrepreneurs. Real-time data collection is therefore a challenge, especially in the industrial sector.

MoIAT has launched industrial census project in coordination with the Competitiveness and Statistics Center (FCSC) and local statistical centres in all Emirates with the aim of creating a baseline for industrial data in the country, and then providing an integrated database for the industrial sector to support decision-making and data readiness for international indicators.

National initiatives and policies to decarbonize the Energy Sector

The UAE has consistently positioned itself as a trailblazer in implementing proactive measures and launching initiatives aimed at reducing carbon emissions within its energy sector. This longstanding commitment, which was initiated several years ago, has been continuously reinforced through a series of strategic actions and policies.

Figure 21: An ambitious journey



Some of these pivotal strategies and initiatives include the Energy Strategy 2050, initially introduced in 2017 and subsequently updated in 2023, the National Hydrogen Strategy, as well as a range of energy strategy programs. These collective efforts are geared towards optimizing the utilization of clean energy sources, notably nuclear and solar energy, while actively phasing out coal from the UAE's energy portfolio. These initiatives have propelled the nation towards its overarching objective of establishing a sustainable and environmentally friendly energy sector ultimately aiming to achieve sector-wide decarbonization by the year 2050. The figure above highlights the UAE's journey to achieve net zero by 2050.

UAE Energy strategy 2050

The revised Strategy 2050 sets forth a comprehensive vision with several key objectives. Its primary focus is to accelerate the adoption of renewable and nuclear energy sources, optimize energy efficiency, stimulate research and development, foster innovation in energy technologies, bolster local clean energy production capabilities, and attract investments into the UAE's renewable and clean energy sector.

The strategy sets ambitious targets for the year 2030, including - tripling the UAE's renewable energy capacity to reach a total of 14.2 gigawatts; increasing consumption efficiency of individuals and corporates up to 45%; increasing the contribution of clean energy generation to 32% of the energy mix; achieving a grid emission factor of 0.27 kg Co2/kWh, making the UAE one of the lowest emitters, compared to the global average; launching the first wind program to diversify its energy mix, with 103.5-megawatt landmark wind project across four locations.

Hydrogen strategy

The overarching objective of the National Hydrogen Strategy is to bolster low-carbon industries within the UAE by decreasing the emissions in the hard to abate sectors (industrial and transportation), play a pivotal role in attaining net zero emissions by 2050, and reinforce the UAE's standing as a leading producer of low carbon hydrogen. The strategy targets a production of 1.4 million tons of low-emission hydrogen per annum by 2031.

This strategy places significant emphasis on ten enabling factors, as depicted below. It lays out a comprehensive roadmap outlining the critical measures the UAE will undertake to expedite the expansion of the hydrogen economy and curtail emissions within sectors characterized by high emissions intensity.

Figure 22: Enablers for hydrogen strategy

Image courtesy: Ministry of Energy and Infrastructure

National initiatives and policies to decarbonize the Water Sector

The UAE encounters distinctive obstacles in the management of its water resources due to its arid climate, limited freshwater sources, and the rapid expansion of its population. The UAE government has prioritized its water sector to secure a sustainable water supply and address water scarcity issues in a manner that is environmentally sound. Some pivotal aspects of the UAE's efforts towards a sustainable water sector encompass a focus on water conservation, the treatment and responsible management of wastewater, research and development endeavors, international collaboration and cooperation, enhancements in agricultural water efficiency, proactive measures for climate change adaptation, and the establishment of robust policies and regulations. Noteworthy initiatives aimed at promoting a sustainable water sector include:

The UAE Water Security Strategy 2036

The UAE Water Security Strategy 2036 is designed with the primary goal of guaranteeing consistent and sustainable access to water resources, both in routine circumstances and during emergency situations. The overarching objectives of this strategy are as follows:

- Reduce Total Water Demand: The aim is to curtail the overall demand for water resources by an impressive 21 percent.
- Enhance Water Productivity: The strategy targets an increase in the water productivity index to USD 110 per cubic meter, reflecting a significant improvement in water resource utilization.
- Mitigate Water Scarcity: To address water scarcity concerns, the strategy seeks to reduce the water scarcity index by three degrees, thereby alleviating water stress.

- Promote Treated Water Reuse: The strategy places a strong emphasis on the reuse of treated water, with the goal of achieving a remarkable 95 percent reuse rate.
- Boost National Water Storage: To enhance water security, the strategy aims to increase the national water storage capacity to a level that ensures a two-day supply, even under challenging circumstances.

National Water and Energy Demand Management Program

The National Water and Energy Demand Management Program is dedicated to achieving a 42-45% percent enhancement in efficiency across the UAE's top energy-consuming sectors, which encompass transportation, industry, and construction. The program is structured around three core pillars: energy optimization, water management, and the rationalization of consumption.

This program serves as a unifying force, bringing together all stakeholders in the UAE, in alignment with the overarching objectives of the UAE Energy Strategy 2050 and the UAE Water Security Strategy 2036.

International cooperative programs

The UAE is deeply involved in international climate initiatives, investing over USD 50 billion in renewable energy projects across 70 countries and planning to invest another USD 50 billion in the next decade. They've also pledged over USD 400 million for clean energy and are in collaboration with the US through the Partnership for Accelerating Clean Energy (PACE), aiming to fund USD 100 billion to support 100 GW of clean energy by 2035. Major UAE companies like ADNOC, Mubadala, and TAQA have made significant investments in Masdar, one of the world's largest renewable energy developers. Masdar operates in over 40 countries and aims to expand its renewable energy capacity to 100 GW by 2030.

The Partnership for Accelerating Clean Energy (PACE)

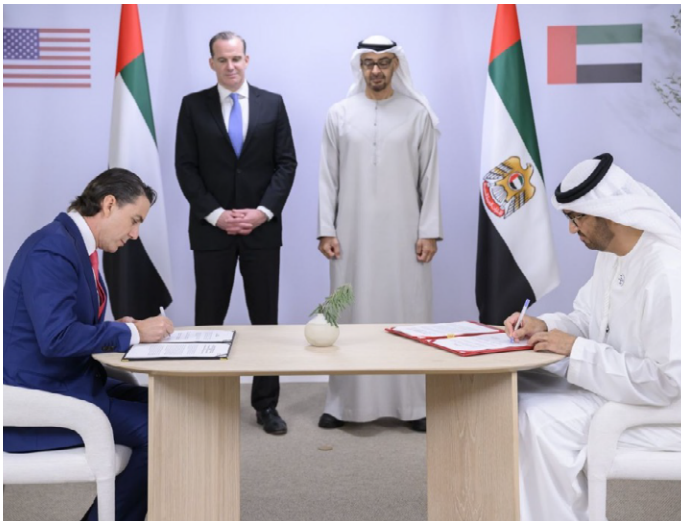


Image courtesy: Embassy of the UAE, Washington DC

The Ministry of Foreign Affairs (MOFA) plays a significant role in executing key national initiatives and projects, exerting influence over the foreign policy and diplomatic interactions of the UAE. It is important to note that MOFA also maintains extensive involvement with various International Organizations and Conventions that pertain to or have relevance to the UAE's foreign assistance and initiatives.

These include:

Water:

- The water initiative stands as a top priority for both the UAE's leadership and MOFA. An example of this commitment is the His Highness Mohammed Bin Zayed Water Initiative (MBZWI), which incorporates an international cooperation component.
- This initiative constitutes a crucial component of the UAE's foreign aid efforts and strategic approach.
- Furthermore, MOFA's foreign policy strategy encompasses climate policy, serving as a powerful tool to influence diplomacy and bilateral relations.

Energy:

MOFA's involvement is indispensable in the energy sector due to the developmental nature of the initiatives and the significant impact of energy on the national interests and security of the UAE.

- The strategic use of energy investments for political leverage is an important instrument wielded by MOFA.
- MOFA remains actively engaged in a variety of renewable energy funds and global initiatives, including projects such as the UAE Caribbean Renewable Energy Fund, which has a funding of USD 50 million.

In summary, MOFA plays a vital role as a key stakeholder in this realm, influencing the UAE's foreign policy, participating in international organizations and conventions related to foreign assistance, and actively contributing to initiatives in water and energy that are critical to the nation's development and diplomatic efforts and is at the forefront of championing the UAE's foreign assistance strategy and policy, which includes a commitment to addressing "climate change" as one of its seven global priority themes. From 2018 to August 2023, the UAE's foreign assistance endeavours aimed at combating climate change have amounted to a substantial USD 1.35 billion. These efforts have reached 161 countries worldwide, underscoring a shared commitment to tackling one of the most urgent challenges of today's era.

Bilateral climate cooperation

Engaging in bilateral collaborations stands as a fundamental pillar within Ministry of Foreign Affairs' (MOFA) approach to managing international affairs and the government's foreign relations and initiatives. Examples of these initiatives encompass projects such as the Negev, the PACE agreement, bilateral Memoranda of Understanding (MOUs), and forthcoming ventures, including partnership agreements focused on renewable energy projects in developing nations, notably within the Pacific and Caribbean regions. Few key examples include:

Partnership for Accelerating Clean Energy (PACE): The UAE and the US have forged a new partnership to combat climate change, promote clean energy technology, and enhance their collaborative efforts. In November 2022, the UAE and the US initiated the Partnership for Accelerating Clean Energy (PACE), aiming to mobilize USD 100 billion to establish 100 GW of clean energy by 2035. This venture signifies the joint determination of two significant energy contributors to undergo a rapid and robust energy shift. As of January 2023, it was disclosed that a sum of USD 20 billion would be channelled to support 15 GW of eco-friendly energy projects in the US by 2035. The initial investments for PACE will be funded by USD 7 billion from private sector equity, triggering an additional USD 13 billion from US debt financing and similar mechanisms.

Bilateral Memoranda of Understanding (MOUs): The governments of the UK and UAE have inked a Memorandum of Understanding (MoU). This agreement is designed to enhance the exchange of technical know-how, guidance, capabilities, and proficiency. It will also foster increased collaboration in energy and climate sectors and is anticipated to spur job growth and investment in the UK. During the Abu Dhabi Sustainability Week, the UK Business and Energy Secretary, Grant Shapps, and the UAE's Minister of Energy and Infrastructure, His Excellency Suhail Mohammed Al Mazrouei, signed the Clean Energy MoU. This strengthens the solid economic ties formed between the two countries from their 2018 MoU regarding Energy Cooperation. The updated MoU broadens the areas of bilateral partnership to include emerging energy sources like the low carbon super fuel, hydrogen. This is highlighted by ADNOC, UAE's premier energy firm, acquiring a 25% share in BP's blue hydrogen project, H2Teesside, in the previous year.

Furthermore, the agreement recognizes the UAE's strides in climate initiatives, their vision for clean energy ventures, and their pursuit of collaborative energy solutions with aligned partners.

Emirati-German Energy Alliance: In 2017, the UAE and Germany chose to enhance their thriving cooperation in the energy domain by forming the Emirati-German Energy Partnership. Acknowledging the vital interplay between climate and energy, this partnership evolved into the Emirati-German Energy and Climate Partnership in October 2022. Collaborative goals are set during bilateral steering committee sessions. The mutual undertakings materialize through working groups that actively involve the corporate sector. This revamped partnership promotes the sharing of expertise, organizes educational trips, hosts delegation visits, and conducts bilateral seminars.

Climate Partnership Signing, Berlin 2022

Image courtesy: Emirati-German Energy and Climate Partnership

Japan: During Prime Minister Fumio Kishida's visit, Japan and the UAE pledged to collaborate on technology and climate change. This visit, which is Kishida's second in the region, aims to ensure energy provisions and advance eco-friendly technology. The alliance encompasses an initiative to enhance energy security and establishes a structure for the UAE to partner with Japan in areas such as semiconductor and battery tech investments.

AIM for Climate: The Agriculture Innovation Mission for Climate (AIM for Climate) is a joint initiative established by the United States and the UAE, officially launched during COP26 under the leadership of President Joe Biden. AIM for Climate is designed to combat climate change and global food insecurity by bringing together various stakeholders to significantly boost investments in climate-smart agriculture and innovative food systems. This initiative spans a five-year period, from 2021 to 2025.

Notably, AIM for Climate partners have gone beyond expectations by increasing investments in climate-smart agriculture and food systems innovation to over $13 billion, surpassing the challenge set by U.S. Special Envoy for Climate John Kerry at COP27, which aimed to reach $10 billion by COP28. The partnership has expanded to include new members, such as the governments of Argentina, Fiji, Guatemala, India, Panama, Paraguay, and Sri Lanka, raising the total number of governments, innovation sprints, and knowledge partners to over 500.

Mangrove Alliance for Climate: The Mangrove Alliance for Climate (MAC) is a collaborative effort between the UAE and Indonesia, officially launched at COP27 by HE Mariam Almheiri. MAC builds upon global initiatives to champion biodiversity and shines a spotlight on mangroves as a nature-based solution to address climate change.

MAC's primary objective is to scale up and expedite the conservation, restoration, and expansion of mangrove ecosystems worldwide, benefitting communities and recognizing the pivotal role of these ecosystems in mitigating and adapting to climate change. MAC's members, comprising nearly 20 governments, commit to planting, rehabilitating, and restoring mangroves within their respective countries, as well as providing support to others with similar objectives.

Additionally, MAC fully aligns with the Mangrove Breakthrough, which is guided by scientific principles and aims to secure the future of 15 million hectares of mangroves by halting and reversing mangrove losses while doubling the protection of mangroves on a global scale.

Korea: Running joint operation committee (JOC) to strengthen cooperation and exchange experiences of policy, law and institutions, science, and technology in the field of water resources including groundwater management, smart water management, sea water desalination etc. on the basis of mutual benefit. Recently accomplished low energy sea water Reverse Osmosis, R&D project at Al Aryam Island in collaboration with Masdar.

CHAPTER 4: Adaptation Measures

Chapter 4
Adaptation Measures

Introduction

Climate change adaptation holds equal significance to mitigation in the UAE, given that the country is susceptible to climate change consequences that resemble those experienced by other countries in the region. These potential effects encompass alterations in meteorological patterns, elevated temperatures in both air and seawater, rising sea levels, and an escalation in extreme weather occurrences. The UAE occupies a coastal region characterized by extreme aridity, where the average annual rainfall is less than 100 mm, and water resources are scarce. During the summer months, the temperature and humidity levels soar, with peak temperatures exceeding 49°C and humidity levels approaching 100% on exceptionally humid days.

Consequently, the projected effects of climate change will impact the UAE directly and indirectly, touching upon its economy, environment, and societal well-being. These anticipated adverse effects will ripple through marine and terrestrial ecosystems, agricultural productivity, and the accessibility of water resources. Moreover, the rising sea levels pose a potential threat to vital UAE infrastructure, including desalination and power facilities, as well as habitats situated along coastal areas bordering the Arabian Gulf or the Gulf of Oman.

Considering the anticipated climate change challenges, the UAE is actively rolling out a comprehensive set of policies and initiatives at both the national and local levels. These efforts are aimed at enhancing resilience to climate change and mitigating its impacts, with some initiatives yielding co-benefits for mitigation. The decision-making process is grounded in extensive stakeholder engagement, which includes private sector participation, and is guided by the latest scientific research, to effectively bridge the gap between science and policy.

Moving forward, the National Climate Change Plan will entail the development of in-depth adaptation strategies for various key sectors, aiming to minimize vulnerabilities and bolster the UAE's capacity to adapt. The National Climate Change Plan focuses on three key objectives (i) manage GHG emissions, (ii) build climate resilience by managing risk and building adaptive capacity; (iii) advance UAE's economic diversification agenda through innovative solutions. Noting that National GHG emission management systems, national adaptation planning and management, and private sector-based innovative diversification programs are key climate priorities of the country.

In line with National Climate Change Plan in 2017, MOCCAE established National Climate Change Adaptation Program in 2018. Acquiring an enhanced understanding of climate impacts, prioritizing high risks, and identifying adaptation options. Under this program, MOCCAE conducted climate change risk assessments for the priority sectors in 2019 and planning implementable adaptation strategies from there onwards. Followed by mainstreaming adaptation strategies in 2025 and conducting monitoring and evaluation to ensure evidence-based adaptation in 2030-2050.

MOCCAE published Risk assessment reports in 2019 for priority sectors: Public Health, Energy, Infrastructure, Environment, and Insurance sector newly added (in 2021-22).

For each sector, actionable adaptation plans are currently in the process of development at the emirate level, aligning with the requirements of the National Adaptation Plan (NAP). These plans are designed to effectively address the high-priority risks that have previously been identified. The overarching goal of the NAP is to emphasize, integrate, execute, and oversee adaptation strategies across various sectors, involving all relevant stakeholders within both governmental and non-governmental domains. These plans will encompass detailed information regarding specific actions, the responsible leaders and supporting participants, timelines, metrics for monitoring and evaluation, as well as preliminary cost estimates and anticipated impacts. This comprehensive approach is intended to mainstream climate change adaptation and bolster resilience within sector-specific development strategies while identifying crucial projects and action plans for funding. Through the NAP, the UAE is proactively enhancing its capacity to adapt to the challenges of climate change by pinpointing both short-term and long-term priority adaptation measures.

Methodology Adopted for Climate Risk Assessment

The methodology used to carry out climate risk assessment adopted the guiding formula for calculating "risk based on the magnitude and likelihood of the climate impacts". The 5 Step approach is adopted which includes stock-taking, identifying potential impacts, evaluating impacts, assessing, and prioritizing risks, and identifying adaptation measures together with stakeholder consultation and monitoring and reviewing mechanisms.

Key Findings:

Health Sector: The impacts of climate change on public health, both direct and indirect, include heat stress and heat strokes due to rising temperatures, potential drowning caused by coastal flooding, storm surges, and heavy rain. Building climate-resilient health systems involves implementing climate-smart health programs, enhancing emergency preparedness and management, and establishing integrated risk monitoring, among other measures.

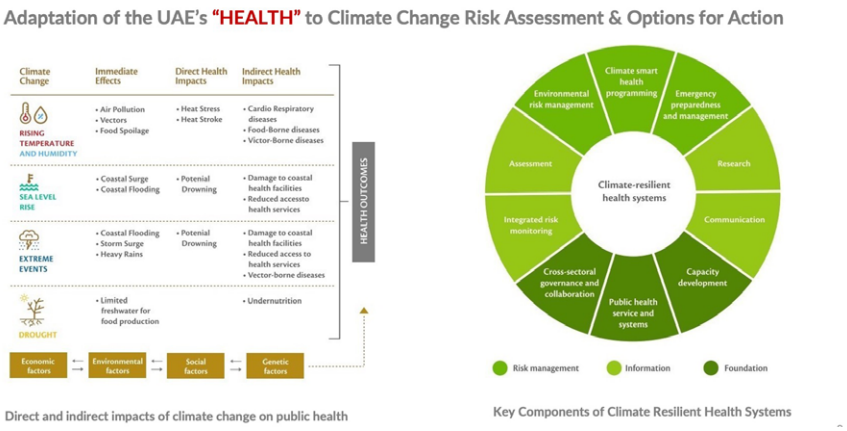


Image courtesy: Ministry of Climate Change and Environment, UAE

Energy Sector: The evaluation of the energy sector concerning climate change encompasses electricity generation, transmission, distribution, and end-use. Opportunities for adaptation in the energy sector include investments in climate-smart technologies, location-specific risk assessment knowledge, sharing and training on power-sector adaptation, developing long-term climate-proof strategies, and integrating climate risk assessment and adaptation planning into the energy sector.

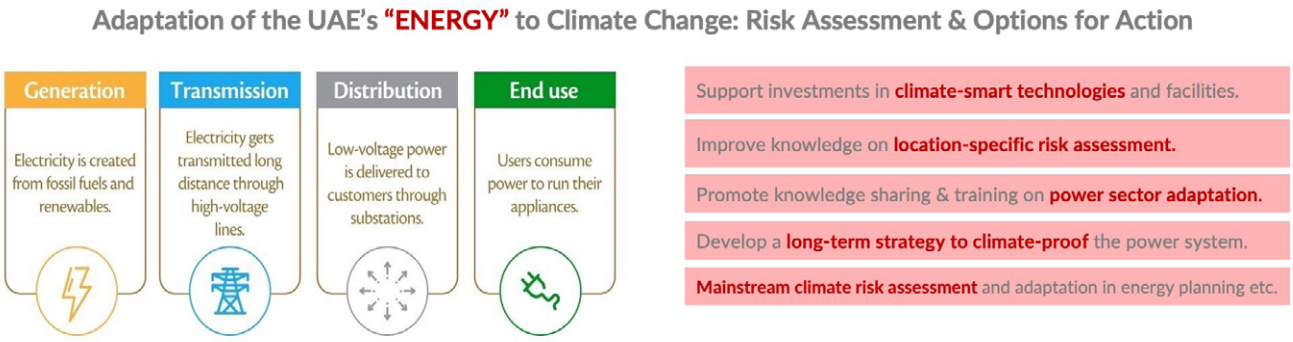


Image courtesy: Ministry of Climate Change and Environment, UAE

Infrastructure Sector: Climate change affects various specific infrastructures such as roads, railways, ports, water supply systems, bridges, buildings, airports, and sanitation. Adaptation opportunities in this sector involve strengthening the policy framework for infrastructure resilience, enhancing capacity in climate data, raising public awareness, fostering collaboration in risk assessment and adaptation within the infrastructure sector, and providing resilience guidelines at both federal and emirate levels.

