



UNITED ARAB EMIRATES

1. INTRODUCTION

The UAE's energy transition is a global leader, driven by ambitious strategies such as the UAE Energy Strategy 2050 and the Net Zero by 2050 initiative. The country 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 regulatory authority, the Federal Ministry of Energy and Infrastructure maintains central oversight of the energy sector. Each emirate has its own regulatory body and operators, such as the Department of Energy Abu Dhabi, and Dubai Supreme Council of Energy, and the utilities are DEWA, EWEC, SEWA, Etihad WE, and other national champions such as Masdar, ADNOC, Beeah, and Mubadala Energy. Driven by rapid urbanization and industrial growth. National policies have been developed focusing on tripling renewable capacity by 2030 and reducing dependence on oil and gas by leveraging the country's abundant solar resources and investing in nuclear power, such as the Barakah Nuclear Plant and the Mohammed Bin Rashid Al Maktoum Solar Park. By integrating AI, big data, and smart grids, the UAE modernizes its infrastructure to ensure energy security, economic growth, and environmental preservation.

The UAE's energy transition is driven by a multifaceted approach that addresses three key elements; energy security, energy equity, and environmental sustainability.

Energy security: the UAE has invested heavily in diversifying its energy sources, reducing its reliance on oil and gas through the development of renewable energy projects, such as solar and wind power, as well as nuclear power facilities. The Barakah Nuclear Power Plant represents a significant step in securing a reliable and long-term energy supply. UAE illustrates its journey by highlighting the significant milestones achieved in increasing our renewable energy (RE) capacity. Between 2019 and 2023, the UAE doubled its renewable energy capacity, with clean energy installed contributing 23.72% to the national energy mix by 2023 and aiming to reach 30% by 2030.

Energy Equity: To enhance equitable access to energy, the UAE has modernized infrastructure, boosted energy efficiency, and explored smart grid technologies. This has helped to make energy more affordable and accessible for all including rural and industrial areas. Moreover, The UAE's power and water sector are crucial for its commitment to innovation and sustainability along with growth ambitions.

Environmental Sustainability: Central to the UAE's energy transition, projects like The Mohammed bin Rashid Al Maktoum Solar Park, the largest single-site solar park in the world with a planned production capacity of 5,000 MW by 2030, the Noor Abu Dhabi solar plant (1.177MW) and the Al Dhafra solar plant (2100 MW) contribute significantly to reduce CO₂ emissions by millions of tons annually. The UAE has set ambitious clean energy generation targets, committing to 32% clean electricity produced by 2030 with the goal of achieving carbon neutrality by 2050. Thus, aligning the country's goal with global sustainability trends while reducing its carbon footprint.

1.1 POLICY CHANGES THAT COULD AFFECT FUTURE TRILEMMA PERFORMANCE

The UAE's Hydrogen Strategy which has been launched by the Ministry of Energy & Infrastructure, has the potential to bolster both energy security and environmental sustainability by introducing an alternative clean energy carrier for transportation, industry, and export. Additionally, the continued development of carbon capture, utilization, and storage (CCUS) projects will aid in addressing the environmental sustainability pillar of the Trilemma by reducing emissions from fossil fuel-based power generation.

Furthermore, Abu Dhabi targets 60% clean electricity by 2035 and aims for a carbon-neutral economy by 2050. Policies and regulations, including Clean Energy Targets 2035, are in place to facilitate decarbonization. Abu Dhabi's Clean Energy Certification Scheme is a regulatory framework designed to incentivize and promote the adoption of clean energy sources through a certification process, creating a market for Clean Energy Certificates to facilitate compliance with renewable energy targets and environmental goals.



On the other side, The Mohammed bin Rashid Al Maktoum Solar Park, which DEWA is implementing, is the largest single-site solar park in the world, using the Independent Power Producer (IPP) model. It will have a production capacity of more than 5,000MW by 2030 with a total investment of AED 50 billion. Upon its completion, the Solar Park will reduce more than 6.5 million tonnes of carbon emissions annually. The total capacity of the solar energy projects commissioned at the solar park has reached 2,860MW from photovoltaic (PV) solar panels and Concentrated Solar Power (CSP). The total capacity of the projects under construction at the solar park is 1,800MW from PV technology. The Solar Park supports the Dubai Clean Energy Strategy 2050 and the Dubai Net Zero Carbon Emissions Strategy 2050 to provide 100% of its energy production capacity from clean energy sources by 2050.

