2021

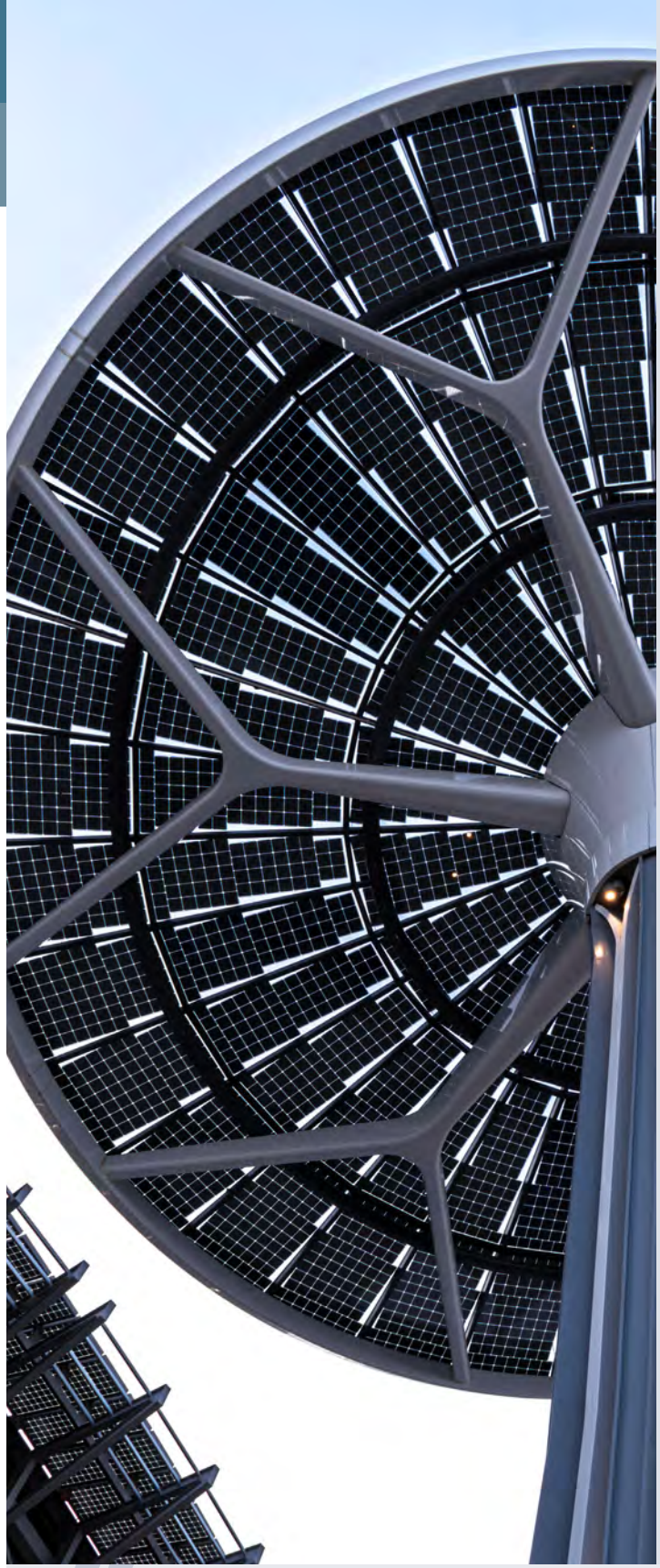
ENERGY & UTILITIES

ADQ FWD

القابضة فورورد

Journey to Clean, Sustainable Energy

PAPER



FOREWORD

The global energy landscape is evolving towards cleaner energy sources.

The usage of clean energy sources will grow rapidly as the cost of renewables drops. Pathways to reduce demand and current CO_2 levels require an accelerated roll-out coupled with the application of innovative solutions.

To deliver the United Arab Emirates' (UAE) successful transition to clean energy, diversification of the power supply, expanding the roll-out of Clean Energy Certificates (CECs), and leveraging Carbon, Capture, Utilisation and Storage (CCUS) will continue to be critical.

Collaboration will also be key to unlocking a sustainable future. Orchestrated action from the energy and industrial sectors alongside policymakers, regulators and government is needed to deploy renewables at speed and scale, incentivised by long-term stable policies and regulations.

The transition ahead presents huge opportunities for economic growth, millions of new jobs, and the emergence of game-changing technologies.

This paper outlines the key investments and strategies that will help facilitate the UAE's established and future pipeline of clean energy solutions and, in doing so, navigate the journey to clean, sustainable energy.

"This ADQ FWD paper explores how we can optimise the region's potential in renewables to accelerate the transition to a sustainable and reliable future."