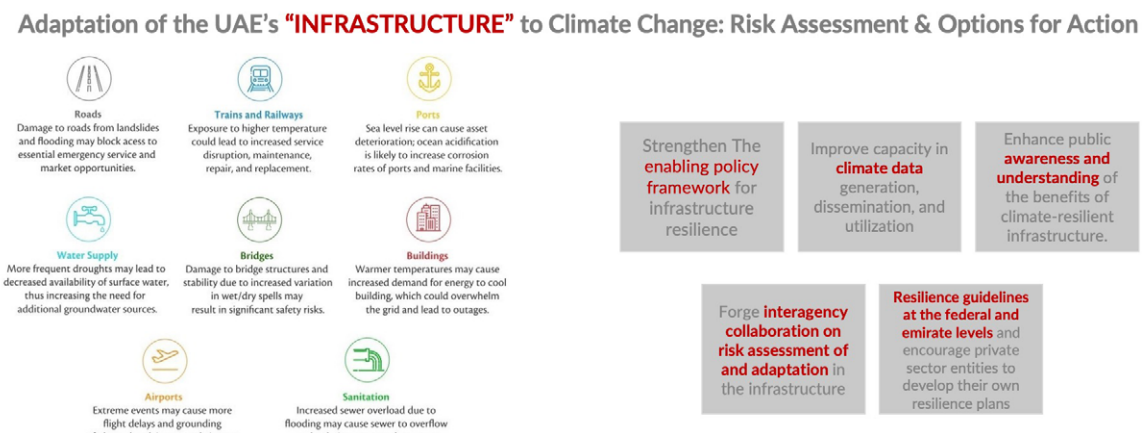


Image courtesy: Ministry of Climate Change and Environment, UAE

Environment Sector: Key environmental systems, including coastal, terrestrial, ocean, food production, and freshwater systems, are susceptible to climate change impacts with potentially severe consequences. Adaptation opportunities in the environment sector encompass strengthening ecosystem-based adaptation, understanding the interplay between climate and human factors, implementing payment for ecosystem services (PES), assessing climate vulnerability in protected areas, improving climate change projections, and promoting integrated policy frameworks for resilience.

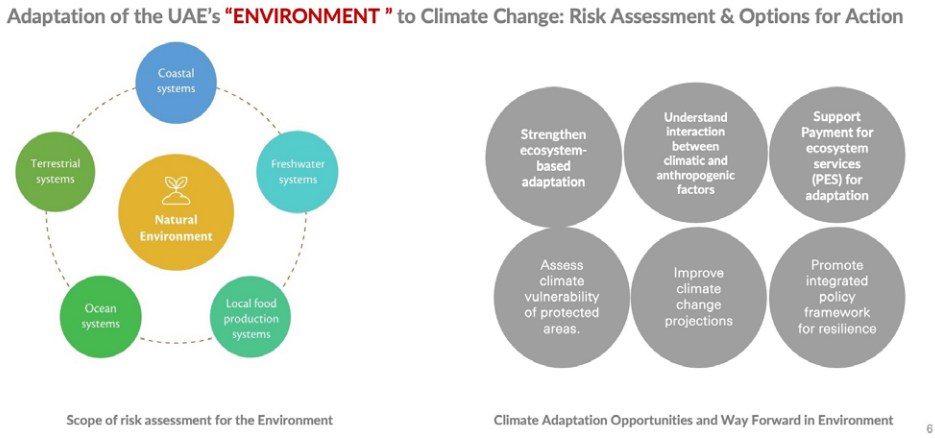


Image courtesy: Ministry of Climate Change and Environment, UAE

Insurance Sector: Risks identified in the insurance sector include transition risks such as policy and legal challenges, technology changes, market fluctuations, and reputation risks, as well as physical risks. Adaptation opportunities influencing strategic planning and risk management of financial impacts include adjustments to governance structures, underwriting portfolios, investment portfolios, risk management practices, and an expansion of disclosure and regulatory requirements within the insurance sector.

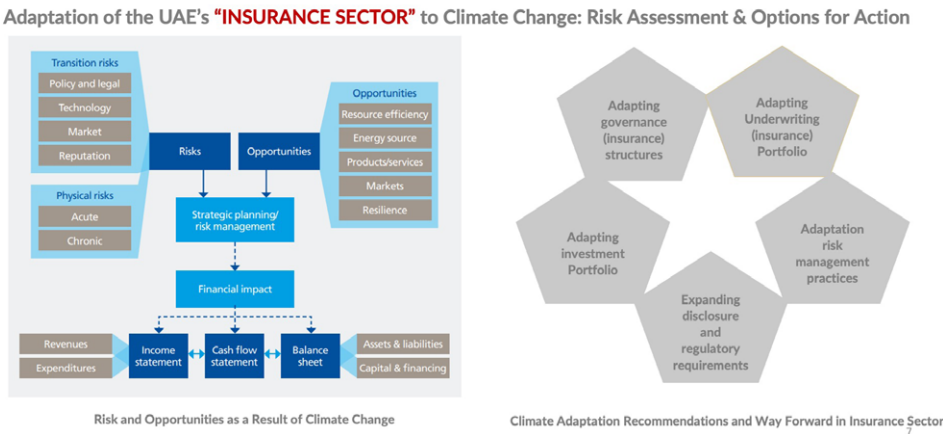


Image courtesy: Ministry of Climate Change and Environment, UAE

Regional Climate Change Modelling

Prospective climate modelling and forecasting studies play a pivotal role in formulating appropriate adaptation strategies. To enhance the accuracy of future climate projections and the efficacy of corresponding policy actions, the Abu Dhabi Global Environmental Data Initiative (AGEDI) undertook an extensive multi-year project from 2013 to 2016. This project aimed to investigate the repercussions of climate change at local, national, and regional levels, encompassing terrestrial and marine ecosystems, coastal areas, food security, and water resources. The project's key findings underscored the significance of prioritizing climate change adaptation within UAE policy and provided valuable insights for the development of the National Climate Change Plan.

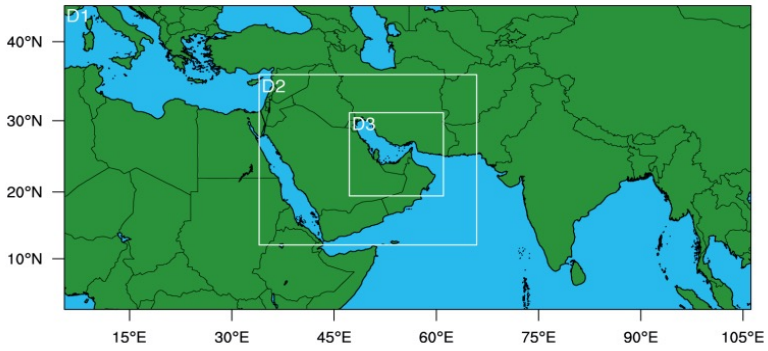
AGEDI's work was grounded in regional climate modelling. Globally, scientific forecasts of climate change impacts rely on General Circulation Models (GCMs), which are comprehensive climate models at a global scale, simulating physical processes in the atmosphere, ocean, cryosphere (frozen Earth surface areas), and land surface to project how the global climate system responds to rising GHG levels. However, GCM outputs often lack the granularity needed to adequately represent local and regional topography and meteorological dynamics in the Arabian Gulf region. Given the region's intricate terrain and the potential for volatile meteorological conditions, particularly extreme wind events, the significance of regional modelling becomes evident.

Regional Atmospheric Modelling

The Regional Atmospheric Modelling employed the Weather Research Forecasting (WRF) Model developed by the National Center for Atmospheric Research (NCAR) to perform dynamic downscaling of output data from the Community Climate System Model Version 4 (CCSM4) GCM. This downscaling was conducted with a focus on two Representative Concentration Pathways (RCPs) outlined in the IPCC Fifth Assessment Report (AR5): RCP8.5, representing a high emissions trajectory, and RCP4.5, indicating a low-to-moderate emissions scenario. The model's performance was validated against historical data spanning from 1986 to 2005, utilizing nested domains of increasing resolution, including 36 km, 12 km, and 4 km, which marked a significant enhancement compared to the CCSM4's 100 km resolution.

Several noteworthy findings emerged from this study, suggesting that climate change will lead to increased heat and humidity across the entire Arabian Peninsula. For instance, during the 2060-2079 period, compared to historical records, the already hot and humid summer months are projected to experience a temperature rise ranging from 2°C under RCP 4.5 to 3°C under RCP 8.5. Humidity levels are anticipated to rise by approximately 10% throughout the UAE and particularly in the north-eastern region of the country. Moreover, there is a possibility of an uptick in average annual precipitation in the UAE, especially during the summer season, although projections also suggest a potential increase in heavy rainfall events, alongside a reduction in the number of days with rainfall.

Figure 24: Geographic Mapping



Source: AGEDI 2016. Technical Summary Regional Atmospheric Modelling. LNRCCP. CCRG/NCAR.

Figure 25: UAE Average air temperature

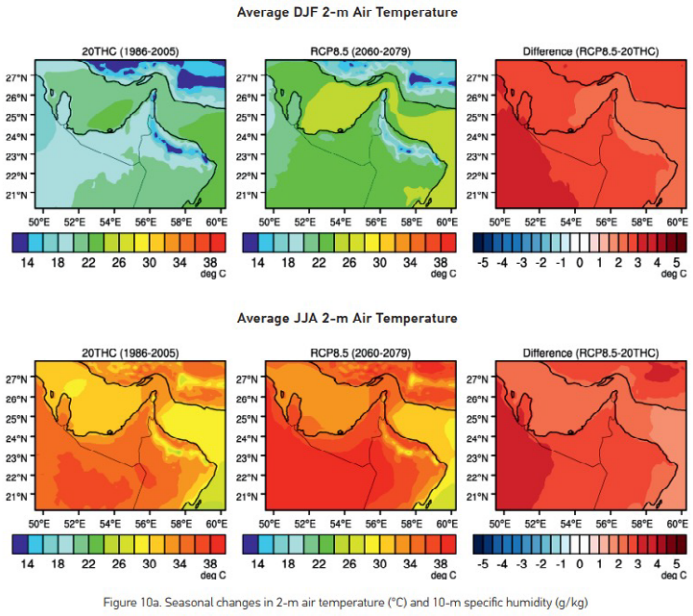


Figure 10a. Seasonal changes in 2-m air temperature (°C) and 10-m specific humidity (g/kg)

Source: AGEDI 2016. Technical Summary Regional Atmospheric Modelling. LNRCCP. CCRG/NCAR.

Projected temperature trends for the UAE, as determined by the validated WRF model, are displayed for three time periods: the historical period (left), the 2060-2079 period under RCP 8.5 (center), and the percentage variation (right). These temperature patterns are averaged over the winter months (top) and the summer months (bottom).

Figure 26: UAE Average humidity

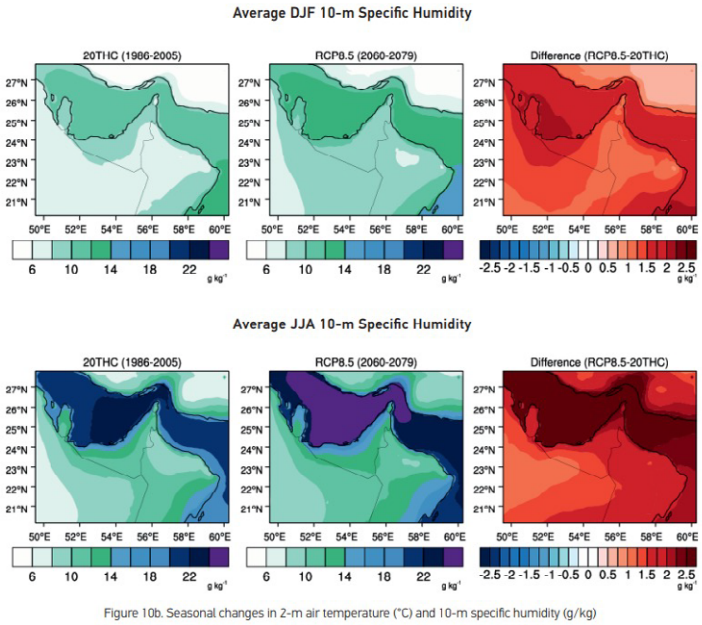


Figure 10b. Seasonal changes in 2-m air temperature (°C) and 10-m specific humidity (g/kg)

Source: AGEDI 2016. Technical Summary Regional Atmospheric Modelling. LNRCCP. CCRG/NCAR.

Projected humidity levels across the UAE, as determined by the validated WRF model, are depicted for three-time frames: the historical period (left), the 2060-2079 period under RCP 8.5 (center), and the percentage variation (right). These humidity trends are averaged over the winter months (top) and the summer months (bottom).

Regional Ocean Modelling

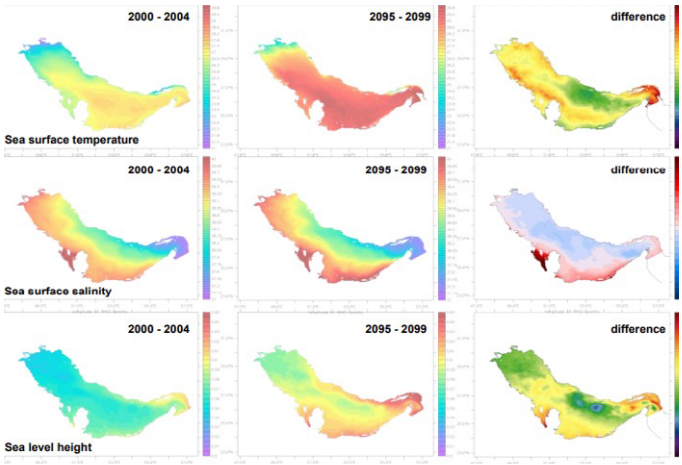
The Regional Ocean Modelling utilized the Regional Ocean Modelling System (ROMS) to conduct downscaling of data generated by the Mixed Resolution General Circulation Model (GCM) developed by the Max Planck Institute for Meteorology (MPI). Specifically, the analysis focused on a single Representative Concentration Pathway (RCP), namely RCP 8.5. The validation of the regional ocean model involved historical data spanning from 2002 to 2006, within the Arabian Gulf domain. This validation was conducted using an average horizontal resolution of 1.1 km and a vertical resolution ranging from 0.1 cm to 4 meters.

The findings reveal notable alterations in the Arabian Gulf compared to historical patterns, particularly concerning temperature, salinity, and circulation dynamics. However, these changes exhibit uneven distribution across the Arabian Gulf. For instance, in the late 21st century (2095-2099), a projected increase in sea surface temperature of approximately 1.7°C is anticipated in the central Gulf area, while certain regions, like the vicinity of the Strait of Hormuz, may witness an even more significant rise of about 2.8°C. Sea surface salinity is expected to exhibit both decreases and increases, contingent upon location. Modest salinity increases of about 0.5 practical salinity units (psu) are foreseen along the UAE coastline south of the Northern Emirates by the late 21st century.

Projections also indicate sea level rise within a range of about 2.7 cm (in the central Gulf area) to 5 cm (around the Strait of Hormuz), contingent upon location, by the late 21st

century. It is important to note that the modelling did not encompass all major contributors to sea level rise, owing to current limitations in the suite of General Circulation Models (GCMs), including the MPI-Mixed Resolution GCM. For a more precise regional sea level rise projection, it would be necessary to integrate key factors such as thermal expansion and deglaciation into the GCMs, a process currently underway in the ocean modelling scientific community.

UAE Temperature, salinity, and sea level height changes



Source: AGEDI 2016. Technical Summary Regional Atmospheric Modelling. LNRCCP. CCRG/NCAR.

Average sea surface temperature (in degrees Celsius), sea surface salinity (in practical salinity units), and sea level height (in centimetres) during the early (2000-2004) and late 21st century (2095-2099) in the Arabian Gulf.

These findings align with the trends observed in global General Circulation Models (GCMs). However, the regional models offer more granular and precise projections, which can not only inform the development of relevant policies aimed at enhancing climate resilience and mitigating climate-related risks but also provide insights into potential business opportunities. For instance, businesses can consider future climatic conditions, such as wind direction, when planning the construction of renewable energy plants.

Furthermore, the increase in the salinity of the Arabian Gulf due to climate change is expected to be exacerbated by desalination processes used for producing potable water. The Arabian Peninsula heavily relies on desalinated seawater. Since 2000, the region has seen an annual increase of about 9% in desalinated water production, with approximately 10% per year in the UAE alone. This trend is expected to continue to meet the growing water demand driven by population growth and socio-economic development.

AGEDI's study delved into the combined impacts of climate change and desalination on the Arabian Gulf. The study utilized the Regional Ocean Model and projected changes based on four potential scenarios of plant discharge levels through mid-century (2040-2050). The study revealed that the release of hot and highly saline brine from desalination plants will have significant repercussions on surface and bottom temperatures, as well as

salinity levels, across the Gulf, with the extent of these changes depending on location and depth. These alterations are likely to impact seagrass and other ecosystems that support a wide range of aquatic species, underscoring the need for careful consideration when developing climate-adaptive measures for the Arabian Gulf.

Overcoming Vulnerability

Agriculture, Fisheries & Food Security

Climate change is poised to have a significant impact on the agricultural sector in the UAE. This includes the potential consequences of elevated temperatures and increased salinity due to higher rates of evaporation, which may limit the variety of crops that can thrive in the already dry desert environment. Additionally, such changes could make crops more susceptible to the emergence of plant pests.

In response to these challenges, the Ministry of Climate Change and Environment is actively working towards enhancing the sustainability of agriculture in the UAE. Their efforts aim to promote efficient use of natural resources in a way that is both economically viable and environmentally and socially sustainable. These endeavours are particularly crucial for bolstering the UAE's food security, given the limited availability of water resources and arable land.

The UAE is committed to reducing its demand for water resources and has set a target to decrease the water supply required for agriculture to 7.1 million cubic meters per day by 2036, a reduction from the 8.2 million in 2016. To achieve this goal, numerous initiatives are underway to introduce innovative farming solutions and technologies. For instance, the Agriculture 4.0 initiative aims to modernize traditional farms with technology-driven operational models that enhance production efficiency while adhering to the water budget outlined in the UAE Water Strategy 2036. Additionally, the UAE has made significant investments in several vertical farming projects. Notably, the world's largest vertical farm, situated in Dubai and developed in partnership with Emirates Flight Catering, is projected to yield an equivalent of 3.6 million square meters of farmland while using 99% less water than conventional farming methods.

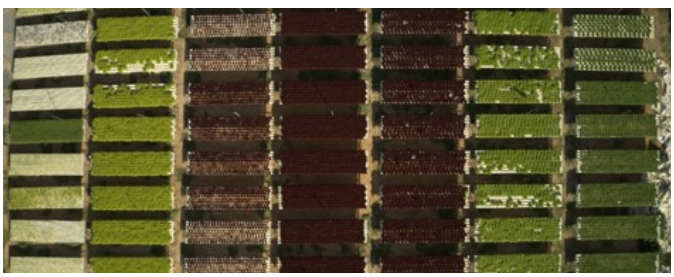


Image courtesy: Ministry of Climate Change and Environment, UAE

One noteworthy approach being implemented is the adoption of climate-smart agriculture (CSA). This strategy involves encouraging farmers to embrace various farming systems, including:

- **Organic farming:** This method is favoured because it emits fewer greenhouse gases and can sequester higher levels of atmospheric carbon dioxide when compared to conventional farming.

- **Hydroponic farming:** Hydroponics offers a promising alternative to traditional farming that relies heavily on water. This innovative approach is being explored as a way to reduce water consumption while maintaining agricultural productivity.

Furthermore, the UAE is also employing an Integrated Pest Management (IPM) approach, primarily through the "NAKILNA" ("Our Palm") initiative. This initiative is focused on controlling palm pests, which is vital for ensuring the sustainability of palm cultivation—an economically significant aspect of the UAE's agricultural sector.