1.2 CHALLENGES AND OPPORTUNITIES FOR THE IMPROVEMENT OF EACH DIMENSION

The UAE's energy transition involves navigating a mix of challenges and opportunities within energy security, environmental sustainability, and energy equity. Energy security is impacted by the country's reliance on imported natural gas and global market fluctuations. To counter this, the UAE is investing in renewable energy, and nuclear power, and enhancing energy infrastructure. Ensuring equitable access to energy is vital, and the use of distributed energy resources (DERs) and smart grids will help promote affordability and inclusivity. On environmental sustainability, reducing carbon emissions through initiatives and strategies and managing renewable energy waste are key challenges. By investing in clean energy and promoting efficiency, the UAE is working towards a more sustainable, resilient future. Through this multifaceted approach, the UAE aims to build a balanced and forward-looking energy system.

1.3 KEY UNCERTAINTIES IMPACTING TRILEMMA DIMENSIONS

The UAE's energy transition is subject to various challenges, including geopolitical risks, fluctuations in global oil and gas markets, and the high upfront costs of renewable energy technologies. While the country has made significant progress, ensuring stable energy supplies, equitable access, and environmental sustainability remains a complex task. In conclusion, the UAE is at a critical juncture in its energy transition journey, with opportunities and uncertainties that will shape its Trilemma performance in the coming decades. The success of its policy initiatives will not only impact its domestic energy landscape but will also set a standard for the region and the global community.

2. POLICY PATHFINDING FOR MANAGING THE TRILEMMA IN THE UAE

2.1 APPLICABILITY OF SIGNALS FROM THE 2024 WORLD ENERGY TRILEMMA REPORT TO THE UAE'S ENERGY TRANSITION

The UAE has achieved substantial progress in its shift towards a more sustainable energy future, aligning with the global moves towards cleaner and more sustainable energy sources. Insights from the 2024 World Energy Trilemma Report offer key guidance for the UAE's energy transition, particularly in balancing the three dimensions of the trilemma: energy security, energy equity, and environmental sustainability.

For example, based on the energy security dimension, The UAE's strategic shift towards clean energy is to diversify the energy mix to ensure energy security. The country's substantial investments in projects like the Mohammed bin Rashid Al Maktoum Solar Park and the Barakah Nuclear Power Plant underscore the nation's commitment to diversifying energy sources and ensuring a sustainable energy future.

The UAE's commitment to energy transition is further exemplified by projects such as the Al Sila Wind project, a renewable energy initiative with a generation capacity of up to 140 MW. This project will generate enough clean electricity to power 36,000 homes, displacing 190,000 tonnes of carbon dioxide annually. Al Sila's contribution is instrumental in achieving Abu Dhabi's Clean Energy Strategic Target 2035, demonstrating its dedication to sustainability and climate change mitigation.

Furthermore, DEWA has achieved a significant milestone with the Commercial Operation Date (COD) of the 950-megawatt (MW) fourth phase of the Mohammed Bin Rashid Solar Park. This project is the largest single-site concentrated solar plant in the world, utilizing three hybrid



technologies: 600 MW from a parabolic basin complex, 100 MW from a CSP tower, and 250 MW from photovoltaic solar panels. It features the tallest solar tower globally, standing at 263.126 meters, and boasts the largest thermal energy storage capacity at 5,907 megawatt hours (MWh), as recognized by Guinness World Records.

Aligned with the UAE's Energy Strategy 2050, which prioritizes the diversification of energy sources and the expansion of clean energy capacity, the country aims to triple its renewable energy capacity by 2030. However, increasing renewable sources in the grid introduces challenges such as energy storage and grid resilience to ensure a stable, continuous energy supply.

The UAE's commitment to energy equity is demonstrated through its efforts to provide affordable and accessible energy for all. Progress has been made in expanding access to clean energy options, with emerging technologies like distributed energy resources (DER's) and smart meters playing a key role. These initiatives empower individuals and communities, enhance grid resilience, and promote energy efficiency, contributing to a more equitable and sustainable energy future.