Mansour AlMulla
Group Chief Investment Officer, ADQ

The UAE's carbon reduction journey

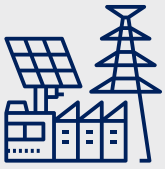
The UAE is the first in the region to:

Deploy a multi-unit operating nuclear energy plant

Develop a Clean Energy Certificates scheme

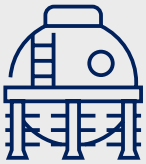
Develop an industrial scale Carbon Capture, Utilisation and Storage facility

Upcoming initiatives in the UAE include:



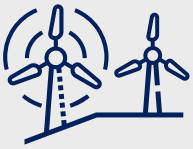
The world's largest single-site solar park

The world's lowest solar tariff



The region's first industrial-scale solar-driven green hydrogen facility

The region's first green steel manufacturing plant



The UAE's first wind farm, with feasibility studies underway

SECTION ONE

The global trends shaping the future of energy

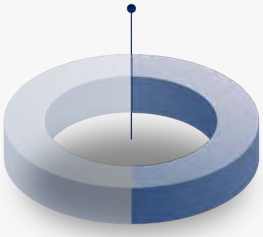
A record level of global renewables-based generation capacity was added in 2020 – more than four times the capacity added from other sources.

Capacity additions have increased by 45% to almost 280 gigawatts (GW), displacing 336 metric tonnes of CO_2 annually. This current trajectory is unlikely to falter in the near term, with a renewable capacity of 270 GW predicted to be added by the end of 2021, and 280 GW in 2022.

2050 OUTLOOK

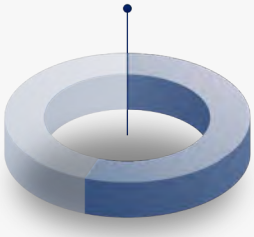
To meet rising global energy demand, large scale investments are required in renewables.

~50%



Projected increase in total global energy demand through 2050

60%



Renewables will be the majority of many countries' energy consumption by 2050

USD 1.7 trillion

By 2050, projected annual spend on energy transition

As energy demand continues to grow, supply will be met based on economic merit. Globally, new renewable plants are becoming increasingly competitive due to the mass production of solar panels coupled with innovation in financing and project structuring.

"Abu Dhabi has made great strides towards sustainable energy development with mega renewable and clean energy initiatives. By maximizing our collaboration, engagement, and resource optimization, we can further enable an effective energy transition that boosts decarbonization and economic prosperity."

HE Engineer Ahmed Mohammed Belajer Al Rumaithi
Undersecretary, Abu Dhabi Department of Energy (DoE)

Key requirements to stabilise the climate while powering the global economy

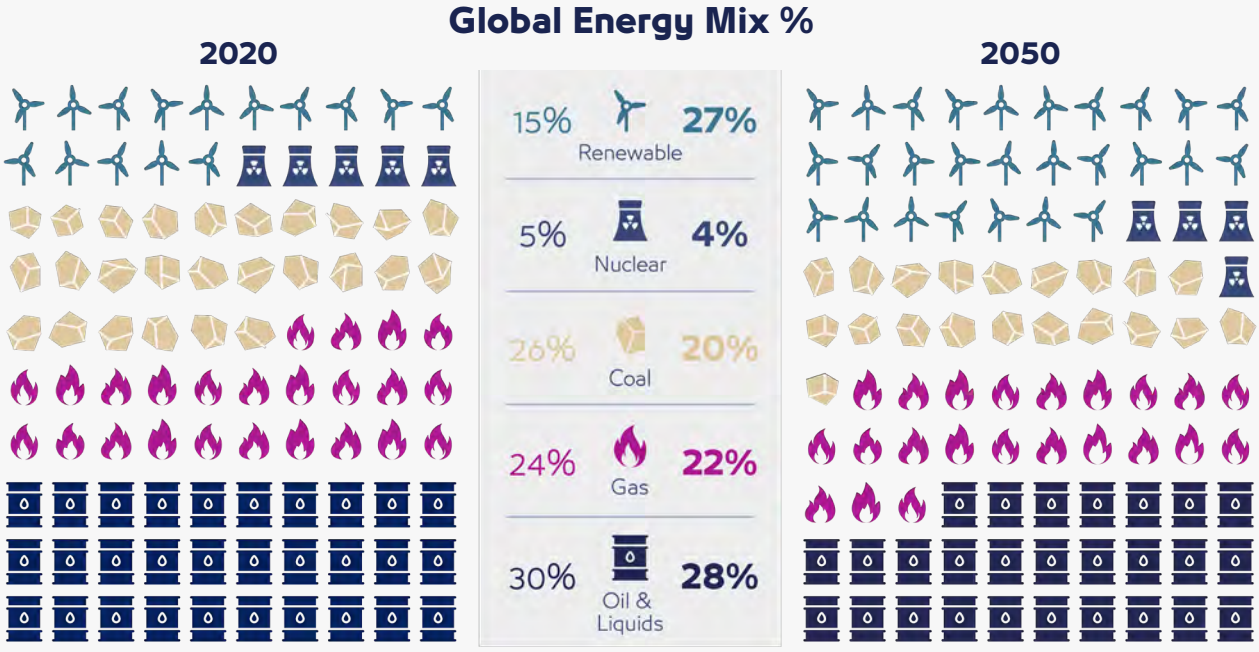
One of the key challenges facing the energy sector is to ensure sufficient, diverse and balanced capacity as new forms of clean energy are fed into the electricity grid.