Moreover, the UAE is actively developing and implementing a range of initiatives aimed at bolstering the resilience of its Agro-food system in the face of climate change. These efforts encompass both adaptation and mitigation strategies. For instance, they include:

- Promoting Climate-Resilient Crop Varieties: Encouraging the adoption of crop varieties that can thrive in changing climatic conditions.
- Utilizing Advanced Protected Agriculture Technologies: Embracing modified protected agriculture techniques, such as highly efficient greenhouses equipped with cooling systems and water recycling systems.
- Establishing Strategic Water Reserves: Creating reserves of water resources to ensure reliable access for agricultural needs.
- Adopting Clean Energy and Low-Carbon Agro-Systems: Emphasizing the use of clean energy sources and low-carbon agricultural systems, including enhanced logistics platforms.

Regulations also play a pivotal role in ensuring sustainable agricultural practices. In this regard, research and development (R&D) serve as a critical driver for the sustainable growth of the agricultural sector. Prominent research institutions based in the UAE, including the International Centre for Bio-saline Agriculture and the International Centre for Agricultural Research in the Dry Areas, are actively engaged in innovative measures to improve agricultural productivity and sustainability, especially in hyper-arid and saline environments.

For instance, a ground-breaking research facility was inaugurated in March 2016 in Abu Dhabi, which grows both food (such as fish and shrimp) and biofuel crops (salt-tolerant halophyte plants) on desert land irrigated with seawater. Managed by the Masdar Institute of Science and Technology and funded by the Sustainable Bioenergy Research Consortium, this project not only addresses climate change adaptation but also offers mitigation co-benefits. If proven successful, it has the potential to be scaled up to a 200-hectare site. Innovation in research and development is expected to further advance through the Emirates Committee for Sustainable Environment Research, established in 2016 with a primary focus on addressing environmental sustainability and climate change.

In addition to agricultural efforts, the UAE is actively promoting sustainable fisheries to counteract the impacts of climate change on marine ecosystems. Measures include regulations to protect endangered species during breeding seasons, the installation of artificial reefs to support marine species growth, and the introduction of aquaculture.

The establishment of the state-of-the-art Sheikh Khalifa bin Zayed Marine Research Centre, which includes hatcheries for local species, is another significant step in this direction.

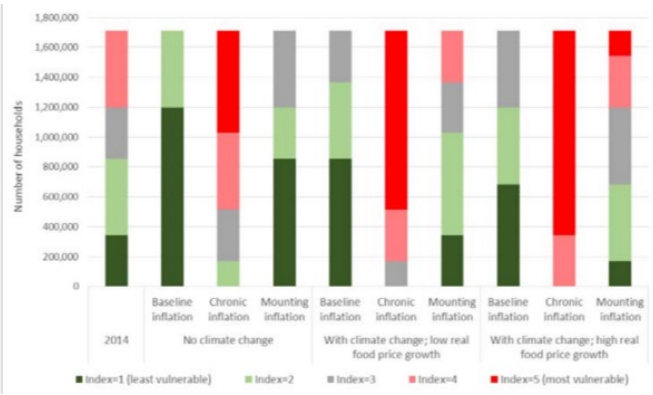
Recognizing the importance of healthy oceans and sustainable fisheries, the UAE leadership has emphasized the role of innovation, creativity, and research and development in supporting the maritime sector while ensuring responsible management of marine resources. This commitment to sustainability and collaboration was highlighted during the 2022 International Maritime Transport and Logistics Conference, with discussions on potential partnerships with Egypt to enhance maritime capabilities and promote the blue economy within both countries.

Despite these efforts, the UAE faces challenges in its food security due to limited arable land and water resources, necessitating significant food imports. While currently classified as “food secure” by international food security indexes, the UAE acknowledges the potential long-term impact of climate change and other factors on its food security. To address this concern, the Abu Dhabi Global Environmental Data Initiative (AGEDI) conducted a recent food security project. This project examined how future climatic conditions could affect the agricultural productivity of major food-exporting countries to the UAE and, consequently, the long-term food security of the UAE, with a specific focus on the potential impact on UAE households. The study relied on trade statistics from the Food and Agriculture Organization and utilized the outputs of the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), developed by the International Food Policy Research Institute (IFPRI).

The study considered various scenarios, including levels of future inflation, food prices, and the impacts of climate change. Its findings indicated that the supply of certain products, such as wheat and rice, could be constrained under climate change, potentially leading to price increases that may disproportionately affect lower- to middle-income households, increasing the share of their budgets spent on food. Notably, when climate change is added to an already stressed situation (e.g., chronic inflation), the number of the most vulnerable households could double under a “high real food price” scenario.

It’s worth noting that the IMPACT model is a global model covering 115 countries/regions, with the UAE grouped within the Gulf region. However, further refinement and specificity reflecting the unique characteristics of the UAE may enhance the accuracy of projections related to future food security and its associated impacts.

Figure 31: Number of UAE households classified by the Micro Index, all scenarios



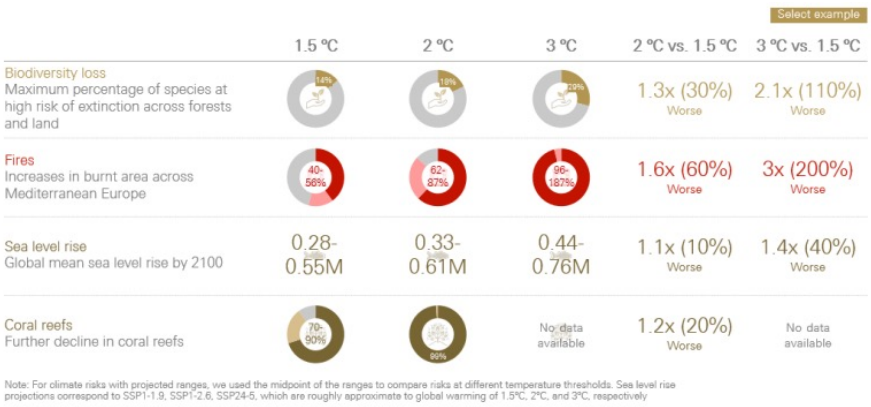
Source: AGEDI. 2015. Food Security and Climate Change. LNRCCP. CCRG

Biodiversity

The UAE is home to a diverse array of wildlife and plant species, many of which face significant threats from factors like pollution, rapid urbanization, and climate change, among others. Few of these species have been categorized as “vulnerable” or “endangered” on the IUCN Red List maintained by the International Union for Conservation of Nature (IUCN). Some notable examples include the Arabian tahr, Arabian leopard, Arabian Oryx, green turtle, fin whale, and dugongs.

In response to these conservation challenges, the UAE has taken proactive steps. The country had developed a National Biodiversity Strategy and Action Plan (NBSAP) to serve as a guiding framework for conserving biodiversity over the decade, which is now being updated to achieve, KM Global Biodiversity Framework targets. Additionally, a National Strategy to Combat Desertification has been established. These initiatives have paved the way for the implementation of numerous projects aimed at preserving the UAE’s biodiversity and harnessing the various ecosystem services that are integral to human well-being.

Figure 32: Impacts of climate change under different temperature levels



Source: Ministry of Climate Change and Environment, UAE

Blue Carbon

A fundamental component of the UAE's ecological response to climate change revolves around "Blue Carbon," encompassing coastal and marine ecosystems like mangrove forests, salt marshes, and seagrass beds. These ecosystems serve as protective barriers for shorelines, provide essential nursery grounds and habitats for a diverse array of species, and support coastal tourism. Furthermore, their preservation and enhancement offer climate change mitigation benefits, given their capacity to sequester and store carbon at a significantly faster rate, and in a more permanent manner, compared to terrestrial ecosystems. The UAE also possesses extensive sabkha (salt flats), which, while not actively sequestering carbon, serve as carbon storage reservoirs.

To this end, comprehensive studies have been conducted to establish a baseline assessment of carbon within Blue Carbon ecosystems across various settings in the UAE, including lagoons and both natural and cultivated mangrove areas. Leading this crucial work are key entities such as the Ministry of Climate Change and Environment, AGEDI, and the Environment Agency – Abu Dhabi, with support from relevant local authorities and international experts in Blue Carbon. The findings from these studies reveal that carbon stocks in the hyper-arid and saline mangroves of the UAE generally fall at the lower end of the global scale, with an average of 293.15 Mg C/ha across all studied sites, compared to the global average of approximately 1000 Mg C/ha. However, significant variations are observed at different locations within the UAE, with notably high carbon stocks found in some regions, such as the south of the City of Kalba, where older, mature mangrove forests has a carbon stock of 824 Mg/ha[19].

These studies have been instrumental in identifying particularly valuable carbon stocks and have underscored the critical importance of implementing appropriate conservation measures to safeguard Blue Carbon ecosystems. Destruction of these ecosystems would result in the release of carbon into the atmosphere, contributing to global warming. Furthermore, it takes several decades for mangroves to sequester and store an equivalent amount of carbon as mature mangrove forests.

Recognizing the global significance of Blue Carbon ecosystems, the UAE has joined the International Partnership for Blue Carbon, initiated during the COP 21 Paris Climate Change Conference, to facilitate best practices sharing and collective action for the protection of these ecosystems worldwide. A more recent effort is the launch of the Mangrove alliance for Climate (MAC) which build on global efforts to promote biodiversity and shine a spotlight on nature-based solutions, the Mangrove Alliance for Climate (MAC), which is spearheaded by the UAE in partnership with Indonesia, promotes mangroves as a nature-based solution to climate change. MAC was launched at COP27. At the regional level, AGEDI has undertaken two projects to assess the vulnerability of marine and terrestrial biodiversity to long-term climate change impacts.

Marine and terrestrial biodiversity

- The Marine Biodiversity project encompasses four main components:
- Development of a comprehensive marine species database for the Arabian Gulf, subsequently incorporated into publicly accessible online databases, including "FishBase" for fish species and "SeaLife-Base" for non-fish species.

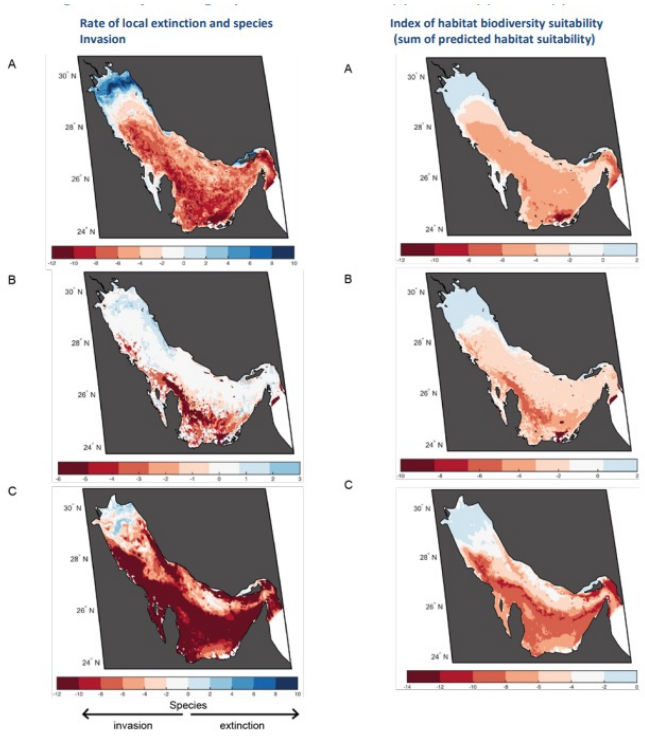
[19]UAE's First Long Term Strategy

- Reconstruction of historical fish catch data for seven countries bordering the Arabian Gulf, spanning the period from 1950 to 2010.
- Implementation of environmental niche modelling for 56 priority species, encompassing 48 fish species, three seagrass species, and five vulnerable or endangered charismatic species such as dugongs and dolphins. Multiple models including Regional Ocean Modelling for RCP 8.5; Non-Parametric Probabilistic Ecological Niche Model; Ecological Niche Factor Analysis; Bioclimate Analysis and Prediction Model were employed to project the impacts of climate change on factors like species invasion, local extinctions, and habitat suitability.
- Assessment of the vulnerability of the commercial fishing industry for each country, specifically under the climate change scenario of RCP 8.5.

While there is considerable variation among the results obtained from the three models, they generally suggest the possibility of local extinctions in the Arabian Gulf, with potential reductions in species populations of up to 35% and potential invasions of species reaching up to 5% by the year 2090, relative to 2010. The UAE is identified as one of the regions that may experience losses in marine biodiversity and declines in commercial fish catches, with associated socio-economic consequences.

Certain migratory species, like sea turtles, may possess the capability to adapt to changing climate conditions by altering their migratory patterns, unlike non-migratory species endemic to the Gulf, which may be more severely affected. However, the rate of climate change is concerning, and the species may not be able to adapt in a short span of time. Also, climate change is anticipated to impact a wide range of species, emphasizing the need to strengthen conservation measures, including the enforcement of effective fisheries policies and the establishment of Marine Protected Areas (MPAs), to mitigate potential habitat destruction and enhance species resilience in the face of climate change.

Figure 33: Projected changes by 2090 relative to 2010 from (A) NPPEN and (B) ENFA and (C) BIOCLIM



Source: AGEDI. 2015. Technical Report: Regional Marine Biodiversity Vulnerability and Climate Change. LNRCCP. CCRG/UBC/Changing Ocean Research Unit/Sea Around Us

In the left panel, positive values signify species invasion, whereas negative values indicate species local extinction. In the right panel, values to the right of the scale signify an increase in habitat biodiversity suitability, while values to the left of the scale indicate a decrease in habitat biodiversity suitability.

The Terrestrial Biodiversity project encompassed three primary components:

- Creation of a comprehensive terrestrial species database for the Arabian Peninsula.
- Utilization of MaxEnt for individual species distribution modelling, projecting the effects of climate change on future habitat suitability for 75 priority terrestrial species, spanning amphibians, birds, mammals, plants, and reptiles.
- Implementation of generalized dissimilarity modelling at the community level, covering plants, mammals, breeding birds, and non-breeding birds. This modelling aimed to forecast changes in species composition under current and future climate conditions. Both modelling efforts incorporated outputs from the Regional Atmospheric Modelling for RCP 4.5 and RCP 8.5.

The project's findings indicated that, for the identified priority species, the loss of suitable habitat is anticipated to be most pronounced in the southern half of the Arabian Peninsula, including the UAE. However, it was noted that these losses may be partially offset by gains in suitable habitat. Furthermore, the project suggested that climate change is poised to bring about widespread alterations in existing biodiversity composition, including the local extinction of certain species. Consequently, conservation and management strategies should prioritize the preservation of ecological processes while also allowing for or facilitating shifts in biodiversity patterns.

Additionally, at the regional level, the UAE is actively involved in the development of the Ecosystem-Based Management Strategy for the ROPME Sea Area. Collaborating with the United Nations Environment Programme (UNEP) and consulting with major national, regional, and international stakeholders, the Regional Organization for the Protection of the Marine Environment (ROPME) is in the process of formulating a strategy tailored to the Arabian Gulf. This strategy centers on the interconnectedness between the delivery of ecosystem services and human requirements. It also encompasses implementation mechanisms, including capacity development at both national and regional levels, in accordance with global best practices.

Coastal Zone Management

Coastal regions are directly impacted by the effects of climate change, including challenges such as coastal inundation and erosion due to rising sea levels that affect both habitats and infrastructure. Additionally, marine and coastal ecosystems are at risk of destruction due to ocean acidification and rising temperatures, even though these ecosystems provide valuable services. In response, the UAE has crafted a National Strategy for Marine and Coastal Environment Sustainability, with the overarching goal of conserving and ensuring the sustainability of these ecosystems.

This strategy is founded on principles of integrated coastal zone management, capacity building, public awareness campaigns, and fostering regional and international collaborations. Integrated coastal zone management is pivotal in addressing immediate and long-term coastal challenges linked to climate change. It achieves this by establishing ecosystem-based approaches and applying adaptive management and spatial planning strategies that encourage socio-economic activities while safeguarding environmental integrity.

The implementation of this strategy is overseen by the National Marine and Coastal Environment Monitoring Programme, which ran from 2016 to 2021. This program, carried out in partnership with the National Center of Meteorology and Seismology and relevant local entities, focuses on monitoring marine water quality, biodiversity, and the dynamics of coastal areas. It provides essential data for informed decision-making, periodic reporting, and evaluation of the effectiveness of supporting legislation.

In a similar vein, AGEDI's coastal vulnerability assessment project emerged in response to the need for a quantitative evaluation of near-term (10-15 years) vulnerability in coastal zones due to climate change. This project involved the development of a "coastal vulnerability index" (CVI). Using an ecosystem services-based model known as the "Integrated Valuation of Ecosystem Service and Tradeoffs" (InVEST), which was created by the Natural Capital Project, the project identified areas of exposed shoreline and vulnerable coastal communities. It assessed each 250-square-meter segment of the UAE coastline in terms of climate change risks, including factors like increased storm frequency and sea level rise. The segments were then ranked according to their vulnerability, ranging from lowest to highest.

Moreover, the study shed light on the degree to which natural systems, such as mangroves, coral reefs, and sand dunes, contribute to climate change adaptation by mitigating climate risks to coastal communities and assets. It also explored how changes to these ecosystems impact their ability to provide adaptation benefits. The acquisition of spatial information is especially critical for effective planning, given the multiple, and at times conflicting, uses of coastal land and ecosystems.

The results of this assessment are poised to aid policymakers in adopting appropriate adaptation measures to safeguard vulnerable coastal zones and infrastructure, ensuring their resilience in the face of climate change.

Policies and initiatives

Energy

Federal policies and initiatives:

To prevent damage and wear in power facilities, the UAE conducts regular maintenance inspections and explores opportunities for modernization by collaborating with leading companies in energy-efficient technologies.

In anticipation of increased energy demand for cooling in response to rising temperatures, the UAE is expanding its clean energy generation capacity. Additionally, the country is researching cutting-edge environmentally friendly cooling technologies and methods to reduce the use of refrigerants with a high Global Warming Potential (GWP) and Ozone Depletion Potential (ODP). These approaches include harnessing heat sources like geothermal and waste heat, using recycled or wastewater, and employing low-GWP and zero-ODP refrigerants. The UAE is also focused on reducing energy and water consumption through the adoption of advanced energy-efficient technologies and awareness campaigns.

Emirate-level policies and initiatives:

To combat energy efficiency losses caused by high temperatures at power plants, Etihad Water and Electricity is steadily increasing the deployment of smart meters. In Dubai, the Dubai Electricity and Water Authority (DEWA)

has installed over 2.1 million smart meters for electricity and water by 2022. DEWA is actively promoting the “Smart Applications via Smart Grid and Meters” initiative, which offers various benefits, including automated and detailed meter readings. Meanwhile, in Abu Dhabi, an advanced metering infrastructure (AMI) project is enhancing utility metering across the emirate.

Furthermore, existing power plants are undergoing modernization and upgrades to withstand the impacts of climate change. This involves the adoption of smart infrastructure, integration of power systems, automation, as well as the utilization of artificial intelligence and data analytics to improve efficiency and power generation performance. For instance, a national central cooling company is exploring the potential application of nanotechnology to enhance the efficiency of both new and existing assets. To mitigate the risks associated with climate change impacts on power plant performance and electricity production, the UAE is implementing risk insurance schemes for power generation and risk management systems. As an example, DEWA has developed a comprehensive Climate Change Resilience Plan, guided by a vision, principles, approach, and goals, to ensure the resilience of Dubai’s power and water sector. DEWA’s plan includes a detailed outline of existing mitigation measures, preventive controls, and future resilience actions designed to address potential impacts from various climate change factors.

At the emirate level, Abu Dhabi’s Department of Energy is Leading the Energy Transformation & Transition.

- Beginning its journey with Shams 1, DoE’s concentrated solar plant, in 2011

- Producing electricity for two decades with the lowest carbon emissions
- Pioneer in Renewable Energy - established Masdar Company
- First in the Middle East to build a nuclear program with 4 reactors of 1400 MW each.
- First legally binding Clean Energy Targets in the Middle East. DoE has set a target for 60% of electricity to be produced from clean & and renewable sources by 2035
- Noor Abu Dhabi: The world's biggest solar PV plant. Installed Capacity: 1,177 MW. Powering 90,000 people. Emissions reduction: 1 million metric tons
- Al Taweelah RO plant: largest in the world. Capacity: 909K m3/ day (200 MIGD)
- First country in the Gulf to start an energy transformation program, led by Abu Dhabi
- Hosting the HQ for the International Renewable Energy Agency (IRENA)
- The First country in the Gulf to privatise and establish Independent Water Power Producers (IWPPs) in its energy sector
- Investing in large solar PV projects in Dubai and Mauritania, and wind power in the UK and Seychelles.

Infrastructure

Federal policies and initiatives:

To enhance the resilience of its infrastructure to climate impacts, the UAE is actively advocating for the development and construction of eco-friendly buildings, as well as the renovation of existing structures. The country is also in the process of establishing a comprehensive roadmap that encompasses various aspects of building resilience and sustainability standards for both buildings and roadways.