In line with its commitment to sustainable transportation, the UAE promotes electric vehicles (EVs). National initiatives support EV adoption by expanding infrastructure and public awareness campaigns. The adoption of EVs in the UAE aims to reduce greenhouse gas emissions from transportation and thus improve air quality. EVs also play a pivotal role in reducing reliance on fossil fuels and contributing to energy security. The UAE's ambitious plans to expand the EV fleet highlight its dedication to sustainable transportation, positioning the nation as a leader in this sector and paving the way for a cleaner, greener future. In addition, the UAE is one of the first nations in the region to adopt artificial rain as an innovative solution to combat desertification, and drought, and to increase green spaces. This initiative not only enhances water resources but also mitigates the effects of climate change. The United Arab Emirates ranked second in the Middle East in electric vehicle sales in 2023, accounting for 13% of the market share.

The National Demand Side Management (DSM) program is vital for achieving net-zero emissions by 2050. By optimizing energy consumption and cutting peak demand, DSM initiatives lower greenhouse gas emissions in line with national climate goals. The UAE's National Energy and Water Demand Side Management Program 2050 outlines a robust set of initiatives to reduce energy consumption by 40% through efficiency programs, smart grids, and demand response initiatives, advancing the UAE's net-zero objectives while improving energy security, reducing costs, and fostering sustainable development.

Additionally, the UAE's National Hydrogen Strategy 2031 presents a bold plan to establish the country as a global leader in low-carbon hydrogen production. The strategy targets the production of 1.4 million tonnes per annum (mtpa) of low-carbon hydrogen by 2031. This investment will not only support the UAE's energy diversification and sustainability goals but also contribute significantly to the development of the global hydrogen economy. This strategic focus aims to reduce carbon footprint and create new economic opportunities and jobs in the emerging hydrogen sector.

Finally, the UAE's commitment to achieving net-zero carbon emissions by 2050 is closely aligned with its focus on environmental sustainability. This goal is reinforced by the nation's investment in innovative technologies such as carbon management technologies such as carbon capture, utilization, and storage (CCUS), CCS, DAC, carbon removals and others. Through these investments, the UAE is positioning itself as a leader in industrial decarbonization, advancing toward a more sustainable and environmentally responsible energy future.

2.2 RELEVANT POLICY/STRATEGY OPTIONS FROM THE REPORT FOR THE UAE'S NATIONAL ENERGY STRATEGY

The 2024 World Energy Trilemma Report presents several policy and strategy options that are highly applicable to the UAE's national energy strategy plans, especially as the country seeks to strike a balance between energy security, equity, and environmental sustainability.

- **Diversifying Energy Sources:** A core focus of the UAE Energy Strategy 2050, The UAE has invested domestically over \$45 Billion in clean energy projects over the past 15 years. Current projections



projections indicate that the production capacity of clean energy (including solar and nuclear) will reach 19.8 GW by 2030. The UAE actively supports green infrastructure and clean energy projects worldwide, investing in renewable energy initiatives totalling approximately 50 billion USD in 70 countries, with a particular focus on developing nations.

- **Energy resilience and decarbonization:** The UAE introduced the Federal Energy Management Regulation in Industrial Facilities, which serves as a foundational framework for federal regulations related to sustainability and energy optimization in industries operating across all emirates of the UAE. The focus of this program is directed toward the 50 largest industrial energy consumers in the country.
- **Improving energy access and equity:** Dubai's Demand Side Management (DSM) strategy is part of the UAE's broader push to improve energy efficiency and reduce consumption. Launched in 2013, Dubai's DSM aims to reduce energy and water demand by 30% by 2030. This goal is achieved through initiatives like building retrofits, district cooling, and smart grid technologies, promoting efficient consumption practices across residential, commercial, and industrial sectors which confirms the Emirate's commitment to the Demand Side Management Strategy,
- **Resilience to climate risks:** As the country faces extreme weather conditions due to climate change, The UAE is working on fortifying its energy grid and developing robust climate adaptation strategies, including building energy storage capacities, which align with the global recommendations in the Trilemma report.

By adopting these policy options, the country's ongoing investments and policy shifts are set to enhance its performance across all Trilemma dimensions, ensuring a robust and resilient energy system for the future.