While renewable energy is set to drive the most significant CO_2 reductions, other tools must also be deployed. These include demand side management, energy efficiency, recycling, the electrification of transport and industrial processes, nurturing new markets such as hydrogen, and scaling up the renewable energy industry.

Energy transition investment promises robust returns

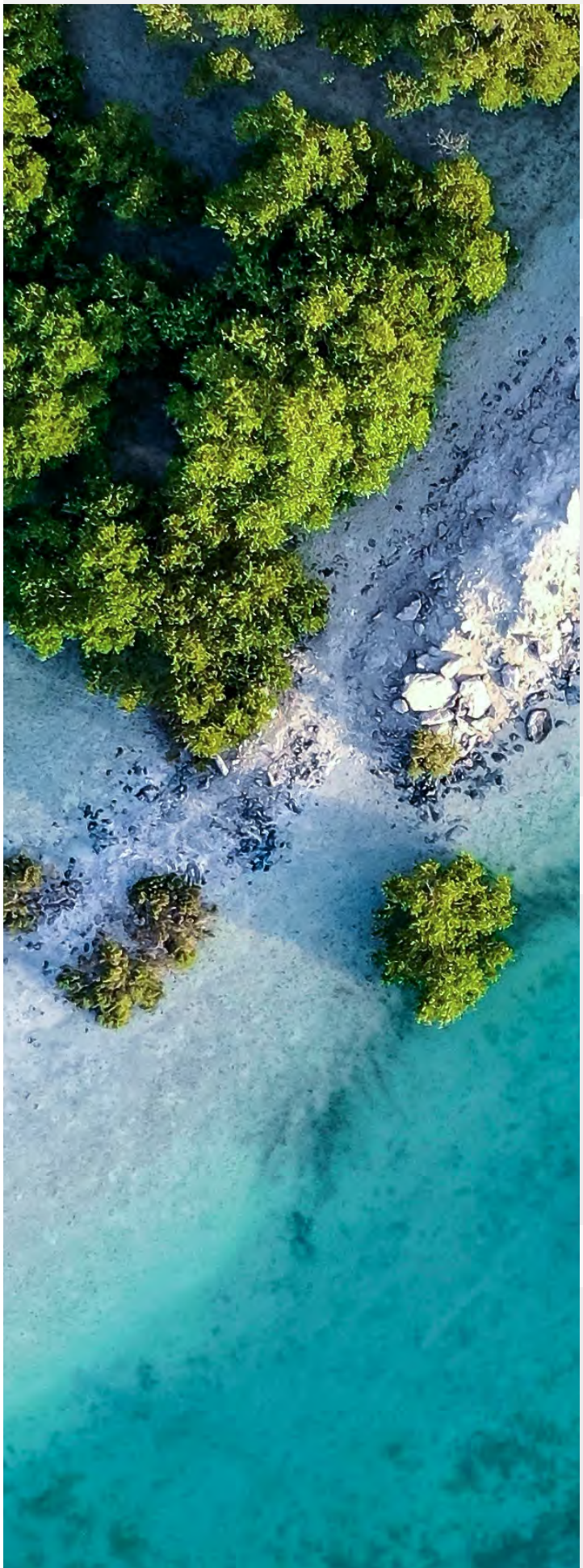
By 2050, the costs of the energy transition are predicted to reach USD 1.7 trillion annually. However, cost savings will provide a robust return on investment, averaging USD 6 trillion per year from reduced air pollution, improved health, and lower environmental damage.

Energy Information Administration (EIA) predicts the mix of global energy consumption will continue shifting as renewables growth outpaces oil growth



Critical steps on the path to Net Zero

Key requirements to stabilise the climate include reducing demand, changing how we power and fuel our lives, scaling up the "carbon management" industry and tackling other Green House Gases (GHG) emissions.