Furthermore, the nation is allocating resources to support research and development projects focused on creating construction materials that can withstand future challenges, including resilient pavements and cements. Additionally, efforts are underway to design infrastructure that can withstand rising sea levels and associated threats.

Emirate-level policies and initiatives:

To mitigate the risks associated with infrastructure, the UAE is making investments in the development and construction of infrastructure that can withstand the challenges posed by climate change. This includes urban planning that addresses the operation and maintenance of existing infrastructure and the creation of new infrastructure.

For instance, the Abu Dhabi 2030 Urban Structure Framework Plan, which is currently undergoing review and updating to account for climate change impacts, outlines the city's future development vision. It incorporates environmental and social considerations into its principles for urban growth. The plan recognizes the critical role of reliable infrastructure in promoting economic progress and managing the transportation of essential resources such as energy, water, and waste within the city. It is also instrumental in safeguarding both the urban and natural environment of the city.

Similarly, the Fujairah 2040 Plan, designed to accommodate a significant population increase, focuses on improving housing and transportation facilities. It includes road enhancements, the construction of water barriers, ports, and additional healthcare facilities.

Ras Al Khaimah has completed a comprehensive flood mitigation study aimed at protecting urban areas from the expected increase in rainfall intensity and adverse weather events. This involves the planning of dams, collection ponds, open drainage channels, and buried drainage pipelines to manage runoff effectively. The emirate is also adopting strategies to cope with rising temperatures, including sustainable community guidelines called Rafah, which emphasize design changes for public infrastructure to enhance liveability, walkability, and outdoor thermal comfort.

As part of the UAE's efforts to climate-proof its infrastructure and communities, emergency and disaster response plans are being developed to ensure preparedness. These plans consider the needs of various groups, including women, youth, and at-risk individuals. Physical safeguards such as coastal monitoring programs and early warning systems are being implemented. Additionally, space-based technologies are being utilized to predict weather disasters and issue early warnings, with the UAE Space Agency actively exploring imagery analysis for flood monitoring services and damage assessments.

Health

Federal policies and initiatives:

The UAE has proactively initiated measures to address health challenges resulting from climate change. A ministerial decree has been issued mandating employers to provide outdoor workers with breaks during the peak summer months to prevent heat-related illnesses.

Furthermore, the UAE has established a National Committee on Climate Change and Health as part of its UAE National Framework for Action on Climate Change and Health for the period 2019-2021. The primary responsibility of this committee is to coordinate the development of a comprehensive national policy and action plan addressing the intersection of health and climate change. It also oversees the implementation of the UAE's public health response to the climate crisis. The UAE has taken steps to foster collaboration between public health authorities and climate-related agencies while ensuring that healthcare professionals are well-equipped with the requisite skills to manage the health risks associated with climate change, particularly among vulnerable populations such as the elderly, pregnant women, and high-risk individuals. Additionally, the country is reinforcing its regulations and policies pertaining to environmental health determinants encompassing water and air quality, food systems, and waste management. Various additional policies are currently under review, including the utilization of advanced technologies to safeguard outdoor workers from heat-related conditions and enhanced surveillance of heat-related illnesses.

Emirate-level policies and initiatives:

Abu Dhabi is actively promoting awareness through its safety in heat program, which is designed to minimize heat exposure in the workplace. The program utilizes the Thermal Work Limit (TWL) heat stress index to evaluate the appropriateness of working conditions. Additionally, in Abu Dhabi, the regulatory body overseeing the healthcare sector has become the first to engage in a partnership with the Partnership for Health System Sustainability and Resilience (PHSSR). PHSSR is an

international collaboration involving academic, governmental, and private institutions aimed at exploring innovative solutions in clinical research, digital health, and innovation. The objective of this collaboration is to ensure the healthcare system's resilience against potential future crises, including pandemics, natural disasters, and the impacts of climate change.

Environment

Federal policies and initiatives:

The UAE's actions in the realm of conservation and nature-based climate solutions are guided by the National Biodiversity Strategy, the National Strategy for Coastal and Marine Environment, and its international environmental commitments.

The National Biodiversity Strategy provides a framework for establishing a network of well-managed ecosystems and designate new protected areas. This involves conducting biodiversity surveys, enacting relevant legislation and guidelines, launching programs and measures to conserve and rehabilitate terrestrial, marine, and freshwater fauna and flora. Currently, the UAE has 49 protected areas covering 15.5% of its total territory.

The escalating ocean temperatures, leading to more frequent and severe coral bleaching incidents, pose a significant threat to the UAE. Coral reefs are vital ecosystems, not only for their provision of goods and services like seafood but also for their role in safeguarding against storm surges. Presently, 42% of the 66 species of reef-building corals in UAE waters face the risk of regional extinction. To address this, the UAE has undertaken substantial measures involving monitoring, rehabilitation, and cultivation of coral reefs. In the country's effort to conserve endangered marine species and crucial habitats, including coral reefs, the UAE has designated 12% of its territorial waters as marine protected areas, with the aim of shielding them from pollution, overfishing, and habitat degradation. Moreover, natural rock barriers and artificial caves are being created to recreate natural habitats and breeding areas for marine species.

Another significant concern is the loss of coastal and terrestrial wetlands, including mangrove areas, coral reefs, and inland swamps. The UAE has identified ten sites as Wetlands of International Importance, such as the Ras Al Khor Wildlife Sanctuary and the Wadi Wurayah National Park. Conservation programs have been conducted in these areas to ensure their sustainability and to conserve their substantial contribution to climate change mitigation and adaptation efforts. In some of these wetland areas, sustainable tourism initiatives are encouraged to generate revenue for conservation efforts. Simultaneously, citizens are being engaged to raise awareness about the importance of wetlands and encourage their active participation in conservation endeavours.

Date palm trees have proven to be valuable in carbon capture and storage, displaying resilience to challenging environmental conditions. With around 100 million date palm trees in the Arab region, they play a crucial role in absorbing and storing carbon. To protect and promote date palm oases, the UAE presented the International Initiative to Protect the Date Palm Oases under Climate Change Challenges at COP27, and it is set to officially launch at COP28. This initiative aims to safeguard oases in Sudan, Mauritania, Jordan, and other regions and develop accredited oases in the UAE, Morocco, Egypt, Algeria, and Tunisia.

The Ghaf tree holds significance in the UAE, representing cultural heritage and resilience to harsh conditions, the tree is also acclaimed to be the national tree for UAE. Well-suited to desert environments, Ghaf trees are essential for reforestation and carbon sequestration efforts in arid regions. Recognizing the importance of preserving Ghaf trees, the EN-WWF initiated the Save the Ghaf Tree campaign, resulting in the planting of 1,000 trees within a year and legislation prohibiting the cutting down of Ghaf trees. The UAE has further instituted rigorous laws prohibiting its felling and has fervently championed afforestation campaigns, resulting in the planting of thousands of Ghaf saplings across diverse terrains. Simultaneously, extensive research initiatives delve into the Ghaf's unique resilience in arid conditions and its pivotal role in sustaining desert ecosystems. Public awareness drives, coupled with the symbolic use of the Ghaf during the "Year of Tolerance" in 2019, underscore its emblematic representation of tolerance and unity.

Additionally, the Ghaf's indispensable role in supporting various desert species accentuates its significance in preserving biodiversity. Non-governmental organizations (NGOs) are actively involved in restoring natural and historic sites. Emirates Nature-WWF, in collaboration with various stakeholders and local communities, is exploring solutions to restore the historic site of Al Bithnah in Fujairah. This project focuses on restoring water access, aiming to conserve biodiversity and rehabilitate the location.

Additionally, the UAE places a strong emphasis on sustainable groundwater resource use. The UAE Hydrological Map initiative assesses the suitability of surface water and groundwater resources for constructing dams and water facilities. Various technologies are employed to augment water resources, including rainwater harvesting in dams and artificial injection of wastewater or stormwater into the ground to replenish groundwater reserves. Considerable investments are also made in advanced monitoring and management systems to ensure sustainable extraction rates and maintain groundwater quality.

These efforts are complemented by continuous water quality monitoring programs, all part of the National Programme for Monitoring and Controlling Marine Water Quality. This program was established to evaluate seawater quality in the country, control marine pollutants, and calculate the Marine Water Quality Index (MWQI) since the deterioration of marine water quality can have detrimental effects on species and their habitats.

Emirate-level policies and initiatives:

Environmental preservation initiatives are also integrated into the planning and development strategies at the emirate level.

For instance, the Abu Dhabi 2030 Urban Structure Framework Plan lays the foundation for a comprehensive system of protected areas, encompassing both marine and terrestrial environments. This framework incorporates environmental factors into all land-use planning activities and places significant emphasis on safeguarding, enhancing, and restoring the natural environment as a core principle of Abu Dhabi's planning and development endeavours.

Similarly, the Dubai 2040 Urban Master Plan is committed to conserving the natural landscapes and reserves within the city. These preserved areas are anticipated to comprise

60% of the emirate's total land area, reflecting Dubai's dedication to protecting its natural heritage and ecosystems.

The Environment Agency – Abu Dhabi (EAD) issued the following policies:

- Policy for sustaining marine water quality in Abu Dhabi Emirate (2021)
- Marine invasive species policy for Abu Dhabi Emirate (2023)
- Grazing Law. Law #11 of 2021 for regulating grazing in Abu Dhabi.

Blue carbon ecosystems

Federal policies and initiatives:

The UAE's potential in terms of carbon storage and protection against sea-level rise provided by mangroves, salt marshes, seagrass meadows, and algal mats was evaluated as part of the UAE National Blue Carbon Project. The findings revealed that these blue carbon ecosystems in the UAE house significant carbon reserves, with the added benefits of recreation and serving as crucial breeding grounds for marine biodiversity. Healthy mangrove ecosystems, for instance, support 80% of global fish populations. This study has enhanced the country's comprehension of blue carbon reserves and their importance, which is now mirrored in policies at both the federal and emirate levels.

Consequently, the UAE has initiated ecosystem restoration efforts by planting mangrove trees, , to strengthen its natural carbon absorption capabilities. The UAE has notably expanded its mangrove coverage and these mangroves sequester approximately 57.67 grams of organic carbon per square meter annually, equivalent to a carbon sequestration rate of 0.5 tons per hectare per year, in addition to the carbon stored within mangrove tree biomass. Additionally, mangroves play a vital role in stabilizing coastal sediments, regulating water flow, preventing erosion, and fortifying coastlines, offering valuable adaptation benefits. As such, the UAE announced at COP26 its ambition to plant 75 million seedlings and explore options to additionally plant 100 million seedlings by 2030.

To further these efforts, the UAE unveiled the Mangrove Action Coalition (MAC) at COP27, in collaboration with Indonesia. The MAC is designed to harness a diverse range of expertise and resources to accelerate the conservation, restoration, and resilience of mangroves. Member countries have committed to planting, rehabilitating, and restoring mangroves within their territories and providing support to fellow members in doing the same through cooperative efforts and knowledge sharing in the realm of Nature-based Solutions (NbS). As of February 2023, several countries, including Australia, India, Japan, Spain, Pakistan, Bahrain, Sri Lanka, Costa Rica, and the GCC Secretariat, have joined the MAC.

Furthermore, an example of a significant public-private partnership is the "Nature-based Solutions (NbS) for Climate, Biodiversity & People" project in the UAE. The project is funded by HSBC and is a partnership between the Ministry of Climate Change and Environment (MOCCAE), the Minister of Economy (MoEc), the Environment Agency – Abu Dhabi (EAD), the Government of Umm Al Quwain, Emirates Nature-WWF and the International Center for Biosaline Agriculture

(ICBA).). This project aims to safeguard and rejuvenate coastal ecosystems as Nature-based Solutions (NbS) to capture carbon dioxide and assess and expand their potential for this purpose.

Emirate-level policies and initiatives:

At the emirate level, Abu Dhabi's dedicated endeavours in coral, mangrove, and seagrass restoration, as well as its efforts to protect the world's second-largest dugong population, have been recognized as a World Restoration Flagship Initiative. This initiative, led by United Nations agencies UNEP and FAO, grants Abu Dhabi eligibility for UN support, funding, and technical expertise. The selection of these ten Flagship Initiatives was officially announced on Restoration Day, December 13, 2022, during the high-level segment of the United Nations Biodiversity Conference (CBD COP15). As part of this recognition, Abu Dhabi initiated a coral reef rehabilitation project aimed at identifying suitable nursery sites for cultivating coral fragments, with an estimated production capacity exceeding 1 million coral colonies.

In 2022, Abu Dhabi launched the Abu Dhabi Mangrove Initiative, a platform for innovation in mangrove research and restoration.

In Dubai, the Dubai Electricity and Water Authority (DEWA) has taken significant measures to preserve the Jebel Ali Wildlife Sanctuary. DEWA actively supports the Emirates Marine Environmental Group (EMEG) by providing the necessary facilities to facilitate their conservation activities. EMEG's primary focus includes activities such as coral translocation and restoration, mangrove afforestation, and sea turtle monitoring, among other conservation efforts.

Food systems

Federal policies and initiatives:

Enhancing Food and Water Security

In 2018, the UAE introduced the National Food Security Strategy 2051, aiming to ensure year-round access to safe and sufficient food and establish the UAE as a global leader in innovative food production. This initiative sets ambitious goals, including achieving the top position on the Global Food Security Index and increasing domestic production of critical food items by 100,000 tonnes by 2051. The strategy revolves around three primary criteria: consumption rates, production capacity, and nutritional values of essential nutrients, including specialized foods.

To promote sustainable consumption practices, soil and water conservation, as well as diversifying the food supply and reducing food waste, the UAE Cabinet endorsed a food security governance model. This led to the formation of the Emirates Food Security Council, entrusted with safeguarding food security. The council is actively working on various initiatives to enhance and sustain food sustainability, including the development of relevant legislation, implementing the national food security system, and introducing comprehensive and diversified food supply initiatives to tackle existing sectoral challenges.

Among these initiatives is the FoodTech Challenge, a global competition designed to foster partnerships and innovation by engaging

leading scientists, technologists, and innovators worldwide in addressing the UAE's food availability challenges, particularly focused on next-generation, nutrient-rich alternatives.

The UAE is also fostering collaborations with public and private entities. The AIM for Climate initiative aims to attract investments that drive innovations in the agri-food sector. Furthermore, in partnership with the private sector and other government bodies, the Ministry of Climate Change and Environment has recently launched two initiatives to enhance agricultural sustainability. The National Farms Sustainability program seeks to bolster local farms by increasing governmental purchases of local products to 100% by 2030. Additionally, in alignment with the Year of Sustainability and COP28, the Ministry initiated the Food and Agriculture Entrepreneurs program, which aims to recruit and train young talent in the agriculture and animal sectors.

Given that agriculture is the largest consumer of freshwater resources, and more than 25% of global energy is dedicated to food production and supply, the UAE recognizes the need to address the water-food-energy nexus, particularly in its arid desert environment. The Water Security Strategy 2036 was established to tackle this challenge by targeting water demand reduction through advanced farming practices, clean technologies, and awareness initiatives.

Sustainable food production and consumption are key priorities identified in the UAE Circular Economy Policy. When applied to the food sector, circular economy strategies contribute to healthier ecosystems, more nutritious food sources, and more efficient utilization of organic waste. As a result, increasing awareness about the adoption of these principles in the agriculture and fisheries sector is a central objective within the UAE Circular Economy Policy.

The UAE has also set sustainable fishing practices as a priority in its National Framework Statement for Sustainable Fisheries (2019-2030). The UAE is aiming to rebuild fish stocks to sustainable levels by 2030, with the objective of achieving an increase in adult stock size to the sustainable

threshold of 30% and ensuring that 70% of its total catch consists of sustainably exploited species. To attain these goals, the UAE is implementing measures to alleviate pressure on fisheries, enhance fish stocks, and rehabilitate marine habitats, including the cultivation and installation of coral reefs for biodiversity restoration. There have already been notable improvements in fish stock sustainability indicators, with a significant increase in the number of fish that can be sustainably harvested within just two years.

Reducing Food Loss and Waste:

Globally, an estimated one-third of total food production is lost or wasted, making food waste a pressing concern. In May 2020, His Highness Sheikh Mohamed bin Zayed Al Nahyan articulated his vision for advancing food security and sustainable food production and consumption, which inspired the National Food Loss and Waste Initiative, known as Ne'ma.

Aligned with the objectives of the UAE National Food Security Strategy, the UAE is intensifying public awareness efforts regarding food issues among residents, government entities, and businesses to encourage waste reduction. To achieve this, the country is actively working on strengthening public awareness through campaigns on nutritional standards and food waste reduction. These campaigns include educating consumers about best-before and use-by labels, as well as reducing food waste during social gatherings, such as weddings and religious celebrations.

The nationwide Food Waste Pledge, initiated in 2018, encourages the UAE's hospitality sector to adopt more efficient food management practices. Additionally, the United Nations Environment Programme (UNEP) launched the food waste alliance, which garnered commitments from five prominent signatories to participate in the Recipe for Change Initiative. Signatories pledge to reduce their own food waste by 50% by 2030, among other objectives. These signatories encompass the most influential hospitality groups in the UAE, covering over sixty hotels across the country. Furthermore, the Food Tech Valley initiative is exploring innovative technologies to minimize food loss and waste.

Additional policy measures under consideration include enhancing the collection and analysis of data related to resource flows in the agricultural sector and developing platforms that can connect food producers with consumers, potentially transforming food waste into a revenue stream.

Financial initiatives and frameworks

The Ministry of Finance in the UAE has implemented various financial tools and frameworks to support federal entities in effectively planning and managing financial resources. One such tool is The Federal Budget Planning Handbook, which provides comprehensive guidance on the budget preparation process, including key dates, responsibilities, and requirements. Additionally, the Ministry has issued the Budget Execution Handbook to complement the Strategy Manual and Performance Management Manual, which outline strategic planning and performance management processes for federal entities. These resources aim to assist government officials involved in UAE federal budgeting in

successfully fulfilling their tasks.

The framework for federal budgeting in the UAE consists of six major elements that adhere to international best practices, enhancing transparency and efficiency. Notably, the alignment of the budget with government strategy through program budgeting and performance monitoring is considered a vital component. The strategic planning process involves developing the UAE government strategy, designing strategic plans by federal entities based on government strategy, and securing Cabinet approval for these plans. The UAE government strategy spans five years and is overseen by the Prime Minister›s Office. It sets strategic objectives that all federal entities must achieve during the strategy cycle.

The federal strategy then cascades down to individual federal entities through a rigorous, tailored process resulting in specific strategic objectives, programs, and activities for each entity. These elements directly contribute to accomplishing entity-specific strategic objectives and, ultimately, implementing the federal strategy and UAE›s vision. Collectively, they form the program structure.

The federal budget operates on a five-year cycle aligned with the government›s strategy. Each year within the fiscal period has a corresponding budget prepared in advance of the five-year period and updated annually within the budget cycle. This alignment ensures consistency in reflecting long-term government strategy within the budget.

Also, the federal budget process encompasses both capital expenditure (CAPEX) and operating expenditure (OPEX). Both types of expenditure are considered within the same budget and program structure, allowing integrated financial planning.

These measures demonstrate the UAE›s commitment to effective financial planning and management through comprehensive financial tools, frameworks, and alignment of strategies and budgets across federal entities.

Government Procurement

Furthermore, the digital procurement policy issued pursuant to Cabinet Resolution No. (1) of 2022 defines the guidelines, controls and standards for procurement operations of the UAE federal government, in line with the government’s digital agenda, best practices and global policies.

Among the government strategies that the Ministry of Finance is continuously implementing, which protect the environment and ultimately help optimize climate change measures Indirectly, is a sustainable procurement based on selecting the best terms, specifications and standards that are compatible with the protection of the environment through the use of renewable materials, resorting to recycling options and partnering with socially responsible suppliers. The Ministry of Finance believes in an ethical conduct of procurement practices based on the promotion of a better environment and the support of environmental friendly companies throughout the procurement cycle. The Ministry of Finance continues to exercise such commitment and ensures it is fully embodied in any future procurement legislation.

CHAPTER 5: Mitigation Measures

Chapter 5
Mitigation Measures

The concepts of mitigation and adaptation have traditionally been considered distinct areas of action. However, there is a growing recognition of their interconnectedness, and it's increasingly clear that certain policies within specific sectors can address both objectives simultaneously. In fact, adaptation efforts can lead to concurrent reductions in GHG emissions. For example, promoting the adoption of low-carbon alternatives in industries not only cuts emissions but also supports carbon sequestration efforts.

Conversely, policies and investments aimed at mitigating GHG emissions through various measures such as promoting electrification, more efficient technologies, renewables and awareness on efficiency in consumption can also contribute to mitigating the adverse impacts of climate change.