2.3 ADDRESSING NEW TRENDS PER DIMENSION IN NATIONAL ENERGY PLANS

Addressing new trends per dimension in national energy plans is vital to the UAE's energy transition strategy. The UAE Energy Strategy 2050 was updated, setting goals for 2030 and ambitions for 2050 to reach net zero. By 2030, the strategy aims to triple renewable energy's share, create 50,000 green jobs, and invest between AED 150 and AED 200 billion. In addition to that it aims to enhance energy efficiency by 42-45% by 2050 to meet the country's rising demand for energy. This ambitious approach reflects the nation's commitment to energy security with a focus on diversifying its energy mix. Additionally, The Barakah Plant is now recognized as a benchmark for new nuclear energy projects around the world and has highlighted the leading role of the UAE in the global clean energy transition. Thanks to the support of the nation's leadership, ENEC, and the Korean partners developed a new model for financing and managing an advanced nuclear energy mega project, which is now rapidly decarbonizing the UAE's power sector. Barakah is expected to supply up to 25% of the UAE's electricity needs, reducing reliance on fossil fuels and contributing to the country's energy security.

On the energy equity front, the UAE's government is committed to ensuring affordable energy access. For instance, the demand-side management (DSM) program aims to optimize electricity consumption patterns by promoting energy-saving measures. Adopting best international standards, this program underpins the nation's largest water and energy efficiency drive, to ensure the security of supply in energy and water sectors by utilizing solar power to cover buildings and industry energy demand as an example, through direct impact long, medium- and short-term plans. This program focuses on four key pillars: agriculture, built environment, industry, and transport. The UAE's DSM strategy targets a 40% reduction in energy consumption from the energy-intensive sector and a 50% reduction in water consumption in the building and agricultural sectors in the UAE by 2050.

Sustainability is a key pillar of the UAE's future energy strategy. The UAE Energy Strategy 2050 positions the country at the forefront of the global energy transition, aiming to achieve a grid emission factor of 0.27 kg CO₂/kWh by 2030, a figure notably lower than the global average. It emphasizes international partnerships to advance sustainability in the energy sector, with projects like the Mohammed bin Rashid Al Maktoum Solar Park, projected to generate 5,000 MW of solar power by 2030. 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. The UAE is also making substantial investments in carbon management (CCUS/CCS) technologies and is working to establish itself as a global leader in hydrogen production and plans to establish a hydrogen R&D centre by 2031, aligning with its broader goals for clean energy and environmental sustainability. Hydrogen, as a clean energy source, offers the potential to drastically reduce carbon emissions, especially in energy-intensive industries and heavy transportation. By investing in hydrogen, the UAE aims to decarbonize multiple sectors, reduce its reliance on fossil fuels, improve air quality, and contribute to its target of net-zero emissions by 2050, further bolstering its environmental sustainability initiatives.

The UAE's commitment to research and development (R&D) in energy security and environmental sustainability is driving advancements toward a resilient, low-carbon future. Through collaborations with research institutions, such as the Khalifa University and the Masdar Institute, the UAE is exploring sustainable practices in water conservation, emissions reduction, and waste management. This focus on R&D is essential in addressing both regional and global environmental challenges, as the UAE continuously integrates sustainable practices and advanced technologies to enhance energy security and build a cleaner, more sustainable environment for future generations.

These objectives highlight the UAE's proactive approach to addressing emerging trends, and ensuring energy security, equity, and sustainability.

What considerations are being made or must be made to ensure a just and resilient energy transition in the context of your country? How to measure progression with justice and resilience?

The UAE's energy transition is shaped by a strong commitment to achieving both justice and resilience in its future energy landscape. A key focus is on energy security, ensuring that all citizens, especially vulnerable populations, benefit from the energy shift. This includes creating affordable energy access and generating clean energy job opportunities. To enhance energy equity and reliability, the UAE is investing in advanced infrastructure, diversifying its energy sources, and increasing grid reliability, as well as deploying energy storage systems. On the environmental front, the UAE is dedicated to minimizing the ecological footprint of its energy sector by reducing carbon emissions, promoting sustainable practices, and conserving its natural resources. The UAE's global energy partnerships emphasize international cooperation to share innovative solutions and support the global fight against climate change. These combined efforts are driving the UAE towards a more sustainable and equitable energy future.

To measure the UAE's progress toward a just and resilient energy transition, several comprehensive indicators must be considered. On the economic side, metrics like GDP growth, job creation, and improvements in energy security are key in evaluating the overall economic resilience during the transition. For environmental sustainability, tracking reductions in greenhouse gas emissions, increased renewable energy penetration, and energy efficiency will provide critical insights into how effectively the UAE is reducing its environmental footprint. Together, these indicators will offer a holistic approach to understanding the UAE's journey towards a sustainable, equitable, and resilient energy future. Monitoring these indicators will ensure the energy transition benefits are distributed fairly and that its energy infrastructure remains robust for future challenges.