Reduce demand

Reduce demand through process optimisation, energy efficiency and growing the circular economy

Change how we power and fuel our lives

Electrify road transport, and increase smart solutions for buildings and industrial processes

Deploy renewables at scale and speed

Expand the use of biomass, biofuels, and bioenergy into other sectors

Grow the hydrogen market significantly

Scale up the 'carbon management' industry

Scale **carbon capture, utilisation and storage**

Stop deforestation

Develop **CO_2 removal** markets

Tackle other GHG emissions

Reform **agriculture and food systems**

Eliminate **escaping methane emissions**

SECTION TWO

The UAE is progressing towards a sustainable future

The UAE is playing a key role in mitigating climate change on a global scale.

Building on its achievements to date, the nation has the resources, expertise, and vision to continue contributing to the global energy transition. The UAE is home to the International Renewable Energy Agency (IRENA) and recently won the bid to host the UN's global climate talks, COP28, in 2023.

The nation's large-scale investments in renewables mitigate the higher overhead costs of fragmented, smaller projects.

The UAE's open and stable regulatory framework, provides increased security and enables pre-developed sites to thrive. With integrated utilities such as the Abu Dhabi National Energy Company (TAQA) in place, transmission can be fast-tracked and lengthy processes are limited, helping to set the nation apart from other advanced markets.

The UAE's renewable energy capacity was 2.3 GW, or approximately 7% of the total power production mix, in 2020. With abundant sunshine year-round, the majority of renewable energy is from solar power today.

As part of managing energy demand in the UAE, the nation aims to reduce consumption by 40% and increase water reuse by 95%.

> "The UAE leads the way in sustainability and innovation, recognising both as the cornerstones of a developed economy and a green future."

HE Yousif Ahmed Al Ali
Assistant Undersecretary for Water, Electricity and Future Energy Affairs, Ministry of Energy and Infrastructure

The UAE's road to Net Zero

In 2021, the UAE became the first amongst the MENA nations to make the pledge to achieve net-zero emissions by 2050.

The recent launch of the UAE's Net Zero by 2050 Strategic Initiative marks the start of a new era for sustainable economic development, with new investments of AED 600 billion planned over the next three decades to drive the clean energy sector.

AED 14bn
UAE's annual spend on innovation, with half allocated to R&D

+400%
UAE's renewable energy sector growth in the last 10 years

AED 600bn
planned investment in clean and renewable energy sources by 2050

Driving the growth of the UAE's clean energy sector

On the journey to a sustainable future, the UAE is capturing cost opportunities, using resources efficiently and tapping into new growth drivers.

ADQ's flagship projects are harnessing the power of new and improved technologies to foster the growth of the renewable energy sector.

> From developing the first nuclear energy plant in the Arab world to one of the world's largest solar farms, these efforts have helped advance the UAE's energy sector, but we must continue to deploy investments effectively.

Hamad Abdulla Al Hammadi
Head of Energy and Utilities, ADQ

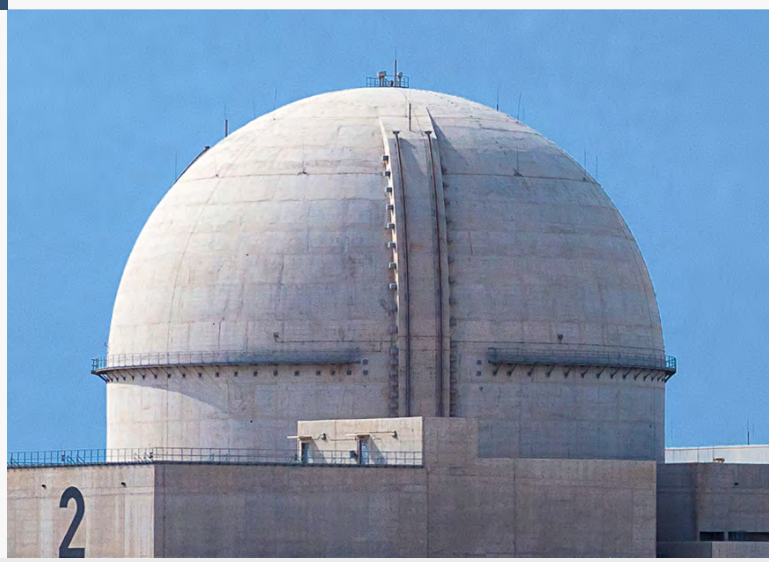
Solar energy

One of the first initiatives to contribute to the UAE's Energy Strategy 2050, **Noor Abu Dhabi** is currently the world's largest single-site solar power plant with 3.4 million solar panels driving 1.2 GW of capacity. Since it began operations in 2019, the plant supplies Abu Dhabi with enough clean energy to meet the needs of 90,000 households annually.