For instance, the Net Zero by 2050 Strategic Initiative launched by the UAE aligns with the objectives of the Paris Agreement, which calls upon signatory nations to develop and implement long-term strategies aimed at reducing greenhouse gas (GHG) emissions. These strategies are designed to contribute to the overarching global goal of achieving net zero GHG emissions on a worldwide scale in the latter half of this century. The initiative underscores the UAE›s commitment to playing a pivotal role in addressing climate change and its dedication to aligning with international efforts to combat global warming and environmental degradation.

Energy efficiency

The UAE is actively pursuing energy demand reduction through the adoption of advanced energy efficiency technologies and the implementation of awareness campaigns. These efforts not only aim to decrease GHG emissions but also alleviate the stress on power facilities exacerbated by climate change effects. At the federal level, a study was initiated to gauge public awareness and behaviour regarding electricity conservation, in 2019. The findings from this study informed the design of a new national conservation campaign, featuring tailored awareness initiatives, activities, and programs tailored to diverse segments of society.

National Energy and Water Demand Side Management Program

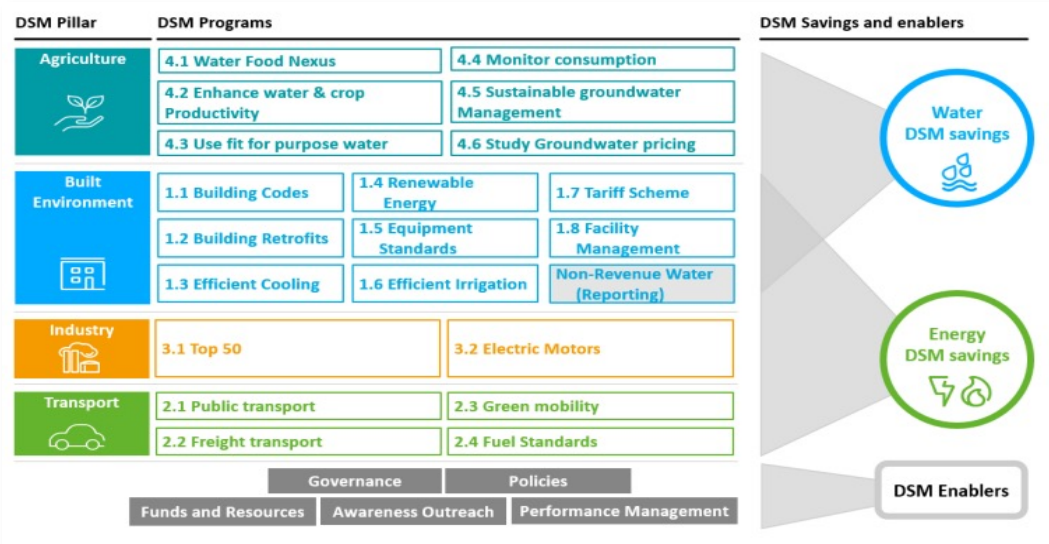


Image courtesy: Government of UAE

Additionally, the UAE has introduced the National Demand-Side Management (DSM) Program 2050, which sets ambitious targets for energy and water savings by 2050. This program aligns with the UAE Energy Strategy 2050 and the UAE Water Security Strategy 2036, as well as local initiatives within each emirate. The National DSM Program 2050 focuses on four key pillars with substantial potential for impact:

- Agriculture: Shifting from unsustainable groundwater extraction to sustainable groundwater management, emphasizing water and food security, efficient irrigation practices, and alternative water sources. The target is to reduce water demand by 60% by 2050.
- Built Environment: Optimizing energy and water efficiency within urban areas through increased adoption of green building practices, retrofitting existing buildings, upgrading fixtures and equipment, and enhancing irrigation methods. The goal is to reduce water demand by 40% and energy demand by 50% by 2050.
- Industry: Promoting responsibility and accountability within the industrial sector through regulations and transparency requirements to encourage efficiency, sustainability, and best practices for energy efficiency. The objective is to reduce energy demand by 33% by 2050.
- Transport: Decreasing energy demand in the transportation sector across emirates

through smart city planning, enhanced public transportation, and green technology adoption. The target is to reduce energy demand by 60% by 2050.

In anticipation of the 28th UN Climate Change Conference (COP28), the Ministry of Energy and Infrastructure (MoEI) collaborated with the Ministry of Industry and Advanced Technology (MoIAT) to undertake a comprehensive evaluation of industrial enterprises across the UAE. This initiative was crafted with the aim of bolstering energy efficiency within the industrial sector.

The assessment encompassed a total of 46 manufacturing facilities in the UAE, spanning various sectors including energy, metals, food and beverage, chemicals, paper, and wood, among others.

The evaluation was concentrated on several key aspects:

- Evaluating the existing level of sustainability within these facilities against the six Sustainable Development Goals (SDGs) set forth by the United Nations Industrial Development Organization (UNIDO).
- Scrutinizing energy management practices and energy efficiency measures, employing a multi-dimensional approach encompassing various factors and Key Performance Indicators (KPIs).
- Identifying areas of improvement and gaps that these facilities aspire to address in the future.
- Equipping these facilities with a comprehensive roadmap towards enhanced energy efficiency and sustainability.

Ultimately, this initiative aligns with the UAE's national vision for sustainability and economic growth, aiming to contribute significantly to these overarching objectives.

Furthermore, to support the national sustainability and economic growth vision, the UAE is also introducing the Federal Energy Management Regulation in Industrial Facilities. The regulation represents a foundational framework for federal regulations related to sustainability and energy optimization in industries operating across all emirates of the UAE. This regulation is designed not to constrain but rather to facilitate the implementation of essential sustainability measures, particularly benefiting industries lacking an existing Energy Management System (EnMS) while adhering to minimal efficiency standards. The focus of this program is directed towards the 50 largest industrial energy consumers in the UAE.

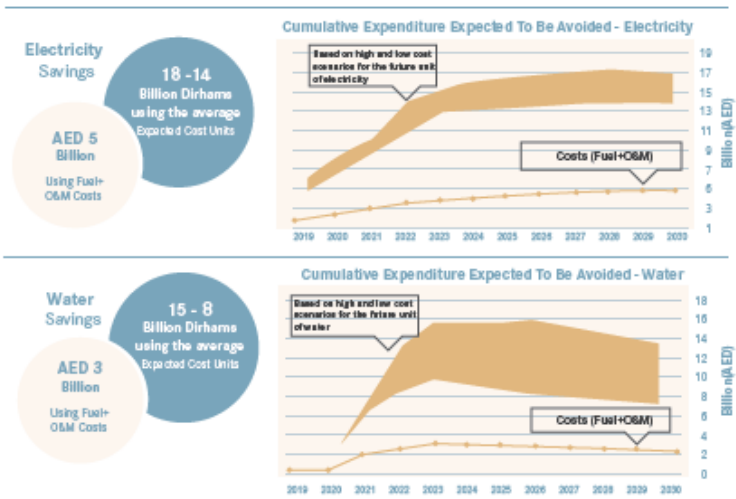
The primary objective of this regulation is to align with and support the overarching Top 50 program, which falls under the industry sector, contributing to a targeted energy savings of 33% by the year 2050. Additionally, it seeks to curtail CO2 emissions within the industrial sector by a substantial 32%, equivalent to approximately 63 million metric tons of CO2 by 2050. Furthermore, this regulation is poised to encourage the industrial sector to adopt energy management practices that not only bolster energy efficiency but also enhance overall productivity.

Additionally, the Ministry of Industry and Advanced Technology (MoIAT) Implements the UAE Energy and water efficiency program, a star-rating program that grants more stars to more efficient appliances in terms of water and electricity consumption. This regulates the import and manufacturing of appliances in the country according to approved standards and allows the consumer to make informed decisions through comparing products. This

program also supports the achievement of national water and energy conservation goals as it spans various products such as commercial and central air conditioners, rotodynamic water pumps, and household appliances including storage water heaters and refrigerating appliances.

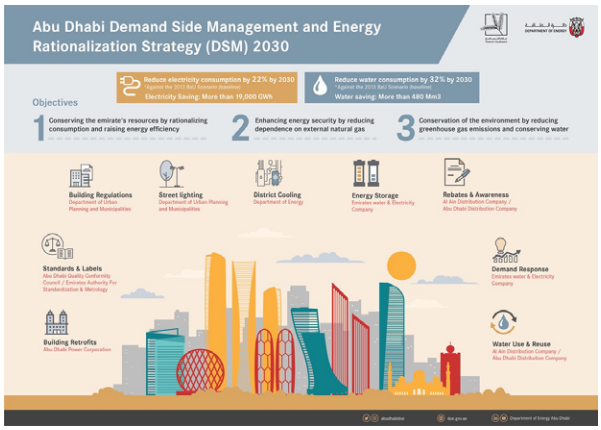
Also, the Electric Motors Standards Regulation is being implemented to support the Electric Motor program within the industry pillar. This regulation sets Minimum Energy Performance Standards (MEPS) for high-consuming electric motors and aims to achieve a reduction of 0.6 Mtoe and 2 MT of CO2 emissions by 2030.

There are energy efficiency related initiatives at Emirate level as well, such as the Abu Dhabi Demand Side Management and Energy Rationalization Strategy 2030. This initiative as the potential to reduce electricity consumption by 22 per cent and water consumption by 32 per cent by 2030 (from the 2013 baseline). The successful implementation of DSM will save billions of Dirhams in water & electricity subsidies and customer bills and significantly reduce the Emirate's carbon footprint.DSM has many benefits to consumers, enterprises, utilities and society, like reduction in GHG emissions, reductions in customer energy bill, reduced need for new power plants, transmission and distribution network, stimulation of economic development, creation of long-term jobs due to new innovations and technologies, reduction in air pollution, reduced dependency on foreign energy sources, reductions in peak power costs for electricity and water, and reduce potential subsidy burdens on Abu Dhabi Government.

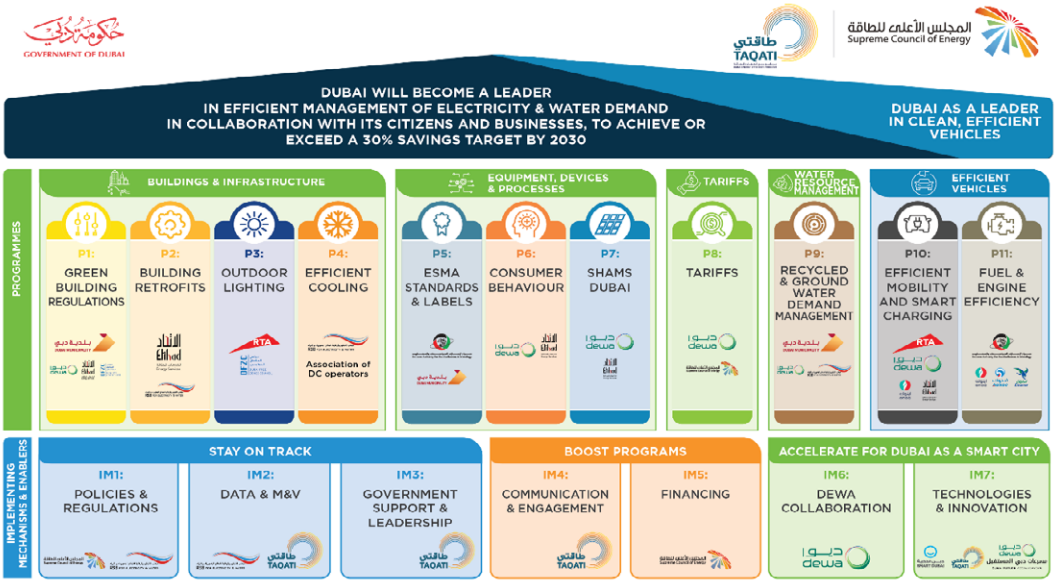


Strategy Alignment

The Abu Dhabi DSM & Energy Rationalization Strategy 2030 Map

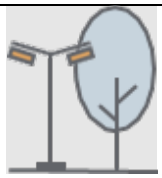
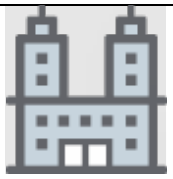
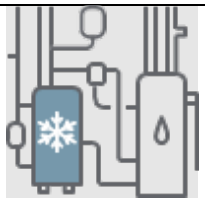


The Government of Dubai has also established DSM programs, and remains committed to achieving ambitious electricity and water savings by implementing them. Dubai targets overall electricity savings of about 19.2 TWh and water savings of 46.3 billion imperial gallons, which correspond to 30% savings versus business as usual by 2030. The DSM Strategy in Dubai is managed by the Dubai Supreme Council of Energy (DSCE), the policymaking entity for Dubai's energy sector. At the end of 2022, DSM programmes have exceeded both electricity and water targets and saved 8.1 TWh of electricity and 16.1 billion imperial gallons (BIG) of water. Compared to business-as-usual consumption, which is the reference for the 30% by 2030 target, those savings represent 14.5% and 11.3% of the total baseline consumption for electricity and water, respectively.



Similarly, Ras Al Khaimah Energy Efficiency & Renewables Strategy 2040 was established in 2018 with overarching objectives to improve competitiveness and sustainability of the Ras Al Khaimah economy, while also building local skills, capabilities and a diverse market for products and services related to energy efficiency and renewables. It sets a target of 30% energy savings, 20% water savings and 20% contribution from renewable energy sources by 2040, compared to a 2017 baseline.

The 9 core DSM programmes include:

	**Building Regulations** To promote a greener city, the construction industry has been regulated by applying the 'Estidama' Pearl Rating System – 1 Rating is required for new communities, buildings and villas, and 2 Rating for government owned buildings.
	**Standards & Labels** Introduction of labels on all energy end-use appliances and equipment entering the market indicating the minimum energy performance standards to help consumers chose products with better energy saving potential.
	**Demand Response** The planned reduction in electricity use by customers when there is a temporary deficit in spinning reserve to match demand. Customers enter into a contract to agree on providing load curtailment if required and are provided with a payment per MW of reduced demand.
	**Street Lighting** The retrofitting of all public lighting in streets, parks, and other spaces across the Emirate of Abu Dhabi with high efficiency LED bulbs.
	**Building Retrofits** Government buildings will be retrofitted to improve the efficiency of cooling, lighting and water components. An energy performance contracting model will be used, whereby the Super ESCO funds the efficiency improvement and recovers the implementation costs from utility bill savings.
	**Rebates & Behavioural Change** Rebate programs will be offered to residential consumers as an incentive to purchase high-efficient A/C units with shortened payback periods.
	**Efficient Water Use /Reuse** This focuses on implementing measures to optimize use of desalinated water and improve the utilization of treated water instead of desalinated water in large consumption and irrigated areas.
	**District Cooling** means the centralized production and distribution of cooling energy for large building units. It enhances efficiency and reliability and conserves environmental resources. The private sector will implement retrofits and installations in new developments.
	**Energy Storage** Energy storage at grid level is a technique used to capture electricity at lower demand period to be released when demand rises. This facilitates the grid integration of large solar farms and offsets spinning reserve and the use of peaker plants, which are a source of pollution.

Sustainable development and green building

With the aim of enhancing the climate resilience of its infrastructure, the UAE is actively promoting the construction of new green buildings and the renovation of existing ones. As part of these endeavours, the UAE, through the Demand-Side Management (DSM) program, is committed to ensure regular updates to building codes, thereby advancing the energy efficiency of new constructions, and retrofitting older, less efficient buildings. Such national policies, which are oriented towards decarbonizing the buildings sector, yield clear benefits and synergies for both mitigation and adaptation efforts.

Green buildings play a pivotal role in mitigating climate change by curbing energy consumption and GHG emissions through energy-efficient architectural design, the utilization of renewable energy sources, and the implementation of efficient heating and cooling systems. Furthermore, these green structures contribute to climate change adaptation by incorporating features that can withstand extreme weather conditions.

Expo City

Image courtesy: Ministry of Climate Change and Environment, UAE

The UAE has concentrated on project development and critical legislative parameters to ensure the practical implementation of its climate change initiatives, which include:

Green Building Enabler

To track and control emissions from steel plants in the UAE, MoIAT developed the UAE scheme for Reinforced steel.

A project that defines the technical requirements for reinforcing steel and includes an environmental declaration requirement for all stages of the supply chain. Based on the results found through this requirement, further procedures will later be developed for emission control will be put in place for steel plants.

Government Building Retrofit Project

The project aims to significantly reduce energy and water consumption in government buildings through a comprehensive rehabilitation effort. This initiative employs a shared savings mechanism and establishes partnerships between the public and private sectors to ensure its success.

In its initial phase, known as Phase 1, this project was introduced as a pilot program encompassing ten buildings. Phase 1 sought to achieve a notable reduction in energy consumption while also targeting a 25% decrease in water consumption. The outcomes of Phase 1 provided valuable insights and paved the way for the next stage of this endeavour.

Phase 2 of the project is set to encompass a much larger scale, involving the retrofitting of 422 government buildings. The primary objective of Phase 2 is to achieve a minimum 20% reduction in both energy and water consumption compared to the average consumption levels of the preceding three years.

To identify the buildings included in this ambitious undertaking, a meticulous assessment was conducted to pinpoint the 422 federal government buildings with the highest energy and water consumption across all seven emirates. These buildings encompass various functions, including those related to health, places of worship, education, and administration, distributed throughout the nation. Moreover, to facilitate efficient project management and monitoring of outcomes, an electronic platform has been developed. This platform serves as a centralized hub connecting all retrofitted projects, enabling the tracking of achieved savings.

The Government Building Retrofit Project harbours several key objectives, including:

- Achieving a minimum 20% reduction in energy and water consumption in federal buildings, resulting in substantial energy cost savings.
- Reducing water consumption within the built environment sector by a significant volume, equivalent to 196 million cubic meters by the year 2030.
- Lowering electricity consumption in the Built Environment sector by 7 terawatt-hours (TWh) by 2030.
- Promoting the use of clean energy sources to contribute to the reduction of overall energy consumption.
- Enhancing the equipment and operational standards within federal buildings to ensure long-term efficiency.
- Integration with the monitoring systems employed by federal authorities for effective oversight and reporting.

National Green Building Regulation

The National Green Building Regulation has been devised to fulfil essential, non-negotiable energy and water standards for new construction projects throughout the UAE. The primary objective of the NGBR is to ensure the implementation of minimal sustainability criteria in new buildings across the UAE, all while allowing for flexibility and adaptation as needed.

This regulation was collaboratively crafted through the participation of the National Green Code Committee, representing responsible entities in each emirate. The aim was to align the NGBR with existing regulations and operational codes.

This initiative encompasses a range of objectives, including, but not limited to:

- Establishing minimum design prerequisites for all emirates.
- Enhancing the built environment across the UAE to preserve valuable resources such as energy, water, waste, and materials while minimizing environmental impact.
- Periodically updating Green Building Codes and Regulations in alignment with all emirates and free zones.
- Encouraging the incorporation of optimal efficiency principles in building design from the outset.

- Encouraging the adoption of energy and water equipment in accordance with efficiency standards established by relevant authorities.
- Improving overall quality of life and promoting happiness.
- Achieving a 95% improvement in air quality within construction projects.
- Reducing energy demand in the building sector by 51%.
- Decreasing water demand in the building sector by 40%.
- Enhancing recycling practices for construction waste, aiming for a 50% recycling rate.
- Elevating awareness levels about sustainable building practices.

Al Sa'fat – Dubai Green Building System

Al Sa'fat includes a set of mandatory requirements for all new buildings to obtain the Silver Sa'fa. Owners aiming to achieve higher performance may apply a set of additional requirements to achieve the Golden or Platinum Sa'fa.

Al Sa'fat system enhances buildings users' safety and ensures a more sustainable environment for future generations. It also encourages innovation to achieve integration between green systems and technologies in building design, which in turn is reflected in improving performance, reducing energy consumption, increasing the efficiency of electrical and mechanical systems, and therefore reducing the carbon footprint.

Barjeel, the Green Building Regulations of Ras Al Khaimah

The regulations primarily focuses on new construction and stands as a cornerstone of the Strategy in its efforts to achieve energy savings objectives. It began with a voluntary phase on January 29, 2019, and is anticipated to transition to mandatory compliance for all new buildings.

Barjeel delineates minimal standards across five key categories: Energy Efficiency, Water Efficiency, Renewable Energy, Materials and Resources, as well as Comfort and Wellbeing.

Within Barjeel, there are two tiers of requirements: the fundamental regulations, which encompass straightforward criteria suitable for smaller buildings, and the comprehensive regulations, which include additional requisites tailored to larger and more intricate structures.

The targets set forth by Barjeel aim to realize a 30% reduction in energy and water consumption in buildings compliant with its regulations compared to conventional construction practices. Furthermore, there is a supplementary objective to double these savings by the year 2040.