3. BEYOND TRADITIONAL DIMENSIONS

The UAE is leveraging digital innovations to transform its energy sector, enhance decision-making, and promote sustainability. Government-led AI and smart grid technologies improve energy efficiency and optimize resource allocation. For example, DEWA's smart grid integrates digital solutions, such as smart meters and real-time energy monitoring, allowing for better forecasting of energy demand and automated adjustments to consumption patterns. Additionally, IoT (Internet of Things) sensors are being deployed across energy infrastructures to gather data, improve asset performance, and reduce waste.

In the context of renewables, the UAE is utilizing predictive analytics to maximize the efficiency of solar and wind farms. Digital tools also play a critical role in integrating energy storage systems and optimizing renewable energy use during peak demand. Moreover, The UAE is actively exploring blockchain technologies to create transparent and secure systems for trading green energy



certificates. Blockchain's decentralized nature and immutability can enhance the integrity of renewable energy transactions, fostering trust among participants and promoting wider adoption of clean energy sources.

The UAE is promoting multi-sector collaborations between public and private sectors to ensure the resilience and sustainability of its energy systems. Key sectors like transport, industry, and water management are being integrated into the energy transition, reflecting a holistic approach to sustainability. For instance, the Etihad Rail project, combining the transport sector with energy efficiency goals, is designed to reduce carbon emissions while providing a more sustainable freight and passenger network. Similarly, Masdar City showcases the potential for integrating renewable energy, electric vehicles, and energy-efficient buildings to create a sustainable urban environment. These interconnections illustrate how various sectors can work together to achieve a more resilient and sustainable future.

The UAE's Energy Strategy 2050 and the National Water and Energy Demand Management Program underscore the importance of cross-sectoral collaboration to achieve its energy transition goals. By fostering partnerships between government agencies, utilities, technology companies, and research institutions, the UAE aims to address critical challenges such as Integrating renewable energy into the grid and reducing energy demand across industries. These partnerships will be instrumental in achieving a more sustainable and resilient energy future for the UAE.

Challenges to these collaborations include regulatory frameworks that need to evolve to accommodate innovation, as well as the siloed nature of some sectors that limits the sharing of resources and knowledge. However, innovative approaches like public-private partnerships (PPPs), joint ventures, and regulatory sandbox initiatives are helping to overcome these barriers, promote innovation, and create a more conducive environment for cross-sectoral partnerships.

The UAE took center stage by hosting COP28 which marked a transformative approach to global climate discussions, focusing on inclusion and collective efforts towards combating climate change. As the first Global Stocktake of the Paris Agreement progress, COP28 highlighted the UAE Consensus, the foundation of the conference, which aimed to fulfill commitments and introduce new initiatives across different agenda items, including adaptation, mitigation, capacity transfer, and other areas.

In the UAE, community engagement plays an increasingly important role in driving more effective and equitable energy policies. Programs to raise energy literacy help ensure that citizens and businesses understand the importance of sustainability and energy efficiency. For example, initiatives like the Shams Dubai program allow homeowners and businesses to install rooftop solar panels, directly contributing to the country's renewable energy targets while fostering public involvement in the energy transition.

National awareness and educational campaigns like Save to Sustain (the national awareness campaign for energy and water conservation) launched by the UAE Ministry of Energy and Infrastructure help different society segments (like students- families- employees- labourers- tourists) implement more sustainable practices to save energy and water. Save to Sustain has successfully raised awareness about energy-saving practices to have daily sustainable habit not only practices. Overall, Save to Sustain campaign has played a crucial role in promoting energy conservation and sustainability in the UAE. It has helped to raise public awareness, encourage behavioural changes, and contribute to the country's efforts to achieve its energy efficiency goals.

Finally, the UAE government has recognized that diverse community engagement is necessary to achieve its sustainability goals. By empowering local communities, women, and youth, the country can create more inclusive energy policies that address the needs of all segments of society. Programs supporting entrepreneurial startups in clean energy and encouraging youth participation in energy policy discussions through forums like the Youth 4 Sustainability (Y4S) initiative, which is a global initiative launched by Masdar, a leading renewable energy company in the UAE where It aims to empower young people to become sustainability leaders and drive the global sustainability agenda forward.