Currently under construction, the 2 GW **Al-Dhafra** Solar Photovoltaic (PV) project will have the capacity to power approximately 160,000 households across the UAE. When complete, the project will be the largest single-site solar park globally with the world's lowest tariff. It is being developed by a consortium led by TAQA, in collaboration with Masdar, France's EDF Renewables and China's JinkoPower.

Nuclear energy

The **Barakah Nuclear Energy Plant**, a joint venture between the Emirates Nuclear Energy Corporation (ENEC) and Korea Electric Power Corporation (KEPCO), is the first nuclear power station in the Arab world. Once the plant is fully operational by 2023, it will produce 5.6 GW of zero emission electricity – the equivalent of up to 25% of the UAE's electricity needs – and prevent the release of up to 21 million tonnes of carbon emissions annually.



> The opportunities to drive economic growth whilst cutting carbon emissions are abundant across the clean energy sector.

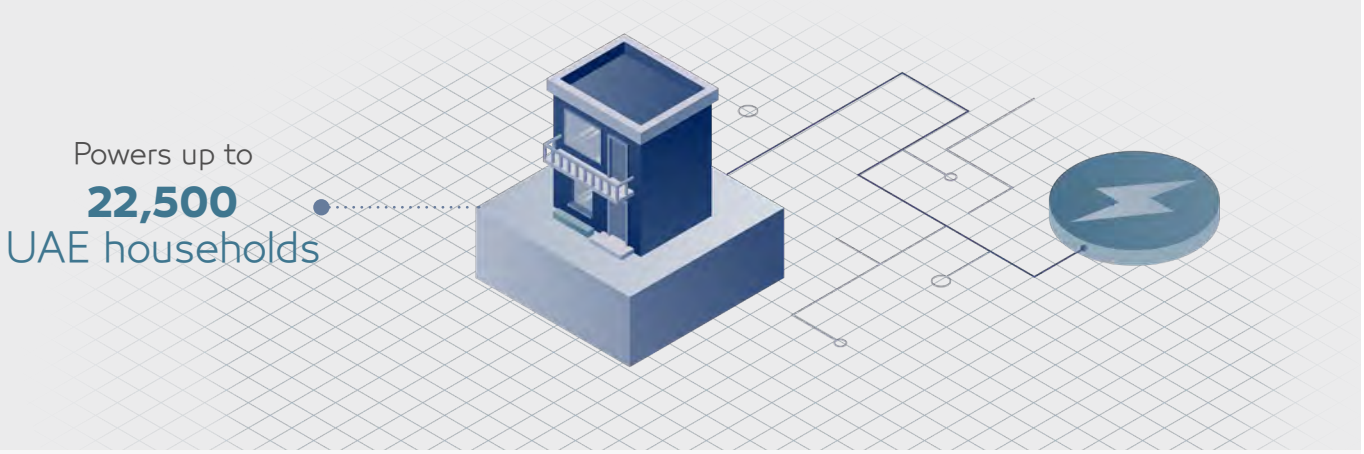
HE Mohamed Ibrahim Al Hammadi
Managing Director & Chief Executive Officer, Emirates Nuclear Energy Corporation (ENEC)

Carbon Capture, Utilisation, and Storage (CCUS)

CCUS will be a vital tool in the fight against climate change. As well as preventing CO_2 from entering the atmosphere, it enables the use of clean burning gas to enhance oil recovery, and can be leveraged for other industrial uses such as power generation and desalination.