Solar Energy Project for Government Buildings

The Ministry of Energy and Infrastructure is expanding the use of solar energy in government buildings to reduce operational costs and carbon emissions. Mini solar power stations have been added to the rooftops of eligible government buildings, generating an initial 4 megawatts for schools, hospitals, and mosques.

Image courtesy: Ministry of Climate Change and Environment, UAE

Policy Regulating Local Energy Market

The policy provides guidelines for the contractual framework among energy stakeholders and various contracting mechanisms. It aims to consolidate business operations, financing, and partnerships between the public and private sectors. Short-term objectives include reducing water use by 23%, cutting operational costs by 20% in federal buildings, contributing 5% to clean energy, enhancing building sustainability by 5-10%, and raising awareness about energy and water conservation and behavioural change. In the long term, the policy is projected to decrease energy demand in the building sector by 51% by 2050.

Enhance transportation sector efficiency

The UAE is committed to adopting international best practices to decarbonize its transportation sector, encompassing strategies like electrification, shared mobility (e.g., carpooling and ridesharing), public transportation, and active transportation modes such as walking and cycling. The nation's approach involves reducing reliance on private vehicles, transitioning passenger vehicles (including cars, taxis, buses, and motorcycles) to electric power, potentially exploring hydrogen for trucks and mechanical vehicles, and promoting freight transport via rail. Efforts will also be made to foster mixed-use communities and industrial clusters to minimize transportation needs. Electrifying or employing low-carbon fuels for domestic maritime and aviation sectors is imperative for achieving net-zero emissions by mid-century.

Image courtesy: Ministry of Climate Change and Environment, UAE

Furthermore, the UAE aims to lead in sustainable international travel by aligning with targets set by organizations like the International Civil Aviation Organization (ICAO). The nation plans to meet a significant portion of international aviation fuel demand with e-kerosene (a type of Sustainable Aviation Fuel, SAF) starting at 1% in 2030 and scaling up to over 50% by 2050. Similarly, the UAE intends to boost the production of green or blue ammonia and methanol, starting at 1% in 2030 and reaching 75% by 2050, to support the decarbonization of international shipping.

The UAE has already made progress in promoting modal shifts, encouraging the adoption of non-Internal Combustion Engine (ICE) vehicles, such as Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs), and developing necessary infrastructure like cycling tracks to decarbonize

its transportation sector. These initiatives align with both federal and emirate-level efforts and mirror global trends.

At the federal level, the UAE's Demand Side Management (DSM) program seeks to reduce transport emissions by 60% by 2050 compared to business-as-usual scenarios. It promotes modal shifts toward sustainable transportation options like metro and rail for both passengers and freight. The DSM program incentivizes the adoption of hybrid and BEVs through various financial and non-financial incentives. Additionally, the program gradually introduces more stringent fuel standards for passenger cars, buses, and trucks, which is a significant driver for emissions reduction.

To achieve its transport sector decarbonization goals, the UAE will adhere to the "avoid-shift-improve" approach, with a strong emphasis on widespread integration of electric vehicles as a pivotal component of its climate change mitigation efforts. The UAE plans, and is already taking steps, to act accordingly:

UAE National EV Chargers Roadmap

The UAE's National Electric Vehicle (EV) Chargers Roadmap is an ambitious initiative aimed at boosting the adoption of electric vehicles and enhancing the country's EV infrastructure. As part of this endeavour, a significant expansion of charging stations is planned. By the end of 2023, a total of 360 new AC and DC charging stations will be deployed, increasing the nationwide count to an impressive 914. This expansion effort aligns with the establishment of a dedicated national platform responsible for efficiently monitoring and operating these charging stations.

In addition to these infrastructure enhancements, a user-friendly mobile application is under development. This app is designed to assist electric vehicle owners in easily locating charging stations, enabling advance reservations, and providing information about the charger's type and condition. Furthermore, the government is actively forging partnerships with electric vehicle manufacturers to offer enticing incentives. These incentives are intended not only to promote electric vehicle adoption but also to contribute to a more sustainable and eco-friendly future.

Global EV Market

The UAE government introduced the National Program for Demand Side Management in March 2021, which aimed to streamline efforts to reduce national energy consumption. The Green Mobility project is a part of the transportation sector's initiatives within this program, with the goal of achieving a 40% reduction in energy consumption, equivalent to 4.6 MTOE (Million Tons of Oil Equivalent), by the year 2050.

In 2022, the significant initiative known as the "Global Electric Vehicle Market" was approved. This project is focused on increasing the production of electric vehicles in the UAE, ensuring the country's presence on the global stage in the electric and hybrid car markets. It also guarantees the availability of maintenance services, workforce qualifications, and cutting-edge technology. Furthermore, the project aims to stimulate the sales of electric and hybrid vehicles within the country, expand the electric vehicle market, including establishing service centers, and promote the growth of small and medium-sized national emerging companies.

The primary objectives of this initiative included reducing energy consumption in the transportation sector by 0.5 MTOE by December 2022, cutting carbon emissions from

the transportation sector by 2 MTCO2 by December 2022, opening the UAE market to major electric and hybrid vehicle manufacturers, and achieving a 10% increase in electric and hybrid vehicle sales by July 2023.

National program to convert conventional vehicles (run by fuel) to Electrical vehicles

The Ministry of Industry and Advanced Technology is developing a project that aims to proactively establish regulations to control the conversion of preowned, conventional vehicles to electric vehicles, contributing to the UAE's decarbonization and circular economy objectives. The outcome of this project includes issuing a national technical regulation and accrediting both producers and inspection and examination centres. This project will reduce the environmental impact of outdated vehicles, increase the lifespan of vehicles, and create new markets for advanced technologies.

National Electric Vehicles Policy

The UAE is actively promoting the development of its electric vehicle (EV) infrastructure by establishing unified standards for EV charging stations. This initiative is in line with the national roadmap, which emphasizes the importance of coordination and collaboration with federal authorities to simplify the registration process for electric vehicles. The ultimate objective is not only to foster the growth of the EV market but also to ensure that electric vehicles constitute 50% of total car sales by the year 2050. This transformative shift is expected to play a pivotal role in achieving a remarkable 40% reduction in energy consumption within the transportation sector and a significant decrease of 404 kilotons in carbon emissions by 2050, aligning with the country's commitment to environmental sustainability.

Image courtesy: Ministry of Climate Change and Environment, UAE

Moreover, as part of its support for a circular economy policy, the UAE is actively working towards establishing a thriving and environmentally conscious EV ecosystem. To complete this cycle, efforts are being directed towards the development of a comprehensive legislative and technical framework for the recycling of electric vehicle batteries. This approach ensures the responsible and environmentally friendly management of EV technology.

Abu Dhabi EV charging policy

Abu Dhabi has taken a significant step forward in creating the framework to meet the country's Net Zero by 2050 strategic initiative by releasing the regulatory policy for electric vehicle charging infrastructure in the Emirates.

The policy sets out the stipulations and criteria for establishing a network of electric vehicle charging stations across the UAE capital. The principles for ownership, installation, and

management of Electric Vehicle Supply Equipment (EVSE), the electricity supply to EVSE, and the pricing mechanism to end customers are included.

Aiming to support the transition of the UAE and Abu Dhabi to achieving net zero emissions within the next three decades, and in line with Abu Dhabi's development vision, the policy anticipates a progressive increase in the use of electric vehicles on Abu Dhabi's roads in the coming years.

DoE's policy supports Abu Dhabi's Low Emission Vehicle Strategy aimed at diversifying the energy sources used in the transition towards electrification. It recognizes that there is an ongoing global move towards the use of electric vehicles that are charged from the electric grid, which - as the energy mix evolves - allows for the increased use of clean energy for transportation and a corresponding reduction of carbon dioxide emissions and other pollutants.

The uptake of electric vehicles in Abu Dhabi is still in its infancy. Still, the DoE has projected that technical developments will likely result in increased customer demand for these vehicles that will likely become mainstream in the emirate over the coming decade and onwards.

A key barrier to customers purchasing EV vehicles is 'range anxiety' –a concern that they will be unable to find somewhere to charge their EV when using it away from home. The policy will enable necessary investments into this EV charging infrastructure and help tackle this range of anxiety. This should in turn, also encourage consumers to purchase and use EV vehicles in the emirate.

Alongside the DoE, the stakeholders responsible for implementing the policy comprise a number of Abu Dhabi government entities, including the Department of Municipalities and Transport, Integrated Transport Centre, Department of Economic Development, Emirates Water and Electricity Company, Abu Dhabi Distribution Company, Al Ain Distribution Company, ADNOC Distribution Company, and Abu Dhabi Quality and Conformity Council.

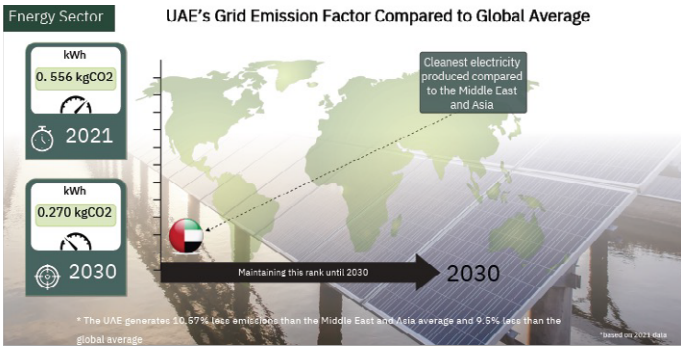
The Abu Dhabi Executive Council approved the Low-Emission Vehicle Strategy in 2016. Formulated by the Department of Municipalities and Transport, the strategy aims to support the uptake of low-emission vehicles within the Emirate of Abu Dhabi as the world commits to a new energy paradigm.

Renewable and nuclear energy

The power and water sector play a pivotal role in the UAE, symbolizing the nation's commitment to innovation and sustainability. In light of the arid climate, population growth, and expanding economic activities, the UAE has made substantial investments in a range of technologies and infrastructure development to ensure a reliable and secure supply of power and water to its residents.

Distinguished by a diverse energy mix that encompasses gas, nuclear, waste, and solar sources, the power sector in the UAE stands as one of the cleanest grids in the Middle East. The nation has undertaken significant initiatives to increase the proportion of clean energy within its energy portfolio, aligning with its ambitious goal of achieving Net Zero emissions by 2050. Recognizing the substantial contribution of the power and water sector to greenhouse gas emissions, there has been a concerted effort to transition towards sustainable power and water generation.

This transition involves substantial investments in clean technologies and the establishment of supportive policies and regulatory frameworks to facilitate the integration of clean energy into the grid. As a result of these persistent efforts, the share of clean energy capacity has surged from almost negligible a few years ago to over 15% in 2022. This proportion is expected to further increase to 30% by 2030, equivalent to a total of approximately 19.8 gigawatts of clean energy. This includes a threefold increase in renewable capacity to 14.2 gigawatts and 5.6 gigawatts of nuclear energy. Consequently, the grid emission factor is anticipated to decline by more than 50%, reaching 0.27 kgCO2/kWh by 2030, with the ultimate objective of achieving a completely clean grid by 2050.



Source: UAE Energy Strategy 2050

Significant achievements in this transformational journey include the construction of one of the globe's largest solar facilities, with a remarkable capacity of 5.2 gigawatts, located in Dubai. Additionally, Abu Dhabi has made headlines for discovering some of the world's most competitive solar tariffs.

However, despite these noteworthy accomplishments, the decarbonization of the UAE's power and water generation sector remains a pressing endeavour, accompanied by several formidable challenges. While the nation has already initiated numerous actions, as detailed below, achieving the goal of net-zero emissions by the mid-century will demand further climate action from stakeholders across various sectors. This imperative is underscored by various initiatives, including the updated Energy Strategy 2050.

Initiatives and policies in Nuclear and Other Energy sector to promote clean Energy Technologies

UAE Nuclear Energy Policy and UAE Nuclear Law

To promote clean nuclear energy they country adopted various policies and initiatives, these are firmly rooted in stringent safety, transparency, and security standards, fostering the growth of nuclear energy in the UAE for electricity generation purposes.

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UAE Energy Strategy 2050

This comprehensive strategy is designed to achieve several objectives, including tripling renewable energy capacity by 2030 and charting a path to attain Net Zero emissions by 2050. The updated energy strategy delineates specific targets and acknowledges the technical and policy challenges that lie ahead. It adopts a phased approach to overcome these challenges, all while ensuring:

- Substantial reductions in emissions from the water and energy sectors to attain net-zero emissions by 2050.
- The cessation of clean coal's contribution to the energy mix, aligning with the nation's leadership and net zero emission aspirations by 2050.
- A significant enhancement in both individual

and institutional energy consumption efficiency, with a target of 42-45% improvement compared to 2019.

- A threefold increase in the proportion of renewable energy to 14.2 GW by 2030.
- An augmentation in the share of installed clean energy capacity within the total energy mix to reach 30% by 2030, accompanied by a boost in the contribution of clean energy generation to 32% by 2030.

These measures are crucial in ensuring the country remains aligned with its climate change mitigation objectives.

As previously emphasized, the endeavour to expand renewable energy sources within the energy system brings forth specific challenges that must be effectively managed to ensure a dependable and secure increase in renewable capacity across the nation. These challenges, delineated below, are slated to be systematically addressed in the coming years, setting the stage for accelerated and more substantial adoption of renewable energy:

- **Integration of Storage Technologies:** One key challenge involves implementing advanced energy storage technologies. To address this challenge, it is imperative to enact supportive policies and regulations that facilitate the seamless integration of these storage solutions into the existing grid infrastructure. This enables the efficient management of intermittent renewable energy sources.
- **Enhancement of Grid Support:** Another pivotal aspect is the augmentation of grid support and reinforcement mechanisms. Robust frameworks need to be developed to fortify the grid's resilience and flexibility, accommodating the variable nature of renewable energy generation. This includes upgrading infrastructure to ensure smooth power flow and mitigate potential disruptions.
- **Adaptive Tariff Mechanisms**: The intermittent nature of renewables necessitates innovative tariff mechanisms. Tariffs must be designed to account for fluctuations in renewable energy output. This entails creating pricing structures that incentivize energy consumption during periods of abundant renewable generation and promote energy conservation during periods of scarcity.
- **Demand Management Strategies:** The implementation of demand management mechanisms is crucial for effectively integrating the increasing share of renewable energy sources into the grid. These strategies help balance electricity supply and demand, ensuring grid stability and reliability. Measures may include load shedding, demand response programs, and smart grid technologies to optimize energy consumption patterns.

Addressing these challenges comprehensively will pave the way for a more substantial and rapid adoption of renewable energy sources, reinforcing the country's commitment to a sustainable and resilient energy future.

Prominent Renewable and Nuclear Projects in the UAE

Noor Abu Dhabi solar plant

Abu Dhabi's Department of Energy (DoE) continues its strong commitment to renewable energy through impressive solar initiatives. With its substantial 935 MW (AC) capacity, the existing Noor Abu Dhabi solar plant significantly bolsters the country's renewable energy capacity. The under-construction Al Dhafra solar plant is poised to provide a

substantial 1,584 MW (AC) of renewable power. These projects are pivotal in advancing the nation's sustainable energy goals while reducing CO2 emissions by one million tons annually through Noor Abu Dhabi.

Al Ajban Solar Project

The Al Ajban Solar Photovoltaic (PV) Independent Power Project is a ground-breaking renewable energy initiative in Abu Dhabi. Set in the Ajban area, this greenfield solar plant has a capacity of 1.5 gigawatts (AC), sufficient to power around 160,000 UAE homes. When operational, it will reduce Abu Dhabi's CO2 emissions by over 2.4 million metric tonnes annually. Al Ajban Solar PV is pivotal to Abu Dhabi's energy transition and sustainability goals, aligning with the UAE Energy Strategy 2050 and Net Zero by 2050 initiative. This project, alongside Noor Abu Dhabi and Al Dhafra Solar PV, reinforces Abu Dhabi's position as a global leader in solar power, driving energy diversification and decarbonization.

Al Dhafra Solar Project

The Al Dhafra Solar Photovoltaic (PV) project is a remarkable testament to EWEC's commitment to advancing solar power in the UAE. Located just 35 kilometers from Abu Dhabi, it will become the world's largest single-site solar power plant, with a 1.5-gigawatt (AC) capacity. This cutting-edge facility will utilize advanced crystalline, bifacial solar technology, harnessing solar irradiation from both sides of its 4 million panels to deliver highly efficient electricity. Once fully operational, it is poised to reduce Abu Dhabi's CO2 emissions by over 2.4 million metric tonnes annually, equivalent to removing about 470,000 cars from the road. The competitive bidding and financial arrangements for this project have resulted in an exceptionally competitive tariff of AED 4.85 fils/kWh (USD 1.32 cents/kWh). With backing from seven international banks, this project signifies a significant leap in the UAE's renewable energy capacity. Owned by a consortium including TAQA, Masdar, EDF Renewables, and JinkoPower, Al Dhafra Solar PV takes the UAE closer to its sustainable energy goals.

Mohammed bin Rashid Al Maktoum Solar Park

The Mohammed bin Rashid Al Maktoum Solar Park stands as a testament to sustainable energy initiatives, and it holds the distinction of being the world's largest single-site solar park operating under the Independent Power Producer (IPP) model. With a strategic vision for the future, this monumental project is planned to achieve a remarkable production capacity of 5,000 MW by 2030, supported by substantial investments amounting to AED 50 billion. Upon full completion, it is projected to mitigate over 6.5 million tons of carbon emissions annually, contributing significantly to the nation's sustainable energy goals.

Mohammed bin Rashid Al Maktoum Solar Park

Image courtesy: Dubai Electricity and Water Authority (DEWA), UAE

Barakah Nuclear Power Plant

The Barakah Nuclear Energy Plant, with a formidable, planned capacity of 5.6 GW, is a flagship endeavour poised to satisfy approximately 25% of the country's total energy demand once it reaches full operational status. This ambitious nuclear project plays a pivotal role in reducing carbon emissions by an impressive estimated annual figure of almost 22 million tons, marking a significant stride toward a low-carbon energy landscape.

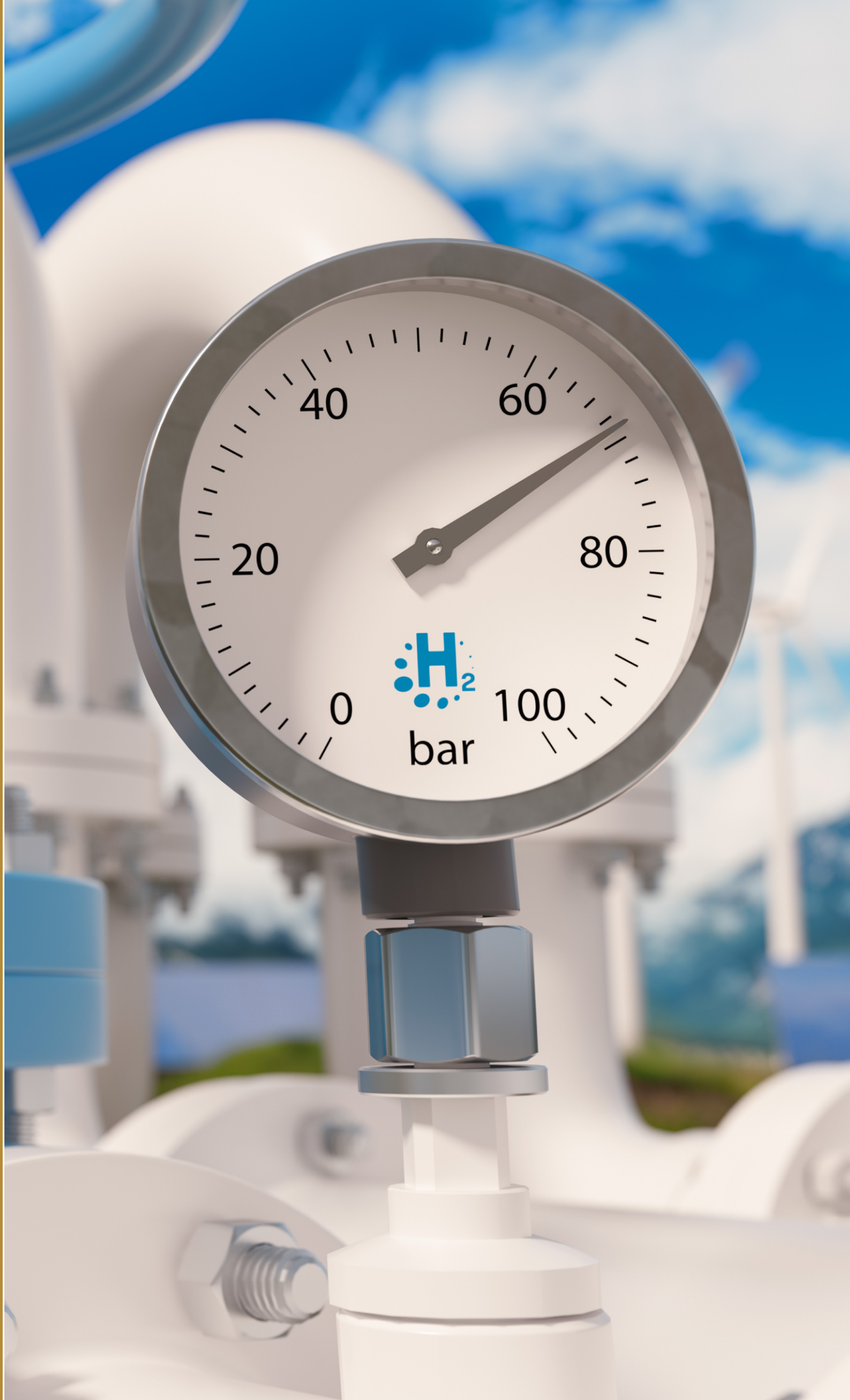
Barakah Nuclear Energy Plant

Image courtesy: Emirates Nuclear Energy Corporation, UAE

Wind power project

The 103.5-MW UAE Wind Program, led by Abu Dhabi Future Energy Company PJSC – Masdar, is set to transform the country's energy landscape by introducing cost-effective, large-scale wind power to the grid, powering 23,000 homes, reducing 120,000 tonnes of CO2, and exemplifying the UAE's commitment to climate action. This initiative represents a significant step towards a sustainable energy future, The project spans four locations, including Sir Bani Yas Island in Abu Dhabi. The other wind farm locations include Delma Island (27MW), and Al Sila in Abu Dhabi (27MW), as well as Al Halah in Fujairah (4.5MW). It was connected to the grid in October 2023.