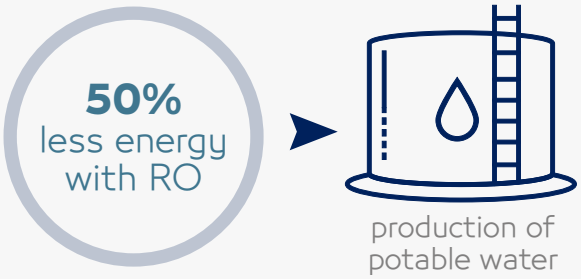
Waste-to-energy

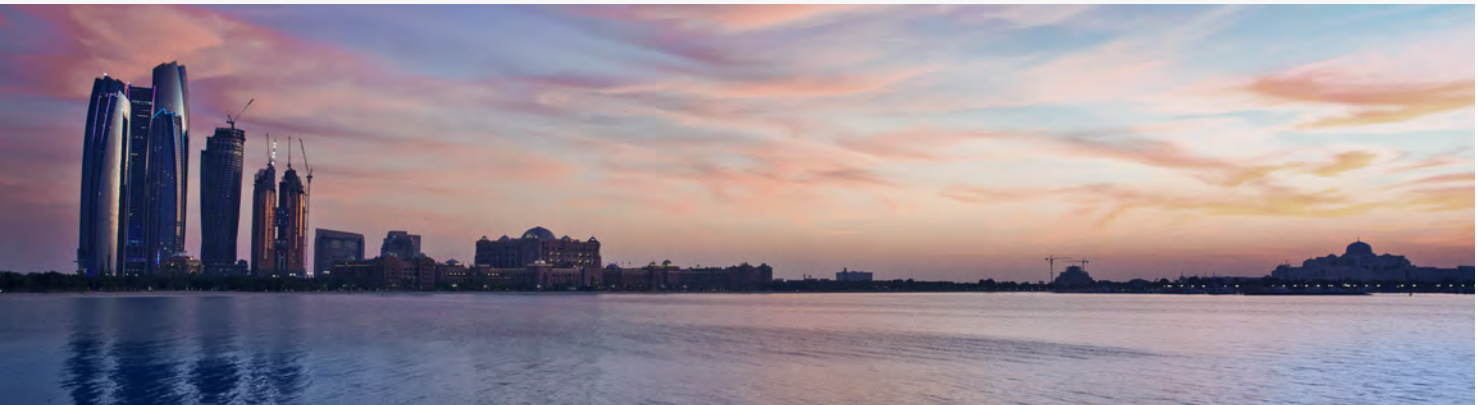
To help develop a circular economy, Emirates Water and Electricity Company (EWEC) and Abu Dhabi Waste Management Centre (Tadweer) plan to create **one of the region's largest waste-to-energy power plants.** It will generate enough electricity to power up to 22,500 UAE households, and is expected to lower CO_2 emissions by up to 1.5 million tonnes per year.

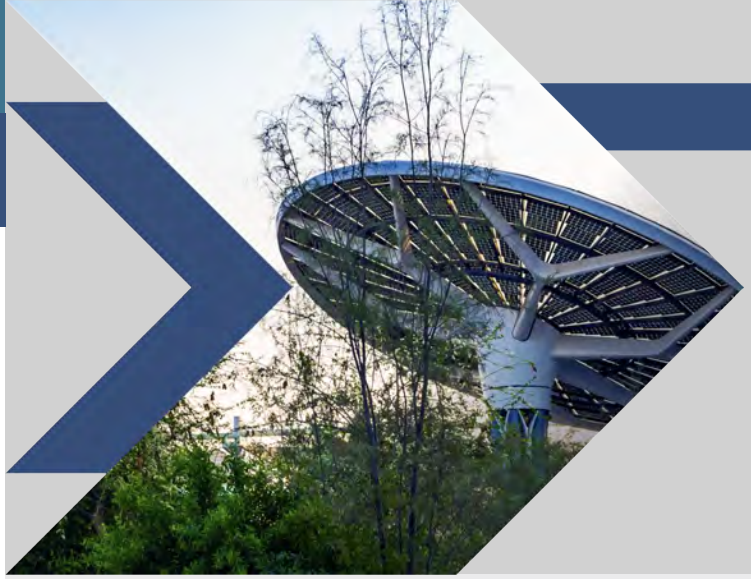


Reverse Osmosis (RO) desalination

EWEC and TAQA are collaborating to deliver highly efficient **RO desalination capacity, by 2030.** RO is more efficient than conventional thermal desalination plants as the technology uses 50% less energy to produce potable water.







SECTION THREE

Leading the charge for sustainable energy growth

The UAE's commitment to clean energy heralds new opportunities. With a robust energy strategy already delivering results, the UAE is well-positioned to lead both regional and global energy markets.

To realise the nation's full potential, both the public and private sectors need to adopt new approaches to electricity network planning, system and market operations, regulation, and public policy.

All onboard with Operation 300bn

As part of the UAE's Projects of the 50, launched in 2021, the nation plans to more than double the contribution of the industrial sector to national GDP from AED 133 billion to AED 300 billion by 2031.

By promoting the local industrial sector, encouraging the emergence of and increasing the level of in-depth knowledge of advanced technologies, Operation 300bn aims to help drive industrial development and consolidate the nation's position as a leading hub for advanced industries.

Ultimately, this will enhance the UAE's global competitiveness and increase its appeal for foreign direct investment, thus supporting the transformation to a more diverse and sustainable economy for the next 50-year growth cycle.

As part of this initiative, TAQA and Emirates Steel inked an agreement with the Ministry of Industry and Advanced Technology in September 2021 to participate in the pioneering national In-Country Value Programme.

More than double the industrial sector's contribution to GDP

"We are seeing huge demand for green industrial products. The UAE is spearheading the race for clean energy, putting us in the driver's seat in delivering sustainable steel."

HE Eng. Saeed Ghumran Al Remeithi
Group Chief Executive Officer, Arkan and Chief Executive Officer, Emirates Steel

Capturing value at a global scale

The UAE is poised to take advantage of major opportunities presented by the energy transition, supporting its mission to develop into the world's most dynamic economy.

Recent events have catalysed a shift towards more sustainable investments. As costs continue to decline, the economics are moving away from fossil fuels towards renewable energy sources.

Facilitating affordable clean energy

Having set out its clean energy ambitions over a decade ago, the UAE has benefited from being an early market mover.

When Noor Abu Dhabi started operating in 2019, it set a record for the world's most-competitive tariff at just AED 8.888 fils per kWh. Last year, in April 2020, TAQA and EWEC announced a new lower tariff of AED 4.97 fils per kWh for Al Dhafra power project.

Advancing the regulatory framework

To facilitate the energy transition, the UAE's regulatory framework must increase the resilience of the power grid while fostering a fair and competitive marketplace.

Policies that secure a future-proof pipeline of innovation are essential to accelerate the pace of change. Financial challenges can be overcome through policies that drive both investment and implementation.

In addition, the transmission of power between the Emirates must be regulated to enable a competitive market and affordable supply of energy nationwide.

"To reduce the UAE's carbon footprint and enable innovation, driving synergies between the public and private sectors is vital."

Jasim Husain Thabet
Group Chief Executive Officer, TAQA Group

The hydrogen opportunity

Leveraging its expertise in gas production and low-cost solar power, the UAE is developing blue and green hydrogen initiatives that offer enormous potential in meeting sustainability targets.

The Abu Dhabi Hydrogen Alliance will accelerate its use in energy-intensive sectors, such as utilities, mobility, and industry, to reduce costs and drive growth. ADNOC and TAQA launched a new global renewable energy and green hydrogen venture with a total generating capacity of at least 30 GW of renewable energy by 2030 – further advancing the UAE's leadership role in green hydrogen.

The powerful potential of hydrogen

Hydrogen has scalable growth potential

530 million tonnes
of green hydrogen could be produced by 2050

$129 billion
was the value of the global hydrogen industry in 2017

10.5 billion
barrels of oil could be displaced by 2050

$183 billion
is the expected value of the global hydrogen industry by 2023

$300 billion
of investments are anticipated in the hydrogen sector by 2030

> Green hydrogen could be the fuel of the future we need to turn the tide of climate change and accelerate the global energy transition.

HE Dr. Nawal Al Hosany
Permanent Representative of the UAE to IRENA

TAQA has outlined its intention to increase the contribution of renewables in its energy mix from 5% to 30%, and to boost domestic power capacity from 18 GW to 30 GW, by 2030.

At the same time, the entity is focused on initiatives that aim to reduce the carbon footprint of the construction, transportation, and industrial sectors, amongst others. These include the announcement of a recent partnership with Emirates Steel to develop a large-scale green hydrogen project that will herald the first green steel production in MENA.

TAQA is also engaged in talks to develop a 2 GW green ammonia project with Abu Dhabi Ports, producing green ammonia to be used in ships as bunker fuel and for export. This would help drive Abu Dhabi as the nucleus of the growing green hydrogen market.

Embracing new technologies

The UAE's capacity to develop new technologies and explore novel low and zero carbon sources is critical to energy diversification.

Adopting emerging technologies such as IoT, Artificial Intelligence (AI), and blockchain applications will be vital to keep pace with changing demand and supply while boosting resilience by mitigating carbon emissions.

"As industry leaders, it's our responsibility to invest in technologies that support a thriving green economy. Enhancing cross-sector collaboration is key to drive us toward our ambitions for the region."

Dietmar Siersdorfer
Managing Director, Siemens Energy Middle East and UAE

Clean Energy Certificates (CECs)

As part of its commitment to transition towards a decarbonised energy sector, the DoE introduced CECs earlier this year.

Backed by a new regulatory policy, the initiative marked Abu Dhabi's entry to the renewable energy credits market and enables entities to trade in renewable and nuclear energy certificates in the emirate.

To ensure global recognition, the International Renewable Energy Certificate (I-REC) Standard Foundation appointed the DoE as the I-REC accredited issuer for Abu Dhabi.

Abu Dhabi's CECs are voluntary, tradable, market-based instruments that confirm the bearer's claims to the attributes - the environmental and social characteristics of electricity generation – generated from renewable energy sources.