CHAPTER 6: Other Information



Chapter 6
Other Information

Research and systematic observation

The Research and Development Governance Policy

The UAE has introduced the ‘Research and Development (R&D) Governance Policy’ and established the ‘Emirates Research and Development Council’ with the aim of bolstering the performance and effectiveness of the country’s science and technology (S&T) sector, ultimately advancing its pursuit of a knowledge-based economy.

Launched in September 2021, the 'R&D Governance Policy' encompasses a set of regulations, principles, and standards of best practices geared toward achieving and continuously enhancing the quality of research across all sectors. The policy seeks to:

- Cultivate a flexible and robust national ecosystem for research and development within the UAE.
- Define a centralized governance body responsible for R&D and delineate the roles and responsibilities of its stakeholders.
- Establish a mechanism for standardizing data and measuring the performance and impact of R&D at the national level.
- Set forth standards to enhance research quality, elevate the performance of national R&D activities, promote ethical and scientific excellence, encourage best practices, and reduce adverse incidents.
- Foster the development of the UAE's human intellectual capital.
- Enhance global competitiveness in emerging industries.
- Create pathways to prioritize markets.

Pillars of the policy consist of two main components:

- **R&D Governance Model:** This first pillar provides a structured framework for R&D governance. Its purpose is to reinforce the R&D ecosystem by clarifying the roles and responsibilities of all parties across various levels of governance, in accordance with global best practices.
- **Emirates Research and Development Council:** The second pillar entails the establishment of the Emirates Research and Development Council, serving as the apex governing body within this framework. The Council's primary mission is to elevate the UAE's global standing as a hub for science and technology and to harmonize all endeavors related to R&D. Notably, the Council is chaired by H.H. Sheikh Abdullah bin Zayed Al Nahyan, the Minister of Foreign Affairs and International Cooperation.

Ministry of Foreign Affairs - Center for Climate Diplomacy (AGDA)

The Centre for Climate Diplomacy, initiated in 2023 by the Anwar Gargash Diplomatic Academy (AGDA) in collaboration with Mubadala and ADNOC, is driven by the objective of guiding the UAE's foreign policy concerning climate change through a fusion of research and diplomatic efforts.

In terms of its mission and purpose, the center is dedicated to establishing a comprehensive research institution that advances the domains of climate research and diplomacy. The primary focus lies in influencing the UAE's foreign policy concerning climate change, with a strong commitment to facilitating proactive engagement in global climate initiatives and advocating for sustainable practices.

The objectives of the center encompass several key areas:

- **Research Excellence:** The foremost dedication is to conduct research that serves as a foundation for climate policies and international negotiations.
- **Guiding Foreign Policy:** The aim is to offer valuable insights that significantly impact the UAE's foreign policy with regard to climate change, ensuring an engaged and proactive stance in global climate initiatives.
- **Inspiring Climate Action:** The goal is to inspire and drive climate action by disseminating knowledge, fostering collaborations, and championing sustainable practices on a global scale.
- **Collaborative Research Agenda:** Collaboration is central to the approach, with efforts focused on establishing a shared research agenda by collaborating with academic and research institutions worldwide, as well as think tanks both in the UAE and internationally.

Key activities of the center encompass capacity building for diplomats, policymakers, and researchers, along with the production of knowledge through cutting-edge research and publications. Furthermore, the center is in the process of establishing a comprehensive institution specializing in climate diplomacy and policy development. Additionally, the center offers training in negotiation skills and integrates climate diplomacy into AGDA's academic programs.

In terms of research projects, the center actively engages in partnerships with both national and international organizations, academic institutions, and governmental bodies to leverage expertise and promote climate diplomacy.

The research efforts of the center are structured around several key pillars:

- Sustainable & Climate Finance
- Adaptation and Resilience
- Energy Transition
- Climate Security & Diplomacy

Ministry of Climate Change and Environment – Climate Change Research Network (CCRN)

MOCCAE has established the Climate Change Research Network (CCRN) to facilitate and promote climate change research both in the UAE and the broader region. The primary objectives of CCRN are as follows:

- To provide a platform for discussions on topics relevant to climate research in the UAE.
- To enable collaboration between government and academia in identifying knowledge and data gaps.
- To assist in the identification of recurring research challenges and their corresponding solutions.
- To create opportunities for climate specialists in the region.

- To serve as a catalyst for research collaboration and joint research projects.
- To facilitate the exchange of knowledge and the sharing of ongoing work and ideas for future research.

The UAE Climate Change Research Network (CCRN) is a coalition of dedicated climate scientists and researchers drawn from reputable universities in the UAE, currently comprising 94 members.

CCRN Research Clusters & Focus

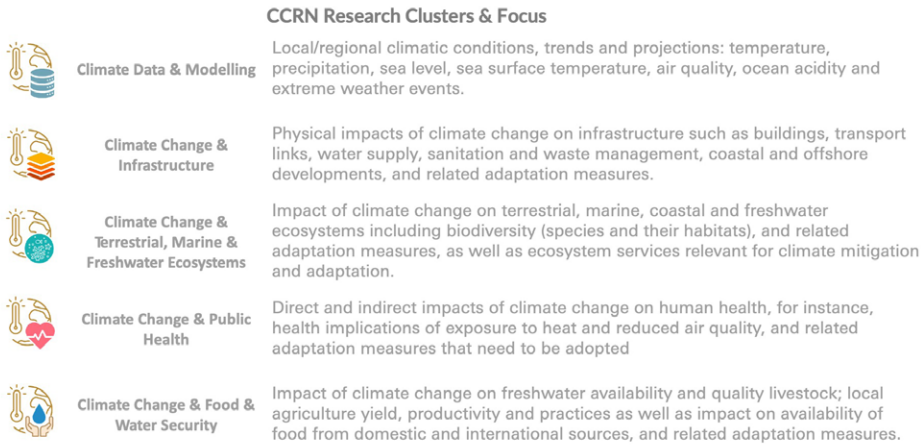


Image courtesy: Ministry of Climate Change and Environment, UAE

In 2021, the UAE State of Climate Report, jointly developed by MOCCAE and UAEU, was released. This report illustrates the potential impact of climate change on the UAE and underscores the pressing need for the country to enhance its adaptive capacity in preparation for forthcoming changes. The CCRN operates as a dedicated body committed to safeguarding the UAE against the climatic shifts outlined in the report.

UAE Climate Projections

Image courtesy: Ministry of Climate Change and Environment, UAE

National Programme to Transform Technology

The 'National Programme for Technology Transformation' has a primary objective of accelerating the technological advancement of the UAE's industrial and production sector. This initiative aligns with Operation 300bn, which is the UAE's industrial strategy aimed at fortifying the sector's local and global competitiveness, sustainability, and expediting digital transformation. Additionally, it is in harmony with the UAE's national priorities, which include fostering a competitive knowledge-based economy, attaining Sustainable Development Goals, and solidifying the UAE's status as a global center for science and technology.

The program's key objectives encompass the development of 1,000 technological projects by 2031, the nurturing of Emirati talent in advanced technology endeavors, facilitating technology developers, entrepreneurs, and emerging technology companies to innovate within the UAE and launch impactful global projects. The initiative plans to invest AED 11 billion in advanced technology, contribute AED 110 billion to the Net Domestic Product (NDP), and enable the annual export of AED 15 billion worth of advanced Emirati technological products. This comprehensive program aims to usher in a new era of technological innovation and economic growth in the UAE.

Few key public and private R&D initiatives include:

ADNOC: ADNOC and Baker Hughes have jointly announced an agreement aimed at expediting the development and commercialization of technology solutions focused on green and low-carbon hydrogen, as well as graphene. This agreement builds upon a strategic technology collaboration agreement initially signed between the two companies in November 2022. Under this new arrangement, ADNOC will partner strategically with Baker Hughes to explore, test, and implement innovative solutions from Baker Hughes' hydrogen portfolio. These solutions encompass cutting-edge decarbonization technologies that Baker Hughes has been actively investing in, spanning the realms of graphene, methane pyrolysis, and next-generation electrolysis.

This significant partnership was formalized during the UAE CLIMATE TECH conference in Abu Dhabi, a gathering of more than 1,000 global policymakers, innovators, and industry leaders who convened to drive the development of technological solutions aimed at reducing carbon emissions. This collaboration also aligns with ADNOC's substantial commitment of USD 15 billion toward decarbonization projects by the year 2030.

Dubai Electricity and Water Authority: The DEWA R&D Centre, situated within the Mohammed bin Rashid Al Maktoum Solar Park, aspires to establish itself as a global hub dedicated to the development and testing of innovative solutions aimed at enhancing DEWA's operations and services. The research areas covered by the Centre encompass solar power, water management, smart grid integration, and energy efficiency.

These fundamental research domains are further bolstered by three pivotal enablers: the Fourth Industrial Revolution, which encompasses cutting-edge technologies such as AI, IoT, Robotics & Drones, 3D Printing, and Advanced Materials; Energy System Analyses; and Space. Utilizing Space-D, the Centre actively engages in the creation of various specialized applications designed to improve grid and water network performance.

Education, training, and public awareness

Education and training

The significance of education in the successful attainment of sustainability objectives is prominently emphasized in the United Nations' 17 Sustainable Development Goals (SDGs) and UNESCO's Education for Sustainable Development (ESD) for 2030. Educational institutions play a pivotal role in advancing sustainability for several key reasons:

- Mobilizing Society: Through research, teaching, and their extensive outreach, educational institutions have the capacity to mobilize society, particularly younger generations, to take action towards sustainability.
- Enhancing Understanding: These institutions facilitate a better comprehension of climate change and its consequences by providing learning opportunities that focus on the natural environment.
- Skill Development: Educational establishments empower citizens to acquire the necessary knowledge and skills to pursue environmentally friendly careers.
- Cultural Transformation: They introduce practices like the circular economy, waste reduction, and resource efficiency into people's daily lives, effectively shaping culture and habits in favour of sustainability.

The UAE and its educational institutions are aligned with this perspective, exemplifying the role of education in promoting climate action at various levels, including within educational organizations, the corporate sector, and government initiatives.

The Next Founder Program and Competition

The Next Founder Program and Competition is a Fully integrated entrepreneurship program & competition that aims to empower students from public and private higher education institutions (Bachelor, Masters, or Ph.D. students), who have business ideas and started operating on a small scale or on an idea level.

Source: Ministry of Education, UAE

The experience equips the participants with the necessary entrepreneurial skills by offering them a unique blend of services such as vocational training, expertise mentorship, and continuous guidance throughout their entrepreneurship journey & Networking opportunities. The 2nd version of the Next Founder Competition, was conducted in partnership with Ruya Careers 2023 (part of Dubai World Trade Center) and Dubai Economy & Tourism's Fund (Dubai Next). This track was designed to focus on Sustainability Start-ups/projects. The Top 5 winners are to compete in COP28 where the Top winner was awarded by MOE.

Source: Ministry of Education, UAE

In addition, the Emarati-preneurs Exhibition and Competition was launched, it is an exhibition and competition aimed at leveraging Emirati Startups. Participants pitch their ideas on the DubaiNext platform, where simultaneously they started raising funds within the event, and the Top 3 winners are selected based on those who achieved the targeted fund. The top 3 winners received a 5000 AED fund grant from DubaiNext.

Source: Ministry of Education, UAE

The Ministry of Education, in collaboration with UNICEF, acknowledges the pivotal role of educators in shaping the future workforce and is training approximately 3000 master trainers and 1500 principals across the nation to incorporate climate education into their curricula.

Several universities in the UAE are actively engaged in sustainability efforts. For example,

- Zayed University offers academic programs related to Sustainability, one of which is the Bachelor of Science in Sustainability, through which students can concentrate their academic focus on areas related to Sustainable Enterprise, Sustainable Policy, and Sustainable Environments. Embarking on such a journey, students are enabled to study the science behind the impact of human behavior on the environment and learn to develop sustainability solutions and lead more responsible actions towards combating climate change.
- Dubai's Heriot-Watt University collaborates closely with the Industrial Decarbonisation Research and Innovation Centre (IDRIC) to advance research and innovation in industrial decarbonization.
- The American University of Sharjah (AUS) is in the process of developing a comprehensive Climate Action Plan to reduce carbon emissions and align with the UAE's Net Zero by 2050 Strategic Initiative.
- Umm Al Quwain University is addressing both mitigation and adaptation targets with its pioneering National Landscape initiative. This unique landscaping project leverages indigenous plants as nature-based solutions to promote native biodiversity, generate cultural benefits, and minimize costs associated with irrigation, fertilization, and maintenance.

On the corporate front, partnerships between businesses and academic institutions are on the rise.

- The MBR Solar Park Innovation Centre collaborates with local and international higher education institutions, organizations, and start-ups to serve as a platform for hosting various academic events, including

conferences, seminars, and workshops.

- Masdar is actively involved in the Youth 4 Sustainability (Y4S) initiative, which facilitates connections between university students, young professionals, influential global business leaders, policymakers, and technology pioneers. This year-long program comprises a series of events designed to equip participants with the latest sustainability practices, fundamental knowledge, skills training, practical work experience, and networking opportunities.

Sustainability Initiatives and Awareness Building

- Expo 2020 Dubai featured sustainability as a central theme, integrating awareness campaigns, training, and educational activities on various environmental issues across the site. It also developed a standardized methodology for estimating and monitoring its carbon footprint, setting an example for mega-events in the UAE.
- Building awareness and fostering behavioural change among society members are crucial aspects of the UAE's climate transition. The government conducts awareness-raising campaigns at both the national and local levels. Nationally, a campaign assesses the awareness and behaviour of the population regarding electricity and water conservation, leading to tailored awareness and educational activities for different segments of society.
- The UAE is developing its Action for Climate Empowerment (ACE) framework, aligning with UN Framework Convention on Climate Change and Paris Agreement requirements. This framework aims to empower all segments of society in climate action, including education, public involvement, and international cooperation.
- At the emirate level, entities like Sharjah electricity and water authority have implemented campaigns to reduce energy consumption during peak hours. In Dubai, DEWA PJSC launched the Smart Living Initiative to enable customers to monitor water and electricity consumption digitally. Abu Dhabi introduced a guide for efficient gardening practices to conserve water. Ras Al Khaimah's Energy Saving Tips campaign focuses on energy and water savings through efficient appliances and practices.
- Environment Agency Abu Dhabi (EAD) actively collaborates with local and international partners to promote sustainability through its Sustainable School Initiative and Sustainable Campus Initiative, fostering a culture of environmental responsibility and sustainability within educational institutions and on their premises.
- Internationally recognized events like Abu Dhabi Sustainability Week (ADSW) and the Water, Energy, Technology, and Environment Exhibition (WETEX) in Dubai Solar Show bring together policymakers, business leaders, and the public to discuss strategies and solutions for a net-zero future through workshops and discussions.
- Expo 2020's Sustainability Pavilion (Terra) offers an immersive educational experience to raise awareness about climate change and environmental responsibility. The pavilion's educational initiatives continue beyond Expo, addressing global challenges and encouraging dialogue and awareness.

- These initiatives collectively reflect the UAE's comprehensive approach to building capacity, raising awareness, and empowering all segments of society to actively engage in climate action.

Public awareness campaigns

Community awareness and behaviour serve as a powerful representation of a nation's dedication to sustainable practices across diverse sectors and its accomplishments in sustainability. Therefore, the Ministry of Energy and Infrastructure is committed to elevating awareness and fostering responsible behaviour within the Emirati community concerning energy conservation. This goal is pursued through the implementation of various awareness and educational initiatives and programs.

As part of the UAE National Demand Side Management (DSM) program, the Ministry has launched a comprehensive national energy conservation campaign that introduces fresh elements and tools tailored to meet the specific needs of society. This campaign serves as one of the enablers of DSM in key sectors, including buildings, transportation, manufacturing, and agriculture. The awareness campaign targets five distinct segments of society: students, families, employees, workers, and tourists.

The UAE DSM 2050 program places significant emphasis on achieving savings through the active involvement of end-users, encompassing both residents and non-residents of the UAE, across all targeted segments. The awareness campaign adopts a holistic approach to engage these groups in an integrated program designed to bring about lasting behavioural changes that will positively impact electricity and water consumption. In this context, "awareness" is used to inform the public about specific issues, while "education" is employed to facilitate behavioural transformations, as outlined in the comprehensive five-step framework.

One notable initiative within the National Conservation Campaign is "SUNTASTIC," which focuses on educating the community about the importance of installing solar energy systems in both government and private facilities. The implementation of this initiative commenced in 2022 and is being executed in three stages, with the aim of transitioning into a new phase next year.

UAE DSM 2050

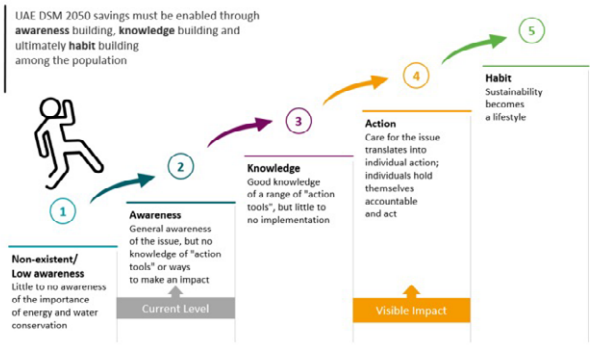


Image courtesy: Government of UAE

The first stage involved collaboration with the Emirates Schools Establishment, where 569 students from 17 schools across various emirates of the country were targeted. These students were introduced to the components of solar systems, and they actively participated in calculating the necessary electrical and solar energy requirements.

Moving on to the second stage, approximately 40 individuals in the emirates of Sharjah and Ras Al Khaimah were the focus of attention. This stage was executed in cooperation with the Sharjah Electricity, Water, and Gas Authority, as well as Etihad Water & Electricity. Participants were educated on the significance of installing solar panels, including their environmental and economic impacts in both the short and long term.

In the third stage, the initiative reached out to employees of the Ministry of Culture and Youth in the emirate of Ras Al Khaimah, targeting 15 employees. Additionally, ongoing coordination is taking place with the Federal Authority for Government Human Resources to conduct a virtual workshop for federal government employees. The aim is to familiarize them with the necessity of installing solar panels and how such installations contribute to the strategic goals of the UAE.

In conjunction with the aforementioned activities, volunteer campaigns have been carried out, engaging various segments of society to maintain pre-installed solar panels as a demonstration of community cohesion and social responsibility. This initiative reached 60 homes in the Emirate of Ajman and involved the participation of 20 volunteers, including employees and workers.

Upon completion of each stage outlined above, an assessment was conducted to measure the knowledge and impact achieved within the target groups. These assessments have helped validate the effectiveness of the initiative's planned approach.