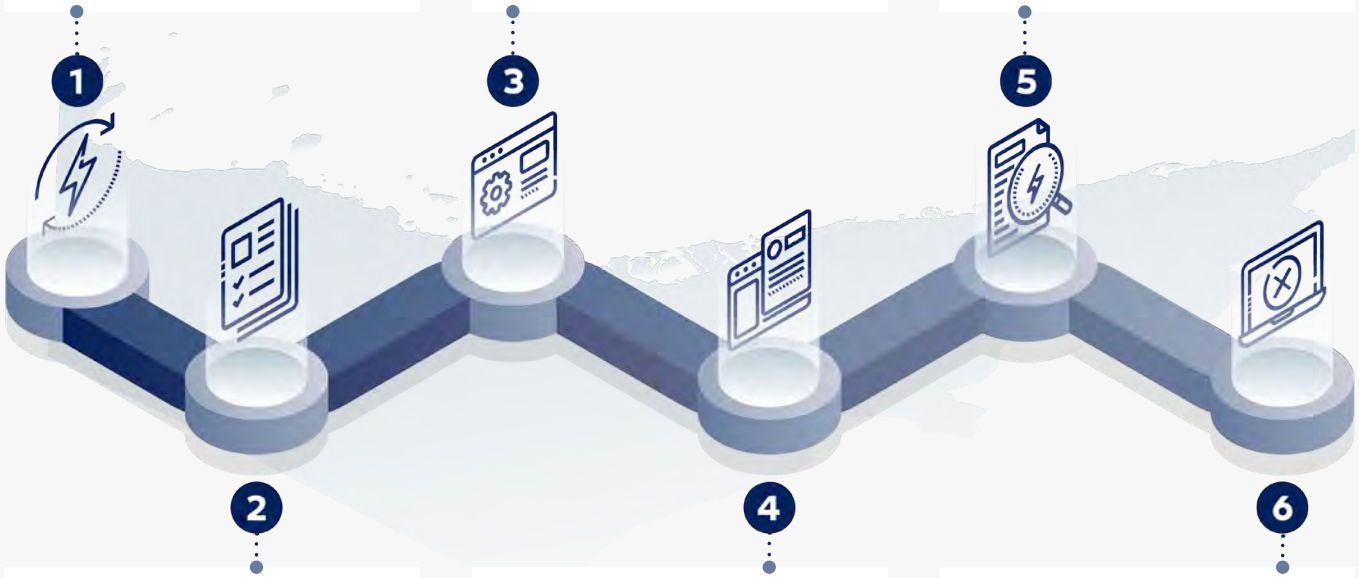
To maintain authenticity and build trust, blockchain technology enables digital CECs to trace energy sources and capture transaction data when certificates are traded. This holds industries accountable from source to consumption.

Decarbonising with Clean Energy Certificates

Energy source: All types of clean energy generation can be granted CECs. An electricity producer can receive CECs per megawatt hour of electricity produced.

Registry: When the application is approved, CECs are issued on an account with the local account registry. The CEC is only available digitally.

Authenticity: The traceability of the origin of electricity makes CECs reliable via blockchain technology.



Application: To obtain CECs, the producer submits an application to the local energy authority.

Open Market: CECs can be bought and sold in an open market and the price is set by supply and demand.

Validity: CECs are cancelled immediately upon use or after four months. This ensures that the energy sold does not exceed the rate of production.

"Clean Energy Certificates enable Abu Dhabi entities to certify the source of electricity from both renewable and clean energy sources, supporting the emirate's energy transition."

Othman Juma Hamid Al Ali
Chief Executive Officer, Emirates Water and Electricity (EWEC)

SECTION FOUR

Conclusion

While the transition to clean, sustainable energy presents a historic challenge, fast-tracking the clean energy agenda will unlock abundant economic growth.

Key drivers for a clean energy future

- Rolling out digital Clean Energy Certificates
- Ensuring a multi-source energy mix
- Leveraging Carbon, Capture, Utilisation and Storage
- Collaborating amongst stakeholders
- Investing in Hydrogen ecosystem
- Developing Reverse Osmosis plants

Early investment in clean energy is paying dividends, enabling the UAE to capitalise on robust growth opportunities whilst helping to drive the global agenda.

However, to deploy renewables at the speed and scale required, orchestrated action across the public and private sectors must be taken quickly.

This is the time to accelerate on our journey to clean, sustainable energy. Going forward, the world needs to collectively reach the finish line in time to ensure a more equitable, greener and cleaner future for all.

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Journey to Clean, Sustainable Energy

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Established in Abu Dhabi in 2018, ADQ is one of the region's largest holding companies with direct and indirect investments in more than 90 companies locally and internationally. Both an asset owner and investor, ADQ's broad portfolio of major enterprises span key sectors of a diversified economy, including energy and utilities, food and agriculture, healthcare and pharma, and mobility and logistics, amongst others. As a strategic partner of Abu Dhabi's government, ADQ is committed to accelerating the transformation of the emirate into a globally competitive and knowledge-based economy.