Furthermore, the UAE is actively promoting the essential shifts in behaviour necessary for a successful climate transition. In this regard, the creation of educational content and campaigns has played a pivotal role, with various examples evident at both the federal and emirate levels:

- The Sharjah Peak Hour Campaign and Rationalisation Hour initiative have been recurring every summer for the past seven years, emphasizing the importance of energy conservation during peak hours.
- Abu Dhabi has developed a comprehensive guide outlining efficient irrigation methods and their associated benefits. The Ministry of Energy and Infrastructure (MOEI) has also published a National Guideline for Efficient Irrigation.
- Ras Al Khaimah's Energy Saving Tips campaign is centered on the significance of using energy-efficient appliances and understanding how they contribute to energy and water savings.
- Dubai's My Energy, My Responsibility campaign aims to raise awareness about conserving electricity and water resources, encouraging responsible consumption.
- The Terra pavilion, repurposed after the closure of Dubai's Expo 2020 site, now serves as a hub for various interactive educational experiences. These include themed weeks addressing global challenges such as biodiversity, food, and agriculture, as well as other initiatives like the World Majilis.

All of these initiatives align with the UAE's Action for Climate Empowerment (ACE) framework. The nation is developing this framework in accordance with the United Nations Framework Convention on Climate Change and the Paris Agreement. ACE represents a call to action for countries to create educational and awareness programs, provide training for scientific, technical, and managerial personnel, facilitate access to climate-related information, promote public engagement, and encourage international collaboration to address climate change and its impacts effectively.

Capacity-building

It is becoming increasingly evident that the shift towards a more environmentally friendly economy will necessitate changes in the way people work and the nature of their occupations. This transformation will lead to the emergence of new jobs that require expertise in sustainability, increased demand for specific roles (e.g., in construction for complex infrastructure projects), fundamental changes in certain job roles (e.g., maintenance requirements for Battery Electric Vehicles (BEVs) differing from Internal Combustion Engine (ICE) vehicles), and downsizing of other occupations (e.g., coal mining jobs). To achieve net-zero targets, it is crucial to provide the workforce with the necessary skills through skilling, re-skilling, and upskilling initiatives.

The UAE is taking proactive steps to equip its citizens with the skills required to address climate change. This commitment is aligned with the UAE Net Zero by 2050 Strategic Initiative, which aims to create and future-proof an average of 160,000 and 400,000 jobs (respectively) between 2025 and 2050. The power and water generation sectors, driven by the demand for highly skilled professionals like engineers in sub-sectors such as solar and batteries, will see significant growth. The heavy industry sector will also require labour upskilling as technologies like Carbon Capture and Storage (CCS) and hydrogen gain prominence. Similar skill needs will arise across various other sectors.

Image courtesy: Government of UAE

To address these workforce requirements and maximize local employment and job creation driven by net-zero objectives, the UAE will implement a dedicated program comprising the following components:

- Enhancing the skills of the UAE's workforce, enabling them to capitalize on opportunities within the green economy, enhancing their capabilities, and promoting awareness of climate change.
- Analysing future talent requirements arising from the net-zero transition, considering both expatriate and UAE national workforce segments.
- Assessing the balance between future talent supply and demand, taking into account factors such as national university enrolment and expatriate worker movements.
- Developing an action plan to address anticipated talent shortages, including initiatives like upskilling and re-skilling programs and international university partnerships.
- Formulating a capacity-building plan for government entities to foster knowledge in sustainability, regulation, and implementation.

Furthermore, the UAE will incorporate just transition elements into its skill enhancement efforts. This initiative builds upon existing UAE endeavours, particularly in capacity building for the public sector. In 2021, the UAE established the Climate Change Research Network (CCRN) to promote collaboration between the government, international partners (e.g., the UN), and academic institutions. Its aim is to enhance knowledge sharing and establish a national climate agenda rooted in scientific principles.

The UAE's Ministry of Economy has also launched a national strategy to attract and retain global talent by positioning the UAE as a top destination for talent in strategic sectors such as energy, food and water security, advanced technology, and Information and Communication Technology (ICT). This strategy seeks to create a conducive environment for attracting and retaining skilled professionals through regulatory frameworks and market conditions. Additionally, the UAE introduced Jahiz, an upskilling program aimed at equipping government workers with essential skills like digitalization, Artificial Intelligence (AI), and concepts related to sustainability such as net-zero, climate change, and the circular economy.

Similar upskilling initiatives are emerging at the emirate level. For instance, the Environmental Sustainability Award in Ras Al Khaimah acknowledges and encourages government sectors to participate in environmental awareness initiatives and recognizes their efforts to reduce ecological impact. Additionally, programs are being introduced to ensure women have a voice and play an active role in sustainability discussions. The Masdar Women in Sustainability, Environment, and Renewable Energy (WiSER) initiative, for example, aims to educate women globally on environmental sustainability and innovation, empowering them to confront the challenges of the climate crisis.

Information and networking

National Conservation Campaign Electronic Platform: Save to sustain is the slogan of the National Conservation Campaign Electronic Platform. The National energy conservation platform was developed to have an easy access for all initiative done in the UAE for energy and water conservation. All stakeholders are part of building the informative side of the platform by uploading their initiatives on the platform with conservation tips, challenges, and awards. The platform will be as a reference tool for all people to know about conservation tips and initiatives in addition they will be able to share and participate with their stories as well.

Image courtesy: Ministry of Energy and Infrastructure, UAE

What is Save to Sustain? A multi-purpose online platform

Who is targeted by Save to Sustain? Initiative owners (entities) and the public

Why does Save to Sustain were developed? To enable behavioural change towards responsible consumption of energy and water

How Save to Sustain is working? Through a collection of tools to activate value exchange between users and motivate them to act

Users of the National energy conservation platform will get many opportunities, including:

- Learn: Articles and games to learn about sustainability, understand personal consumption and receive personalized saving tips.
- Connect: Use circles to connect with others to find local events
- Engage: Participate in challenges and apply for sustainability awards
- Contribute: Find volunteer opportunities of interest and connect with the organizers

- Share: Use forums to share opinions, ideas, and tips for saving energy and water with others

Platform Link: https://ncc.moei.gov.ae/

Additionally, the Ministry of Foreign Affairs, plays a pivotal role in extending the UAE's influence beyond its borders by engaging with foreign governments, semi-governmental entities, the private sector, civil society, and more. Over the years, MOFA has consistently disseminated information, provided financial aid, and fulfilled its mission to support all organizations and entities within UAE while safeguarding the government's national interests. MOFA serves as the official arm for managing foreign relations, conducting diplomatic engagements through various means, both in person and virtually. These diplomatic interactions serve as a primary tool for showcasing and advancing UAE initiatives and achievements, involving foreign missions within the UAE and UAE Missions abroad, employing a combination of online and offline approaches. These missions play a vital role in sharing critical documents with diverse stakeholders in host countries, including government bodies, media, think tanks, academic institutions, scholars, and influencers. MOFA's outreach efforts are instrumental in fostering direct links with foreign governments and building strong relationships and engagements.

The way forward:

The UAE is a member country on the World Energy Council, the ministry of energy and infrastructure take in consideration the important role of the World Energy Council in spreading and applying the concept of energy for human, which aims to design and implement initiatives to enable people and society in three axes: energy security, energy sustainability and the ability to afford energy costs.

The World energy council, on its 100 years, celebrating the opportunity to reflect their integrity, influence, and impact. On this occasion, WEC initiate the centenary campaign to bring all member together and learn more from each other to help strengthen the entire network. The UAE is bringing out the outcome of the national conservation campaign to be one of the pioneers on the centenary campaign. The national conservation campaign can fit in with the pillar of accelerating energy literacy.

CHAPTER 7: Constraints and Gaps

Chapter 7
Constraints and Gaps

The UAE has recognised its role in addressing the global climate crisis, and despite being a non-annex 1 country, the investments the UAE has made, and continue making, in decarbonising its economy and the commitment to achieving net zero are all testament to this. The country recognises that the National Communications is a valuable channel to communicate all these efforts transparently and effectively. The UAE has made notable improvements in preparing its national communications, nevertheless, challenges and gaps persist in sourcing all the required information, adhering to the highest tier of GHG emission estimation in each sector and the overall creation of national communications.

The primary challenge to the development of this National Communications was data related the GHG Inventory estimation, including the availability, accuracy, and consistency of data. These challenges mainly arise from the absence of a central system to periodically source all the required information, aligned to the IPCC guidelines from the various entities contributing to GHG emissions in the UAE. This necessitated the use of default values recommended by the IPCC for the emission estimation under various sectors.

A top-down approach was used in the estimation of emissions within the energy sector. This approach was followed due to the limited availability of data from each entity within the sector. The approach posed a challenge in presenting the sub-sectoral emissions within this section, including transportation, manufacturing, and residential sectors.

Another overarching challenge was integrating data from various sources, sectors, and activities into a cohesive and comprehensive GHG inventory. The task involved ensuring that all data was consistent, complete, and up to date while adhering to the IPCC 2006 guidelines. This challenge was largely addressed through a consultation process to review and validate the data received.

Planned Improvements

The UAE recognizes the value of developing a robust Measurement, Reporting, and Verification (MRV) system. This system will provide transparency, accountability, and credibility to the GHG inventory process, facilitating continuous monitoring of emissions. This system will provide comprehensive information on GHG emissions and air pollutants emissions, following the IPCC 2006 guidelines. The aim is to facilitate effective emissions management and air quality control. To achieve this, the project will develop an Integrated Emission Quantification Tool (IEQT) tailored to the UAE's specific conditions, current and future data, and stakeholder requirements.

The current inventory cycle uses the GWP values of greenhouse gases as per the Fourth Assessment Report (AR4) from IPCC for conversion. This has been noted as a scope for improvement, and the latest guidance will be used in future publications.

The UAE with the support of relevant stakeholders intend to track energy consumption data by fuel type across the industries. This includes a detailed breakdown of fossil fuels, renewable energy sources, and electricity consumption. This data segmentation will enable more precise analysis of emissions associated with different energy sources, facilitating targeted emissions reduction strategies.

Solid waste disposal is an important category for the UAE and should, therefore, be calculated using a Tier 2 methodology. The information needed to do this is not yet available. Work and efforts are directed into advising the relevant institutions on establishing the necessary data flow for future inventories.

Emission estimation within the AFOLU section was conducted using data from sources like the FAO and using IPCC recommended default values and emission factors. However, the UAE recognizes that the area under different land-use categories and the default values, used in the absence of better data, do not best represent the UAE's specific agricultural methods, or characteristics of land use. The UAE's biodiversity team, under the leadership of MoCCaE, is currently undertaking an exercise to measure area under different land use categories through Geographic Information Systems (GIS) to improve accuracy of this data. Results of this assessment will be incorporated into future national-level inventories in the coming years.

Work is also underway to develop UAE-specific emission and growth factors, which would enable the use of higher tier estimation methodologies under the AFOLU section.

Also, the national inventory of HFC emissions are under progress and the updated HFC emissions will be incorporated in the subsequent national level inventories.

Moreover, in recognition of the pressing global challenge posed by climate change, the United Arab Emirates (UAE) has undertaken a comprehensive assessment of its

vulnerabilities and capacity needs in this critical area. The UAE's evaluation has identified financial requirements, technology requirements, and capability-building requirements that need to be addressed to effectively mitigate and adapt to the impacts of climate change.

Financial requirements

To realize the UAE's climate objectives and expedite the transition to a low-carbon, sustainable economy, substantial investments spanning various sectors, including infrastructure and novel technologies, are imperative. As an integral component of the UAE Net Zero 2050 Strategic initiative, a thorough evaluation of financial requirements has been executed utilizing transparent and analytical financial tools and models, projecting an anticipated investment of AED 134 billion from 2023 to 2030. Additionally, the UAE Energy Strategy 2050 strives to triple the share of renewable energy and allocate an investment ranging from AED 150 to AED 200 billion by 2030, addressing the escalating energy demands of the country.

The UAE is actively devising policies to secure the necessary financing that transforms climate action into an enticing investment opportunity. For instance, it is establishing power purchase agreements (PPAs) to foster a competitive power market, thereby attracting international and private investments. By positioning itself as an attractive destination for foreign direct investment (FDI), the UAE seeks to bolster its economy while reducing its dependence on government support and public investments.

Moreover, the government aims to create investment-friendly prospects in industrial and building sectors. Large-scale infrastructure endeavours will be financed through public-private partnerships (PPPs) to optimize cost efficiency and risk management. Additionally, public funds will be utilized to subsidize or fully fund investments in areas such as remote charging infrastructure, which may not yield immediate or attractive financial returns for private investors. PPPs, especially for high-cost, long-term investments, are among the mechanisms required to fund endeavours within the transport sector.

Certain investment areas, including high-emission sectors, carbon capture and storage (CCS), and hydrogen, will necessitate government subsidies and will be promoted by carbon pricing mechanisms.

Additional measures to meet the UAE's financial requisites encompass the creation of a sustainable activities taxonomy to facilitate international investments, the consistent disclosure of climate data, mobilization of both public and private sectors, and the implementation of rigorous and transparent regulations. Plans are also underway to establish a fund supported by carbon pricing to ensure that revenues are segregated and allocated toward decarbonizing the UAE. Various sustainable finance instruments like green bonds/sukuk or reduced-rate loans for companies investing in clean energy are being adopted. Consequently, the UAE is not seeking foreign assistance beyond regular commercial engagement and FDI to achieve its outlined targets.

The UAE is already taking tangible steps and has introduced a series of sustainable finance initiatives to efficiently channel investments and cultivate a competitive green economy. One such initiative is the Green Finance and Investment Support Scheme, a sub-program of

the UAE Green Agenda 2015-2030. This program aims to develop domestic green finance models and products, including energy performance contracts (EPC), public finance initiatives (PFI), and green sukuk. In 2021, the UAE Sustainable Finance Framework 2021-2031 was launched to guide stakeholders toward leveraging private capital for sustainable and green investments and to promote sustainability in financial decision-making.

In 2022, the UAE Sustainable Finance Working Group (SFWG), comprising ministries, financial regulators, and UAE exchanges, issued its Second Public Statement, building upon previous efforts to strengthen sustainability disclosures, foster sustainability-focused corporate governance, and design a comprehensive UAE taxonomy of sustainable activities. Ahead of COP28, SFWG members reaffirmed their commitment to driving the UAE's economic transition through sustainable finance, recognizing the pivotal role of the financial sector in directing capital toward sustainable projects across the nation.

Individual emirates are also taking initiatives to bolster the flow of private capital toward sustainable investments. Notable declarations such as the Dubai and Abu Dhabi Sustainable Finance Declarations have been issued, formalizing the commitment of financial institutions and public authorities in the UAE to pursue a climate-resilient, inclusive, and green economy. Initiatives like the Dubai Green Fund, established by the Dubai Supreme Council of Energy, aim to promote renewable energy and sustainable development by providing funding for projects that support the transition to clean energy sources.

In 2022, Abu Dhabi Global Market (ADGM) introduced a regulatory framework to accelerate the growth of sustainable finance, with a focus on regulating carbon offsets. ADGM also initiated proposals for a comprehensive Environmental, Social, and Governance (ESG) disclosure framework and minimum standards for Climate Transition Funds, Green Funds, and Green Bonds. The Abu Dhabi Sustainable Finance Forum serves as a platform for global institutional investors and financial regulators to engage in discussions related to climate finance. Furthermore, financial institutions in the UAE, such as First Abu Dhabi Bank (FAB) and Standard Chartered, are making significant commitments to environmentally sustainable projects and sustainable financing.

Technology and innovation requirements

The UAE holds a prominent position as a hub for innovation and technology in the Middle East, and its commitment to climate action will further solidify this role. The UAE views climate action as an opportunity and recognizes the necessity of investing in crucial tools, including technology and research and development (R&D), to attain its ambitious objectives. To ensure that essential technologies are available at the right level of maturity and scalability, the UAE has outlined a comprehensive strategy for technology and R&D, demonstrating the credibility of its implementation plan.

Key technologies of focus within the UAE include Carbon Capture and Storage (CCS), Direct Air Capture (DAC), hydrogen production and distribution, green standards for cement and concrete products, and the use of recycled

materials. Additionally, the country is engaged in discussions concerning the potential adoption of Small Modular Reactors (SMRs). Implementing this technology and R&D strategy necessitates the mobilization of essential resources, including funding and human capital development. As part of this mobilization effort, the Emirates Research and Development Council was established in 2021, with the goal of fostering a national environment conducive to research and innovation. This council aims to not only elevate the UAE's global standing in science and technology but also to unify efforts in achieving national R&D priorities, particularly in sustainability, for the development of a knowledge-based, post-oil economy. The UAE has also launched the Virtual R&D Hub, supporting applied research for economic growth.

The UAE consistently conducts research on climate, energy innovations, sustainable technologies, and practices through established scientific research centers and programs. For example, the Dubai Electricity and Water Authority operates a Research and Development center dedicated to innovative solutions in areas such as solar power, water, smart grid integration, and energy efficiency, supported by enablers such as the Fourth Industrial Revolution technologies. Other institutions like Khalifa University of Science and Technology and UAE University offer research programs addressing a wide range of strategic, scientific, and industrial challenges associated with the UAE's transition to a knowledge-based economy, including clean and renewable energy, water, and the environment.

To realize the UAE's climate objectives and expedite the transition to a low-carbon, sustainable economy, substantial investments spanning various sectors, including infrastructure and novel technologies, are imperative. As part of the UAE Net Zero 2050 Strategic Initiative, a comprehensive assessment of financial needs has been conducted. The UAE Energy Strategy 2050 aims to triple the contribution of the renewable energy and invest AED 150 to AED 200 billion by 2030 to meet the country's increasing demand for energy as a result of a rapidly growing economy.

The UAE is also attentive to emerging technologies crucial for advancing its climate agenda, including CCS, blended cement, and recycled materials. Programs supporting local and international entrepreneurs and innovators include the Mohammed Bin Rashid Innovation Fund (MBRIF), Climate Innovations Exchange (CLIX), and Solar Decathlon Middle East (SDME). These initiatives provide funding, mentorship, and networking opportunities for businesses and start-ups focused on climate-related solutions.

International universities and technological institutes present in the UAE, such as NYU, American University Dubai, and the Sorbonne, offer education to local students. The UAE actively seeks collaborative partnerships with leading international institutions to empower its youth in addressing climate challenges through innovation and research.

Capability building requirements

To achieve its goals in both mitigation and adaptation, the UAE is committed to enhancing its human resources and capabilities, empowering its citizens to address climate change. Under the UAE's Net Zero Strategy, it plans to generate an average of 160,000 jobs annually between 2025 and 2050 and aims to future-proof an additional 40,000 jobs. Effective upskilling and capacity building are essential to maximize local employment opportunities and harness the job creation potential offered by the transition to a green economy. The plan involves preparing the UAE's workforce to leverage the opportunities arising from the emerging green economy, mobilizing relevant stakeholders in climate action, enhancing their capabilities, and fostering greater awareness of climate change.

The UAE is making significant efforts to strengthen its capabilities in designing, implementing, enforcing, and monitoring effective policies and regulations to successfully achieve the objectives outlined in its Nationally Determined Contributions (NDC). The UAE is self-reliant in capability building for its climate agenda and has already initiated various initiatives in this regard.

Capacity Building for Government and Private Sector

In 2021, the UAE introduced the UAE Climate Change Research Network (CCRN), which serves as a collaborative platform for scientists and researchers to enhance the collection of climate-related information and conduct policy research on the effects of climate change and adaptation strategies. This initiative aims to bridge the gap between government and academia, fostering knowledge-sharing and guiding a science-based climate agenda for the country.

Launched in 2022, the Jahiz initiative focuses on upskilling government employees by offering programs that develop critical future skills, including digital literacy, data analysis, AI, and expertise in areas such as net-zero concepts, climate change, the circular economy, and sustainability. The Jahiz digital platform provides government employees with training opportunities, enhancing the competitiveness and future readiness of the UAE government.

Recognizing the significant role of educators in shaping the future workforce and preparing students to address the challenges of a changing economy, numerous capacity-building programs target educators. The UAE government, in collaboration with UNICEF, plans to train approximately 3,000 master trainers and 1,500 principals across the country. This training will facilitate the integration of climate education into teacher training, covering cross-curriculum and extra-curriculum activities. The TeachersCOP event aims to give primary and secondary teachers and school directors a voice in global climate discussions.

At the emirate level, Abu Dhabi has introduced the Integrated Energy Model (IEM), known as the Energy Cube, to provide policymakers, business leaders, and investors with a comprehensive view of the energy sector value chain. The IEM serves as a collaborative platform, offering insights for policy and decision-making in the increasingly complex

energy landscape. In Ras Al Khaimah, the Environmental Sustainability Award recognizes institutions for their efforts in reducing environmental footprints and fostering environmental responsibility. The Upskill program, launched in 2021, provides training and certifications on energy efficiency and renewables for various professionals.

Efforts are also underway to build capacity within the private sector. Collaborating with EN-WWF, the UAE has conducted workshops to increase the private sector's capabilities in climate action, with a focus on carbon footprint estimation and emissions reduction strategies. The Leaders of Change mission by EN-WWF supports corporations and government employees in upskilling to promote sustainable development, the Net Zero pathway, and organizational transformation.

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